Good Practice Note

Environment & Social Framework for IPF Operations

Road Safety

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Good Practice Notes (GPNs) are produced to help World Bank staff in providing implementation support to Borrowers in meeting the requirements of the Environmental and Social Framework (ESF). They are written in a style and format that is intended for all staff and development partners to use. GPNs are advisory in nature and are not World Bank policy nor are they mandatory. They will be updated according to emerging good practice.

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Abbreviations

ATP	Audio-tactile profile road markings
BAC	Blood alcohol concentration
BRT	Bus Rapid Transit
C-ESMP	Contractor's Environmental and Social Management Plan
DUI	Driving under the influence of alcohol or narcotics
EA	Executing Agency
EMS	Emergency Medical System
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESHS	Environmental, Social, Health and Safety
ESIRT	Environment and Social Incident Response Toolkit
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS4	Environmental and Social Standard 4 (part of ESF)
FSI	Fatality or Serious Injury
GN	Guidance Note for Borrowers
GPN	Good Practice Notes
GPS	Global Positioning System
IA	Implementing Agency
ICP	International Competitive Procurement
IRTAD	International Road and Traffic Accident Database
LMIC	Low and middle-income countries
MSIP	Management Strategies and Implementation Plans (part of contractor's bid)
IPF	Investment Project Financing
iRAP	International Road Assessment Program
NCAP	New Car Assessment Program
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
OHS	Occupational Health and Safety
OHSP	Occupational Health and Safety Management Plan
PPE	Personal protective equipment

OPTRSR	Overall Project Traffic and Road Safety Risk
PCN	Project Concept Note
PDO	Project Development Objective
QER	Quality Enhancement Review
RAP	Resettlement Action Plan
RSA	Road Safety Audit
RSIA	Road Safety Impact Assessment
RSSAT	Road Safety Screening and Appraisal Tool
SE	Supervision Engineer (responsible for supervising civil works)
SDGs	Sustainable Development Goals
SPD	Standard Procurement Document
SSA	Safe System Assessment
TOR	Terms of Reference
TMP	Traffic Management Plan
TTM	Temporary Traffic Management
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNOPS	United Nations Office for Project Services
WHO	World Health Organization

Glossary

Consultant	Is any individual, firm, company, organization or other institution that has been awarded a contract to provide consulting services to the project and has hired/assigned managers and/or employees to conduct this work. The term 'Supervision Engineer' (SE) refers to firms supervising civil works.
Contractor	Is any firm, company, organization or other institution that has been awarded a contract to conduct infrastructure development works for the project and has hired/assigned managers and/or employees to conduct this work. This also includes sub-contractors hired to undertake activities on behalf of the contractor.
Contractor's Environmental and Social Management Plan (C-ESMP)	The plan prepared by the contractor outlining how they will implement the works activities in accordance with the project's Environmental and Social Management plan (ESMP).
Data for Road Incident Visualization, Evaluation and Reporting (DRIVER)	A web-based road crash data collection system developed by the World Bank, which provides multiple analytic tools; adapts to almost all countries, states, and cities, through its use of Open Street Map; accommodates local crash data records with customizable data entry; has an Open Source license; and is available in many languages.
Environmental, Social, Health and Safety (ESHS)	An umbrella term covering issues related to the impact of a project on the environment, communities and workers.
Executing Agency (EA)	The agency legally responsible for the execution of the project, often the Ministry of Finance or similar.
Fatal and Serious Injuries (FSI)	A metric of those killed or seriously injured in a traffic crash which is used to monitor traffic safety performance. Fatalities are defined as those who die within 30 days of the crash.
General Deterrence	The deterrence of unwanted behaviors in the general population without necessarily catching each person. General deterrence is based on the beliefs of people that they are likely to be caught for a specific offence, that the punishment is significant (enough to deter), and that the punishment is unavoidable. These beliefs can be achieved through having effective enforcement and judicial systems and through promoting these systems and punishments to the public. (See also: Specific Deterrence)
Implementing Agency (IA)	The agency implementing the project's activities, often the Ministry of Infrastructure or similar.
International Road Assessment program (iRAP)	An evidence-based method for assessing the safety of existing roads based on a detailed analysis of the physical features of the road and roadsides, and operating speeds.

Management Strategies and Implementation Plans (MSIP)	Plans included in the bidders bid document describing how they will address the various risks during implementation.
Near-miss	The term for a road crash which almost occurs but is avoided.
New Car Assessment Program (NCAP)	An internationally recognized standardized crash-based safety rating process for light vehicles. Global NCAP is the main body with NCAPs existing in Australia, China, Europe, Japan, Latin America, South Korea, Southeast Asia, and the USA.
Occupational Health and Safety Management Plan (OHSP)	Part of the C-ESMP, this describes how the contractor will address the safety of workers and the local community during construction. The traffic management plan (see below) is a critical element of the OHSP, as are the requirements for vehicle safety equipment.
Operating Speed	The average speed at which motor-vehicles, including two-wheelers, are operating in traffic and free-flow conditions. The operating speed may potentially be higher than the posted speed limit (or design speed), especially in the absence of general deterrence.
Overall Project Traffic and Road Safety Risk (OPTRSR)	The overall traffic and road safety risk on a project arising from considering the road infrastructure, operating speeds (km/h), road user behavior, vehicle standards, and post-crash trauma care.
Road Crash	Sometimes also referred to as a traffic crash, incident, road accident, road traffic accident, etc. This is when a vehicle collides with another vehicle or moving object, pedestrian, animal, road debris, the road surface or other ground, or other stationary obstruction (e.g. a tree, rock, embankment, pole or building). To be a road crash, as defined by international convention, the crash must occur on a road, on a road related area, or arise from events which occur on a road or road related area. For example, a car hitting a house on private property because of an error by the driver on the road (and the lack of a barrier) would still count as a road crash even though the actual crash event occurred on private property. The definition applies whether the crash results in injury, death, and/or property damage.
Road Safety	The study and implementation processes by which traffic and road safety risk is understood and reduced/managed. Other forms of risk in transport not related to road crashes (such as personal security and gender-based violence) are important, but not part of road safety. These are addressed in other elements of the ESF.
Road Safety Audit (RSA)	An independent road safety examination of a road project, or any other type of project which affects road users, to identify the crash potential and safety performance for all kinds of road users. It can be performed on designs or in the field.

Road Safety Screening and Appraisal Tool (RSSAT)	A tool developed by the World Bank to identify road safety performance and screen for opportunities for improvement in road and roadside infrastructure.
Road User	Anyone using or accessing a road, during the construction or operational life of the road, including walking, driving, using public transport, or cycling along the road or roadside, crossing the road, or conducting business on the road or road side. The term 'motorist' represents any person driving a motor vehicle, including cars, motorcycles, trucks, and buses—as well as the occupants.
Safe System	An approach where the traffic and road safety risks are addressed on a systems wide basis, allowing for all road users to make mistakes without causing death or severe injury, by managing the forces to which the human body will be exposed in the event of error and a crash.
Safe System Assessment (SSA)	An assessment of a design against the Safe System principles to confirm that all opportunities have been realized.
Specific Deterrence	Deterrence of unwanted behaviors in specific offenders achieved by catching those offenders (see also: General Deterrence).
Speed Limit	The maximum speed allowed by law on a specific road, and it is usually posted through road signs and enforced by traffic police or cameras. From safety considerations, speed limit should be lower than design speed, which is the speed value that was taken into consideration for the design of the road.
Speed Management	Measures to control speeds, including enforcement, general deterrence, and infrastructure (also known as traffic calming). Traffic calming features include: roundabouts, median islands, speed humps, raised tables, entry treatments, speed cushions, chicanes and modified intersections.
Temporary Traffic Management (TTM)	Measures put in place during construction to temporarily control and/or direct traffic through or around the work zone.
Traffic and Road Safety Risk	An umbrella term relating to the risk (especially of death or injury) arising from a road crash.
Traffic Management Plan (TMP)	Part of the OHS Management Plan, the TMP describes how the contractor will manage traffic during construction to address the safety of workers and the local communities. It should be noted that the TMP will apply both to ESS4 (road safety) and ESS2 as the latter specifically deals with labor and working conditions.
Vulnerable Road Users	Road users who are more vulnerable to harm because they are not in a vehicle, including pedestrians, motorcyclists, cyclists, and those on animals or animal drawn carts.

Contents

1. Introduction

1. The World Bank's Environmental and Social Framework (ESF) calls for road safety to be considered on projects.

Box 1: World Bank's Good Practice Notes

The World Bank is providing a series of Good Practice Notes (GPN) to accompany the ESF to support its implementation. This note focuses on addressing road safety on World Bank financed operations. GPNs are developed in partnership with specialists from inside and outside the Bank and are designed to be reviewed and updated periodically, when appropriate. This note should be read in conjunction with the ESF, including the Policy, the Environmental and Social Standards (ESS1-10) and the accompanying Guidance Notes for Borrowers.

2. Improving road safety is critical to the World Bank's twin goals of eradicating extreme poverty and increasing shared prosperity. Low and middle-income countries (LMICs) suffer 90% of the 1.35 million road crash deaths and up to 50 million injuries occurring annually[1]. These deaths and injuries drive families into economic hardship, and in many cases poverty, when the family's primary income earner is killed or suffers disability. In addition, crash deaths and injuries drain human capital and create costs which have been shown to significantly limit the economic growth of LMICs. Road transport generates 97% of deaths from all modes of transport[2]. Investments in road safety often are not capital intensive. They often amount to 1-5% of the capital costs for a project and yield positive benefit cost ratios as shown in Table 1[3].

Table 1: Benefit Cost Ratio of Various Road Safety Interventions

Type of Measure	Benefit Cost Ratio
Road safety audits and inspections	1.34 - 242
Vehicle design and personal safety equipment	0 – 31.7
Increasing traffic police enforcement	1.0 - 27
Traffic control, including new speed limits	0.5 – 10
Vehicle and garage inspections	1.9 – 7.2
Improving road design and roadside equipment	0.1 – 5.7
Road maintenance	0.7 – 2.87
Driver training, public information and education campaigns	< 0 – 1.1

3. The World Bank has a central role to support the United Nations' (UN) Decade of Action for Road Safety[4] and the related achievement of Sustainable Development Goals (SDG) 3.6 and 11.2[5]. SDG 3.6 sets a target of halving deaths and injuries from road crashes. The World Bank supported 'Sustainable Mobility for All Initiative' (www.sum4all.org) highlights safety as one of the pillars of sustainable mobility.

4. The ESF road safety requirements are defined in Environmental and Social Standard 4 (ESS4):

> "*10. The Borrower will identify, evaluate and monitor the potential traffic[6] and road safety risks to workers, affected communities and road users throughout the project life-cycle and, where*

[1] World Health Organization: WHO (2018 and 2015) Global Status Report on Road Safety. WHO: Geneva.
[2] Sustainable Mobility for All (2017). http://www.sum4all.org/publications/global-mobility-report-2017.
[3] Elvik, R. (2000) *How Much Do Road Accidents Cost the National Economy? Accident Analysis & Prevention*, Open Journal of Civil Engineering, Vol. 6 No.2.
[4] United Nations General Assembly (2010), 'Resolution 64/255, Improving Global Road Safety', United Nations: New York.
[5] United Nations (2015), 'Sustainable Development Goals', New York.
[6] May include all motorized transportation relevant to the project.

appropriate, will develop measures and plans to address them. The Borrower will incorporate technically and financially feasible road safety measures into the project design to prevent and mitigate potential road safety risks to road users and affected communities".

"11. Where appropriate, the Borrower will undertake a road safety assessment for each phase of the project, and will monitor incidents and accidents, and prepare regular reports of such monitoring. The Borrower will use the reports to identify negative safety issues, and establish and implement measures to resolve them."

"12. For vehicles or fleets of vehicles for the purposes of the project (owned or leased), the Borrower will put in place appropriate processes, including driver training, to improve driver and vehicle safety, as well as systems for monitoring and enforcement. The Borrower will consider the safety record or rating of vehicles in purchase or leasing decisions and require regular maintenance of all project vehicles."

"13. For projects that operate construction and other equipment on public roads or where the use of project equipment could have an impact on public roads or other public infrastructure, the Borrower will take appropriate safety measures to avoid the occurrence of incidents and injuries to members of the public associated with the operation of such equipment."

5. This GPN provides guidance to World Bank staff on how to support the Borrowers' efforts to improve road safety on projects with Investment Project Financing (IPF) and thus meet the requirements of ESS4[7].

6. As shown in Figure 1, it is recommended that road safety risks are addressed during the project Preparation and Implementation and the post-project Operations Phases[8] with the necessary foundational work laid during the Preparation Phase. Monitoring and reporting on road safety should be done throughout the Implementation, and ideally continue into the post-project Operations Phases.

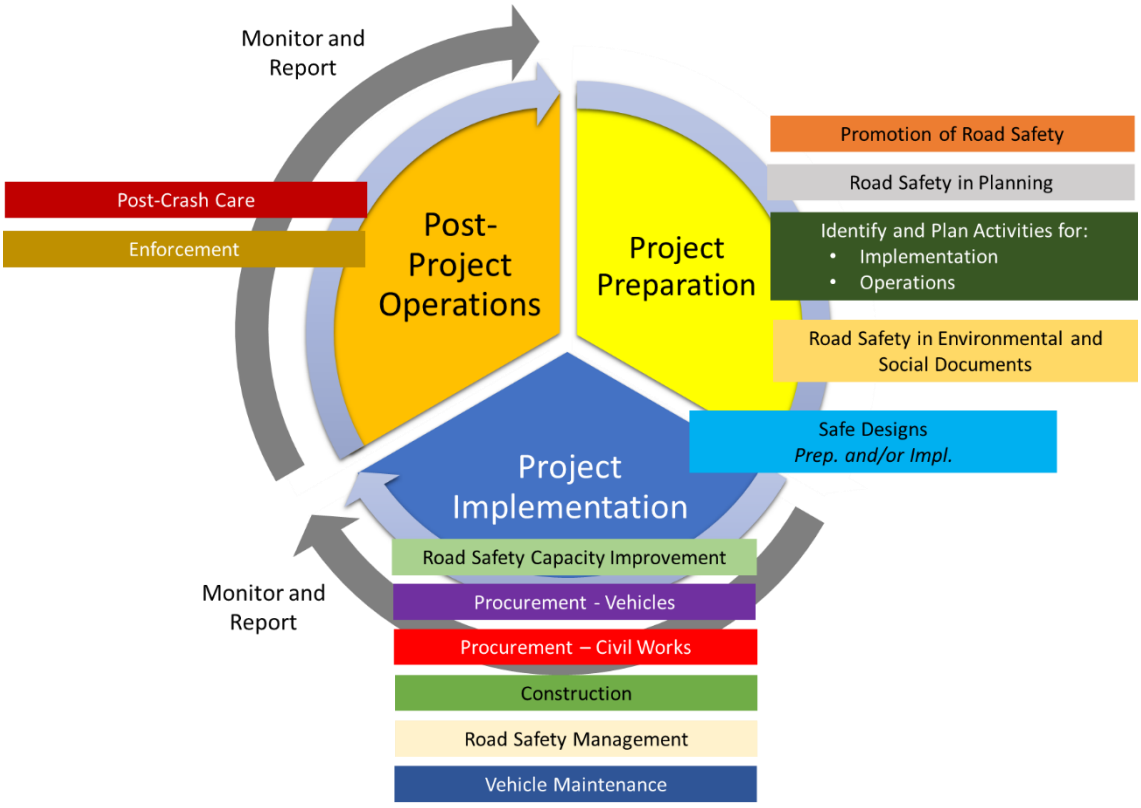
7. The Bank's goals for road safety—particularly those called for in the ESF—will only be achieved through a holistic and systematic approach towards road safety, as embodied in the '**Safe System**' approach. The Safe System approach embraces a zero-harm goal and places a strong emphasis on road builder/ operator and vehicle manufacturer accountability for road safety performance. The genesis of this approach can be found in the Swedish *Vision Zero* and Dutch *Sustainable Safety* strategies of two decades ago that set a long-term goal for the road system to be free of deaths and serious injuries. In a 'Safe System', safe means safe–not partially safe–such as in the well accepted, zero-harm requirement for workplace safety.

8. Annex 1 describes the Safe System approach. Its principles are embodied in the recommended activities and mitigation measures in this GPN. They are based on the goal of avoiding fatalities and serious injuries (FSI) in the event of a crash by reducing the energies transmitted to humans. The recommended road safety activities proposed in Annex 2 are built on the Safe System.

[7] Many of its recommendations can also be applied to projects that pre-date the ESF, as well as other projects not addressed here, such as Program-for-Results, Community Driven Development, and Development Policy Financing. In these other instances appropriate adaptations will be necessary.

[8] It should be noted that in most cases some of the post-project Operations phase activities will happen during the Implementation phase (e.g. enforcement and post-crash care).

Figure 1: GPN Proposed Road Safety Activities Over the Project Cycle and Post-Project



9. Fatalities and serious injuries (FSI) are the largest cost in crashes in all senses; and an emphasis on them sometimes results in different actions than arise when focusing only on reducing crashes. The focus of a Safe System is to eliminate, or at least reduce, FSIs, even though humans will still make errors and crashes may still occur. This is reflected in the GPN's approach to road safety.

10. For project preparation, there are two key activities proposed in the GPN. Chapter 2 describes how to **scope** the road safety risks prior to preparing the PCN. More detailed **assessments** are done as described in Chapter 3, which guide the preparation of the environmental and social documents, identifying the scope and extent of specific project activities to address road safety, guiding appraisal (see Figure 2).

Figure 2: Scoping and Assessments in Project Preparation

11. Resources for applying the recommendations of this GPN are available for download from:

https://tinyurl.com/rs-gpn-resources

2. Scoping

13. The ESF Guidance Note (GN) for Borrowers advises in GN 11.3 "*The identification of risks begins at project identification, so that measures to address potential risks can be incorporated into the project design. As part of the environmental and social assessment, aspects of the project design, such as junction layout, alignment, road signs and signals, provision of pedestrian footways and crossings, barriers (for pedestrians and vehicles), median layout, and access to public transport, are reviewed, taking into account risks that may materialize throughout the project-life cycle, as well as design features that can enhance project benefits."*

Traffic and Road Safety Risks on Different Types of Projects

14. Traffic and road safety risks can arise in a wide variety of projects and are not only related to transport projects which involve road construction, upgrading, or changes. Any project which generates or relocates traffic (including bicycle or pedestrian traffic), influences travel speeds, travel modes, traffic composition or traffic patterns, and is likely to result in new or changed road safety risks, needs to be assessed. Consequently, **in addition to transport projects, ESS4 therefore may apply to urban development, health, education, agriculture projects, etc.** Examples where ESS4 applies include:

- Introduction of a new public transport system—for example a new metro—that changes the flow of pedestrian traffic and thereby result in new or modified traffic and road safety risks;
- Construction activities that require materials brought to site, necessitating management of safety risks arising from construction traffic—particularly to workers[9];
- Construction activities that lead to closures of footpaths, necessitating safe alternative pedestrian facilities and lower speeds;
- New or larger schools, hospitals, transit hubs, or commercial operations, create increased pedestrian or non-motorized traffic. It becomes necessary to assess and plan for the modified vehicular and non-motorized traffic patterns during the design stage, to address road safety impacts;
- A new policy such as a speed limit increase will likely add substantially to traffic deaths and injuries, so should be reconsidered or include extensive infrastructure changes to reduce the risks associated with higher speed and thereby improve safety;
- Projects that alleviate congestion thereby increase speeds. Each 1% increase in speed results in around a 4% increase in deaths[10];
- The addition of multiple access points (for various developments) to an existing or new public road will generate road safety issues.

[9] It should be noted that the application of this GPN and related requirements of ESS4 needs to be considered in the likelihood of an overlap with ESS2 which addresses labor and working conditions.

[10] A comprehensive analysis of studies identified this level of change in deaths with speed. Nilsson, G. (2004). Traffic Safety Dimension and the Power Model to describe the Effect of Speed on Safety, Lund Institute of Technology, Sweden. Many studies of the effects of speed management support this level of impact of changes in speed: Job, RFS & Sakashita, S. (2016). Management of speed: The low-cost, rapidly implementable effective road safety action to deliver the 2020 road safety targets. *Journal of the Australasian College of Road Safety, May 2016*, 65-70.

15. There are at least four types of projects where traffic and road safety risks arise and thus ESS4 applies:

- **Type A - Transport:** Transport projects with road construction or rehabilitation (e.g., highways, rural roads); urban transport projects (e.g., Bus Rapid Transit (BRT), metro); any project which leads to new or changed road infrastructure (e.g. through access roads) such as ports, railways and aviation infrastructure.

- **Type B - Other:** Transport (non-road infrastructure improvement related) and non-transport projects which change speeds, traffic mix or volume, vulnerable road user (pedestrians, bicyclists, motorcyclists) mix, volume, routes or facilities. Examples may include policy changes on speed limits or vehicle import regulations, or the opening of a facility which draws trucks or pedestrians, etc.;

- **Type C – Construction Only:** Projects with road safety impacts during construction only; and,

- **Type D – Vehicle Procurements:** Projects with vehicle procurements as the only influence on road safety (e.g. fleets or even project vehicles).

16. Technical Assistance and Policy projects are often associated with Type A and Type B projects

Who can be Exposed to Traffic and Road Safety Risks

17. Three groups are exposed to traffic and road safety risks:

- **Project Workers** are the individuals and groups engaged in the project Implementation Phase such as direct workers, contracted workers, workers bringing supplies and materials to the work site, and community workers[11];

- **Affected Communities**[12] are the individuals and groups directly exposed to project construction activities and that may also face ongoing exposure to operations once construction is completed; and,

- **Road Users** are the public using the project road either during construction or operation phases. Statistically, during the operation phase, this group are by far the dominant contributor to traffic related FSIs.

  Vulnerable road users are pedestrians, cyclists, and motorcyclists. Well over 50% of deaths in LMICs are these three road user groups. These users are most at risk of an FSI in the event of a crash with a motor vehicle. For example, as shown in Box A1.3, at 30 km/h 15% of pedestrians would be fatalities in a collision, compared to 85% at 60 km/h. Ideally, vulnerable users should be protected through segregation—such as through the provision of footpaths or dedicated cycle/motorcycle lanes. As segregation is impossible in many situations, the next option is speed management: vulnerable road users require a low speed environment to interact with traffic.

[11] Refer to ESS2 on Labor and Working Conditions for a detailed definition of "project workers".
[12] As noted in the ESF Guidance Note to Borrowers GN11.1: "Communities affected by traffic and road safety issues include those alongside, or bisected or fragmented by a road associated with the project. Shops, stalls, and residential properties may all be affected, along with people present on the road itself, whether nonmotorized (pedestrians and cyclists) or motorized (on motorcycles, or in cars, trucks, or buses)."

18. In parallel, **institutional risks** relate to government institutions engaged in the project construction and associated activities. Issues may include lack of adequate regulation, specialized staff, technical know-how and enforcement capacity, monitoring and evaluation capacity. It can occur during project Implementation or in the post-project Operations Phase once the project is closed.

When do Traffic and Road Safety Risks Arise

19. During the **project Implementation Phase** (involving construction or maintenance of any type of infrastructure or buildings—*i.e.* Type A, B and C projects), traffic and road safety risks arise as a result of changed vehicular and pedestrian traffic patterns, flows and/or speeds through or around the construction work zone. They also arise from the use of construction equipment and vehicles, including those transporting construction materials in or to the project site. The procurement of vehicles (Type D projects) has a different set of risks, mainly related to ensuring that safe vehicles are procured, maintained correctly, and that the operators have appropriate skills.

Box 2: The Importance of Baseline Road Safety Data and Stakeholder Engagement

Projects need to undertake baseline data collection to not only establish the appropriate project interventions to address road safety risks, but also as a way of assessing whether the project improved or worsened the situation. Stakeholder engagement will also usually provide detailed guidance on prevailing road safety issues (see Chapter 3).

20. Infrastructure constructed under a project, or the changes to traffic resulting from new developments, will be in operation for many years, and consequently will contribute continually to the road safety situation. Similarly, vehicles procured under projects will be used for several years. **It is therefore important to consider road safety not only in the context of project Implementation, but also the long-term operation.** Operational risks should be anticipated and addressed during the Preparation and Implementation Phases. They can arise from:

- Maintaining existing unsafe speeds or increasing speeds (e.g. from changes in mis-perception of safety by road users, reduced congestion allowing higher speeds, lack of sufficient engineered traffic calming measures, new speed limits, policy changes, and/or improved road surfaces);
- Inadequate enforcement of speeds, impaired driving, vehicle overloading, etc. which leads to a low level of 'general deterrence' and engenders unsafe road user behavior;
- Increased traffic volume:
    - Project-related vehicle fleets (e.g. trucks, ambulances servicing new hospitals);
    - Project-related pedestrian, bicycle, or motor traffic (e.g. increased heavy freight flows from economic activities such as mining or agricultural developments, pedestrian movements to a new school);
    - New generated traffic at project-related locations, new access points (e.g. new schools or service centers on major highways), and in urban corridors with mixed traffic and speeds (e.g. project-related highways passing through unprotected linear villages);
    - Induced traffic, i.e. vehicles altering their usage patterns from another corridor to the project corridor as a response to less congestion or faster trips; and/or,

- Project-related public transport nodes (e.g. pedestrian access to BRT or metro stations, public transport on a rural road).

- Inadequate road safety features on the road to protect road users in the event of inevitable human error:
  - Unsafe or non-existent crash barriers, infrangible objects near roadsides; no clear zones;
  - Inadequate guidance to road users (inadequate lighting, sight distance, poor horizontal and vertical signage);
  - Unclear road environment, which sends road users the wrong messages (e.g. a pedestrian crossing on a high-speed rural road, without additional traffic calming measures, will make a pedestrian feel falsely safe when crossing the street);
  - Inadequate maintenance of road safety features such as delineation or speed calming; and/or,
  - Inadequate safe amenity for vulnerable road users, such as usable footpaths and bus shelters, separated bicycle lanes, and motorcycle lanes.
- Land use changes through transport plans and resulting network structures for public transport, active transport and private and commercial vehicles;
- Greater use of inherently risky travel modes (e.g. increased walking, cycling, and especially motorcycle use will result in more FSIs, unless appropriate protective measures are taken);
- Poor maintenance of vehicles—particularly those procured under the project—compromising vehicle safety;
- Inadequate or nonexistent crash incident management; and/or
- Limited post-crash medical services at the scene, for transporting victims to medical treatment facilities, and at treatment facilities themselves leading to unnecessary deaths and disabilities.

Overall Project Traffic and Road Safety Risk Level

21. As described in Annex 3, at the identification stage of the project, Task Teams should identify the 'Overall Project Traffic and Road Safety Risk' (OPTRSR). This will inform project Preparation and help define the Borrower's responsibilities.

22. As noted earlier, traffic and road safety risks arise from the interaction of many elements: road and roadside design and engineering, travel speeds, the extent and type of road use, road user behavior, vehicle safety features (both active and passive), and post-crash care. Thus, the assessment of risk should consider all these factors, and mitigation of risk may be achieved through multiple interventions, as well as road safety management processes. **Identifying the potential traffic and road risks and their associated level in a project is not an exact science: it requires judgement.**

23. This GPN adopts four levels: 'Low/Moderate/Substantial/High'[13] to define the OPTRSR. There is no purely analytical way of clearly defining the OPTRSR for a given project, so it is essential that a precautionary approach be taken: **always assume a higher rather than lower risk when there is uncertainty**. For Substantial and High-risk projects, it is recommended that the Task Teams include a transport specialist on the team during Preparation to help in the dialogue with the Borrower (see Box 3).

24. **The OPTRSR should be based on the expected risk of traffic and road safety assuming project design elements have been satisfactorily implemented with suitable adjustment for expected reliability.**

25. Table 2 summarizes the process of identifying and rating the traffic and road safety risks level for each of the three groups that can be at risk. For each group, the risk is assessed as Low/Moderate/ Substantial/High. The OPTRSR will be the highest risk identified for the three groups—for example if two are 'Low' but one is 'High' then the OPTRSR is 'High'. Annex 3 provides further details.

Box 3: Road Safety Specialist Support for Substantial and High-Risk Projects

Projects which are identified as having Substantial or High road safety risks should have road safety specialists supporting the Task Team, and ideally the client, for ensuring that the traffic and road safety risks are appropriately mitigated. These may be available through the Transport GP, or from a list of road safety specialists managed by the Transport Road Safety Global Solutions Group.

26. **The OPTRSR process will also provide guidance on focus areas for road safety** mitigation measures**.** Beyond assessing the OPTRSR, the process provides insight into specific **focus areas** which are areas of opportunity in which there may be higher risk within a lower OPTRSR. For example, there may be a significant disregard for speed limits, necessitating other means of speed management (such as through road infrastructure) or additional safety features such as additional crash barriers and speed managed pedestrian crossings. Another example is that there may be a history of not appropriately implementing road safety audit (RSA) recommendations in the actual construction. While this GPN recommends that a construction RSA is not required for Low-risk projects (which should usually only have a design stage RSA), it may in fact be prudent to include a construction RSA (and confirm that RSA recommendations are addressed) given the local situation.

27. For Type A projects, the Transport GP has also developed the '**Road Safety Screening and Appraisal Tool**' (RSSAT). This considers the likely fatality rate with and without the project and can be used to identify road safety performance and screen for opportunities for improvement in road and roadside infrastructure. At the identification stage RSSAT should be applied and the results reported on in conjunction with the OPTRSR. RSSAT is available for download from:

https://www.tinyurl.com/road-safety-gsg

[13] The Directive for implementing the Environmental and Social Policy for Investment Project Financing (October, 2018) Section III C defines these risks with regard to accidents as: High: "high probability of serious adverse effects to human health…"; Substantial: "there is medium to low probability of serious adverse effects to human health … and there are known and reliable mechanisms available to prevent or minimize such incidents"; Moderate: "low probability of serious adverse effects to human health"; and, Low: "if its potential adverse risks to and impacts on human populations … are likely to be minimal or negligible". These definitions have been used in developing the recommendations presented in this GPN.

Table 2: Guiding Questions for Identifying Overall Project Traffic and Road Safety Risk

At Risk Group	During Project Implementation Phase	During Project Operation Phase
Project Workers	• What are the operating speeds and traffic environment at project's constructions areas? • Are the workers protected from traffic by safety barriers? (e.g. if construction workers are near traffic and operating speeds are not managed down to 30 km/h, in the absence of safety barriers effectively protecting workers the risk is high). • What is the complexity of civil works? • What is the experience and capacity of the Contractor(s) and IA in managing similar work zones? • What is the level of traffic enforcement in the country in general, and the project areas in particular?	• Should be recognized that these issues apply during construction as well as for maintenance work during road operations.
Affected Communities	• Who are the affected-communities and where they are located relative to the project road or sites? • How much exposure will affected-communities have to construction traffic, not just at the work site but on haul routes, etc.? • Are there particularly vulnerable sites such as schools and hospitals affected by the construction site or on haul routes? • What will be the impact on mobility and accessibility of communities given current usage and mobility needs?	• Extent to which infrastructure improvements can mitigate any increase in speeds likely to arise. • Provision of facilities to protect vulnerable users. • How the mobility and accessibility of communities will be affected during the operation phase.
Road Users	• To what extent will construction impact on road users, particularly vulnerable ones (i.e. pedestrians, cyclists, motorcyclists)? • Does the current level of traffic enforcement create a general deterrence atmosphere leading to general obedience to traffic regulations?	• Baseline FSI risk along the project roads—and likely FSI risk from improved facilities. • Road safety management capacity and institutional framework. • Road safety infrastructure facilities. • Speed management potential. • Vehicle safety levels. • Use of restraint systems by occupants. • Post-crash care. • Traffic growth and composition.
Overall Project Traffic and Road Safety Risk	• Summarize the Risks during Project Implementation focusing on highest risk areas (and see Annex 3).	• Summarize the Risks during Project Operation focusing on highest risk areas (and see Annex 3).

3. Assessment

ESS4 Paragraph 10: "The Borrower will **identify, evaluate and monitor the potential traffic and road safety risks to workers, affected communities and road users throughout the project life-cycle** and, where appropriate, will develop measures and plans to address them. The Borrower will incorporate technically and financially feasible road safety measures into the project design to prevent and mitigate potential road safety risks to road users and affected communities."

ESS4 Paragraph 11: "Where appropriate, the Borrower **will undertake a road safety assessment for each phase of the project**, and will monitor incidents and accidents, and prepare regular reports of such monitoring. The Borrower will use the reports to identify negative safety issues and establish and implement measures to resolve them."

Assessment Objectives

28. The scoping process (see Chapter 2), project objectives and components will provide an indication of the potential traffic and road safety risks. The objective of the road safety assessment is to consider these risks in more detail and then to develop the mitigation (control) measures to be implemented on the project.

29. The ESF Guidance Note for Borrowers GN11.4 advises: "*A road safety assessment is conducted as part of the environmental and social assessment when the traffic and road safety issues are likely to be significant for the community or road users, for example, in projects that involve new roads, road improvements, traffic management, increasing traffic speed, bus rapid transport, and other forms of urban transport that may change the traffic mix. The assessment considers risks to pedestrians and to important aspects of community cohesion, for example, from bisecting communities or pedestrian routes, creating transport nodes, or affecting access to or traffic on a road. Both construction-related and operational risks are considered. The requirements for vulnerable groups, such as adequate lighting in public areas, suitable ablution facilities near transport, and adequate road crossing structures should all be taken into consideration in the assessment.*"

30. This assessment should be used to inform the Environmental and Social Commitment Plan (ESCP), any Environmental and Social Impact Assessment (ESIA), and the Environmental and Social Management Plan (ESMP). These documents should incorporate road safety considerations appropriate for the levels of risk. The Resettlement Action Plan (RAP) may also need to consider road safety to ensure persons are resettled to a safe environment. These ESMP requirements will ultimately be embodied in the Contractor's ESMP (C-ESMP) which will govern how road safety will be addressed during construction.

31. The Borrower and Task Team will need to apply judgement on how detailed the assessment should be. The assessment should **always be proportionate** with the possible safety implications and likely FSI—recalling that under a Safe System FSI reduction/elimination is the goal, not crash reduction. Thus, the scope of the assessment will depend on the type of the project (i.e. Type A to Type D), its anticipated traffic flows, construction activities, and the resulting road safety risks. For example, a project which adds two entry and exit points to a low-volume road and attracts little extra traffic will call for less assessment than a major road construction project.

32. The key outcome of the assessment will be the identification of risk mitigation measures that need to be embedded in the project's environmental and social documents, designs and activities throughout the project cycle. Whenever construction or rehabilitation of roads is within the project scope, it can be

expected that the outcomes will be reflected in bidding documents, detailed engineering designs, and supervision Terms of Reference (TOR). In cases of projects generating new traffic, the risk assessment may also lead to additional activities being considered under the projects (e.g. road safety enforcement, education, etc.).

33. **All projects which have traffic and road safety risks during construction** will need to include measures in bidding documents and traffic management plans for the construction period (see Tables A2.4 and A2.5 in Annex 2 and Annex 5).

When to do Traffic and Road Safety Assessments

34. From the onset of the project, the Borrower needs to identify and evaluate the potential traffic and road safety risks arising from the project activities and/or their implementation. Identifying these early in the project cycle helps the Borrower to mobilize appropriate resources, to analyze the risks in detail, and identify and adopt mitigation measures.

35. These aspects should be included in the TOR[14] for the ESIA and ESMP (e.g. requiring a planning RSA). As appropriate, the Borrower should include road safety mitigation measures in the: (i) project design; (ii) project operational manual; (iii) civil works design; (iv) occupational health and safety requirements; (v) bidding documents; and, (vi) the civil works contracts (see Tables A2.1 to A2.7 of this GPN).

36. The assessments will need to be completed before the project is fully appraised to inform project structure, components, and the results framework. Substantial and High-risk projects should as a minimum include intermediate indicators related to traffic and road safety risk mitigation.

How to do Traffic and Road Safety Assessments

37. The OPTRSR process described in Chapter 2 will help the Task Team to inform the Borrower what types of road safety assessment will be relevant to the project. Transport infrastructure investments (Type A projects) would naturally call for the most robust assessments, but Type B and C projects with major construction activities may also call for detailed assessments. The road safety specialists working with the Borrower should help prepare the TOR for the assessment, which should be cleared by the Task Team (see Box 3).

38. **Data analyses, modelling or estimates** quantify and forecast road crash FSIs. Depending on data availability, these would aim to identify serious crash locations (noting that typically up to 50% of crashes occur at new locations) and crash types, at-risk individuals and groups, and key risk factors influencing exposure to risk, crash involvement, crash severity and post-crash outcomes. Even in the absence of sound crash data, exposure and relative risk can be estimated especially based on World Health Organization (WHO) estimates for countries, volume by transport mode, well established relationships between risk and operating speeds and other road design and operating features.

39. **Capacity reviews** assess the efficiency and effectiveness of road safety measures already being taken, or which could be adopted, as well as related road safety institutional strengthening priorities. The Bank has developed Guidelines for capacity reviews[15] which can be considered by the Borrower. These will be especially relevant where the project involves road safety relevant policy change such as to

[14] Sample TORs for ESIAs and other road safety related activities are available at: https://tinyurl.com/rs-gpn-resources.
[15] Road Safety Management Capacity Reviews and Safe System Projects Guidelines (2013).

enforcement, regulations, standards, etc. but may also be a valuable means of improving long term management of road safety as part of other projects. The six 'success factors' for overcoming the institutional capacity barriers are: (i) Identify a lead agency in government to guide the national road safety effort; (ii) Assess the problem, policies and institutional settings relating to road traffic injury and the capacity for road traffic injury prevention in each country; (iii) Prepare a national road safety strategy and plan of action; (iv) Allocate financial and human resources to address the problem; (v) Implement specific actions to prevent road traffic crashes, minimize injuries and their consequences, and evaluate the impact of these actions; and, (vi) Support the development of national capacity and international cooperation.

40. **Surveys of the road environment**, to assess the safety of infrastructure provided or planned, traffic volumes (baseline and forecast growth), road user types, and communities at risk. Surveys could include RSAs (see Annex 4), and systematic road safety inspections such as the International Road Assessment Program (iRAP) surveys. These are best done during project Preparation, although RSAs are often done multiple times (see Annex 4). It is important not to regard these as alternatives. Rather iRAP assessments and RSAs may perform separate functions and are both appropriate. It is important that these cover each stage of the project, as appropriate from conception and design through to an opening audit, particularly for projects which build, upgrade, or change roads.

41. **Assessments of designs** are important because adherence to standards does not guarantee a safe design. The use of a design stage RSA (see Annex 4) is recommended for all projects as it helps to ensure that traffic and road safety have been properly considered. Separately, it is recommended that a **Safe System Assessment (SSA)** be done to confirm that every opportunity to achieve a Safe System has been considered (see Annex 4).

42. **Traffic management during construction.** As described in Annex 5, the safety of workers and road users during construction is dependent on the ability of contractors to effectively manage the risks. The risk management process is embodied in the contractor's **Traffic Management Plan (TMP)** which is a document that details the way activities in the road corridor will be carried out. The TMP is a site-specific plan that covers the design, implementation, maintenance and removal of **Temporary Traffic Management (TTM)** measures while work or activities are carried out in the road corridor (road, footpath or berm). The plan details how road users—particularly vulnerable cyclists and pedestrians—will be directed around a work site, crashes, or other temporary road disruption, to minimize inconvenience while providing safe conditions for both the road user and the workers carrying out the activity. The assessment needs to consider: (i) the existing regulatory environment for TTM and how it reflects good practice[16]; (ii) the capacity of contractors to effectively implement TTM; and, (iii) the ability of the IA and the Supervision Engineer (SE) to enforce TTM standards. Annex 5 describes elements of safety during construction that can be used as part of this assessment.

[16] Examples of codes of practice for TTM are available at www.tinyurl.com/road-safety-resources.

Stakeholder Engagement

43. **Engagements with stakeholders**[17], to explore potential traffic and road safety risks arising throughout the project life-cycle. Key stakeholder groups could include roadside communities, heavy vehicle industry associations, public transport providers and users, commuters, vulnerable road users (pedestrians, motorcyclists, and bicycle riders), traffic police, non-governmental organizations (NGOs), and post-crash service providers. Processes for engagement will depend on available and feasible communication means, and may include door-to-door surveys, opportunistic surveys, informal discussions, focus groups and community meetings[18]. These consultations may provide useful information on relevant patterns of behavior and risk exposure but should not be used as a guide to what will work to address risk. **There is a well-established body of evidence on what works, and that evidence is often inconsistent with community views of what works** (see Annex 6).

Box 4: Using Stakeholder Engagement to Improve Road Safety—Experience from Kiribati

As noted in the Implementation Completion Report (ICR), the Kiribati Road Rehabilitation Project (P122151) conducted detailed consultations with stakeholders during the early stages of project preparation. This included targeted focus groups discussions with villages, women, youth, bus drivers, and store owners. Road safety was the main concern, with 92% of pedestrians—the most common road user—stating the road was 'not safe'. Issues raised included safety concerns regarding lack of street lights, bus stops/shelters, lack of proper drainage, and dangers to children from not having pedestrian space to walk to school. The project's preparation, design and post-construction road safety audits helped to ensure that vulnerable road users were accommodated. Designs were adapted to ensure that the needs of people with disabilities would be addressed as much as possible. The project implemented a variety of engineering mechanisms to address stakeholder concerns including 56.8 km of footpaths, 36 bus bays, 253 street lights, 116 speed humps, and reducing the carriageway width to reduce speeds and provide more space for vulnerable users. The project undertook complementary work to improve enforcement through the provision of speed management equipment to the police, training, and enhanced road laws. These efforts helped to offset the impact from higher speeds that would arise from the improvement to the road condition and particularly to protect pedestrians.

[17] See ESS10 for details on the requirements and expectations for stakeholder engagement under the ESF.
[18] An example of an Engagement Handbook focused on road safety issues is at: https://www.nzta.govt.nz/safety/speed-management-resources/engagement-resources/

4. Activities to Address Traffic and Road Safety Risks

ESS4 Paragraph 10: "The Borrower will identify, evaluate and monitor the potential traffic and road safety risks to workers, affected communities and road users throughout the project life-cycle and, where appropriate, will develop measures and plans to address them. The Borrower **will incorporate technically and financially feasible road safety measures into the project design to prevent and mitigate potential road safety risks to road users and affected communities**."

Addressing Traffic and Road Safety Risks

44. The activities and investments in road safety should **always be proportionate** with the possible safety benefits. Thus, when considering mitigation measures it is important that the **exposure** be considered. For example, a winding mountainous road with many vulnerable users would likely be rated as Substantial/High-risk, but if the traffic volumes are sufficiently low, then some of the treatments adopted should be proportionally less than those that would be adopted for a similar high-volume road[19]. Similarly, the stakeholder engagement for a Low-risk project would be anticipated to be less detailed and expansive than for a High-risk project.

45. Table 3 summarizes the types of activities proposed for mitigating road safety risks, with detailed guidance given in Tables A2.1 to A2.7 in Annex 2.

Table 3: Activities to Address Road Safety Risks

Road Safety Activity	See Annex 2 Table	Project Phase [a/]			Targeted Group			Type of Project Applies To			
		Preparation	Implementation	Operations	Workers	Communities	Road Users	A: Transport	B: Other	C: Construction	D: Vehicles
Promoting the Road Safety Agenda	A2.1	✓	✓		✓	✓	✓	✓	✓	✓	
Road Safety in Planning	A2.1	✓				✓	✓	✓	✓		
Road Safety in the ESCP/ESMF/ESMP/RAP	A2.1	✓	✓		✓	✓	✓	✓	✓	✓	✓
Road Safety Capacity Strengthening Opportunities	A2.2	~	✓		✓	✓	✓	✓	✓		
Safe Designs	A2.3	✓	✓			✓	✓	✓	✓		
Procurement – Civil Works	A2.4	~	✓		✓	✓	✓	✓	✓	✓	
Procurement – Vehicles	A2.4	~	✓			✓	✓	✓	✓		✓
Construction	A2.5	~	✓		✓	✓	✓	✓	✓	✓	
Road Safety Management	A2.6	~	✓			✓	✓	✓	✓		✓
Vehicle Maintenance	A2.6	~	✓			✓	✓	✓	✓		✓
Enforcement	A2.7	~	♦	✓		✓	✓	✓	✓		✓
Post-Crash Care	A2.7	~	♦	✓		✓	✓	✓	✓		

Notes: [a/] ~ Indicates that the design of the activity is done during Preparation. ♦ That there will be overlap with the Operations Phase.

[19] One would expect that traffic management devices, guard rail and other devices would be similar, but a higher volume may warrant substantial civil works to improve the horizontal and vertical alignment.

46. In applying the recommendations in Annex 2, **considered judgement is necessary** on which mitigation measures are relevant or provide opportunity for road safety gains. Some—such as improving road safety during construction or including appropriate safety standards for vehicles in procurements—may be readily achieved. Others call for long-term commitments and the project may be the starting point for this journey. The situation will vary from country to country, and this should be factored in[20]. Not all recommended mitigation measures are necessary for each project, but rather they should be **assessed for appropriateness and relevance**.

47. Annex 2 has a strong focus on **infrastructure improvements** as these have been found to have the greatest potential for a lasting impact on road safety. Policy interventions—such as increased enforcement efforts—are seldom sustained over time and may change or be circumvented. This is not to say that non-infrastructure activities should not be considered; but rather that they are secondary to safe infrastructure.

Use Proven Effective Mitigation Measures

48. There are many potential non-infrastructure mitigation measures, and efforts are better directed at measures that have compelling evidence for delivering road safety benefits. Some popular mitigation measures have had mixed results and have been found to be less effective than commonly thought (see Table 4 and Annex 6). Mitigation measures should be adopted based on an evidence-based, data driven approach in which the risks being addressed are the actual risks occurring or likely to occur. Such an approach is strictly in terms of reductions in FSI (not popularity, testimonials that something works, or the fact that others have employed the measure).

Activities During Preparation

49. Table A2.1 in Annex 2 summarizes mitigation measures to be considered during project Preparation. If the detailed designs are available, the design measures in Table A2.3 would also be considered.

Promote the Road Safety Agenda

50. During project Preparation a key activity of the Task Team is to sensitize the Borrower and other key actors to the importance of road safety as a development issue, beyond just meeting the requirements of the Bank's ESF. It is important that all projects (Types A to D) consider the general road safety situation in the country. Stakeholder engagement with NGOs and others who may be influenced by the project or the broader road safety agenda is an important consideration.

Road Safety Planning

51. As shown in Table A2.1, road safety risks can sometimes be reduced during the project planning stage by identifying alternative locations, or even modes of transport. The use of 'planning RSAs' (also called a Road Safety Impact Assessment) can be particularly valuable for defining the key issues and identifying opportunities to reduce risks (see Box 4 for an example of how this was done in Kiribati).

[20] For example, procuring vehicles with an NCAP 4 or 5-star rating may be difficult because they are not readily marketed in the country. However, many countries can avail themselves of the UNOPS program (https://unwebbuyplus.org) and procure vehicles directly from the manufacturer meeting those standards. Should this also not be feasible, the project should then procure vehicles which meet as many of the key UN vehicle safety regulations as possibly (see Annex 8 for a list).

Table 4: Examples of Proven Effective and Ineffective Non-Infrastructure Mitigation Measures

Popular Activity	Proven Effective Measures	Unproven or Less Effective Measures
Driver Skills Training	• Cars: Many hours of on-road supervised driving practice for novice drivers • Specialized vehicles: driver training is not sufficiently researched to dismiss or be relied upon. However, in organizations it may provide safety value (See Box A6.2)	• Most forms of driver training for car drivers: ○ Off road training ○ Skid pan training ○ School based driver training
Motorcycle Rider Training	• None identified	• All scientifically tested motorcycle training including post-license training
School Based Children Education	• Educate to only use supervised crossings (< 8 years old) • Train on how and where to cross roads (> 8 years old)	• General road safety studies
Fear Based Public Campaigns	• Enforcement and general deterrence focused campaigns, especially those which inform of increased deterrence	• High fear messages such as motivating people through the risk of a serious crash • Messages (such as asking people to drive carefully, cross carefully, etc.) without a specific safe behavior being promoted
Improving poor road surfaces (fixing potholes and reducing roughness)	• If speed increases are avoided through other means of controlling speeds (such as speed calming infrastructure)	• Does not improve road safety if speeds are increased by the surface treatment, because safety benefits of the road surface are much smaller than the safety dis-benefits of increased speed

Environmental and Social Documents

52. The key traffic and road safety risks to be mitigated during construction and expected during post-project operations need to be identified from the project environmental and social documents, including the Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Framework (ESMF) and/or Environmental and Social Management Plan (ESMP), Resettlement Action Plan (RAP)[21], and/or Consent Conditions from regulatory authorities. To do this, ensure that the project's social assessment includes assessment of the underlying road safety risks and social situation and maintains safety and ethical considerations related to road safety data collection. The project ESMF/ESMP should detail the road safety monitoring and reporting frequency, overall responsibility (see Chapter 5), and describe specific responsibility for remedial actions[22].

Planning of Activities for Implementation and Post-Project Operations Phases

53. The design of the activities to be done during the Implementation and Operations Phases must be considered during Preparation. Mitigation measures during Implementation are given in Tables A2.2 to A2.5 and relate to: (i) capacity strengthening; (ii) safety through designs; (iii) ensuring the procurement process adequately addresses traffic and road safety risks; and, (iv) adopting measures to address risks during construction. It is during the Operations Phase that the most crashes and FSIs arise. It is therefore

[21] The RAP should address road safety in the context of ensuring that persons affected by resettlement are provided a suitably safe place to be relocated to.

[22] One consideration in the environmental documents is wildlife safety: wildlife can represent a hazard to road users, but also deserve protection as well. Wildlife crossings—such as culverts, underpasses, overpasses, and viaducts, when spaced and sized appropriately, increase permeability and reconnect habitat fragments—thereby reducing road user risks. For a design guide see: https://roadecology.ucdavis.edu/files/content/projects/CA_Wildlife%20Crossings%20Guidance_Manual.pdf.

important that the project design includes close monitoring of the safety performance until the project closes, particularly during the defects notification period when contractors may still be available to do remedial infrastructure works. Table A2.7 presents activities to consider during the Operations Phase.

Activities During Implementation

Capacity Strengthening Opportunities

54. It is important to be realistic about what is achievable and whether there are strong advocates for making improvements, particularly at the highest political level. A sample of good practice measures related to improving road safety management capacity and strategic planning are outlined in under 'Road Safety Capacity Strengthening Opportunities' in Table A2.2. Potential Technical Assistance activities that may be considered in the project design are in Annex 7.

Road Safety in Project Designs

55. **The provision of safe infrastructure through safe designs is essential to achieving a Safe System.** Table A2.3 lists some specific mitigation measures that can be taken to improve road safety through designs. Annex 6 provides details on effective infrastructure improvements from a Safe System perspective, with Table A1.2 presenting a hierarchy of interventions.

Procurement - Civil Works

56. The civil works bidding documents need to fully capture the project's road safety needs as reflected in the project ESMP (and RAP as appropriate). Table A2.4 providing suggestions on how to address road safety in civil works procurements. **Occupational health and safety** (OHS) requirements need to clearly define the requirements to ensure the safety of workers and road users (see Annex 2). Having the contractor provide and adhere to the **Traffic Management Plan (TMP)** is a critical element of ensuring that the OHS safety requirements are met. Annex 5 discusses considerations for the TMP.

57. Prior to clearing the recommended contract award, Task Teams should review the bidder's Management Strategies and Implementation Plans (MSIPs)—particularly related to OHS—and the TMP to confirm that the necessary standards will be met.

Procurement - Vehicles

ESS4 Paragraph 12: "For vehicles or fleets of vehicles for the purposes of the project (owned or leased), the Borrower will **put in place appropriate processes, including driver training, to improve driver and vehicle safety, as well as systems for monitoring and enforcement**. The Borrower will **consider the safety record or rating of vehicles in purchase or leasing decisions and require regular maintenance of all project vehicles**."

58. Vehicles for project purposes may include construction vehicles, logging vehicles, cars, trucks, school buses, ambulances, and in certain circumstances, boats and aircraft[23]. The latter are not addressed here.

59. As discussed in Annex 8, new vehicles procured for the project should have appropriate technical specifications for road safety. Borrowers should strive to apply international good practice vehicle safety standards for vehicles procured under the project. Borrowers should also encourage use of safer

[23] Guidance Note for Borrowers, GN12.1.

vehicles by government counterpart agencies, contractors and consultants. Key considerations (see Table A2.4) are:

- **Crashworthiness test standards:** All new light duty vehicles should comply with the minimum crashworthiness test standards. Unless they are not available, projects should only procure vehicles with New Car Assessment Program (NCAP) or similar ratings of 4 or 5 stars;
- **Seat belt standards:** All motorized vehicles should include seatbelt anchorage and seatbelt systems that are maintained and readily accessible, not pushed under seats or obscured by seat covers;
- **Helmet standards:** Procurement of motorized two-wheel users should include helmets;
- For Substantial/High-risk projects, **speed governing**/limiting technologies are recommended, as well as **GPS tracking** for vehicles operated by the contractor and the SE (see Annex 5); and,
- Buses and ambulances are recommended to have **alcohol interlocks** fitted, used and serviced. In some instances, these may also be appropriate for vehicles operated by contractors and the SE.

Road Safety During Construction

60. Annex 5 discusses road safety during construction in detail, with mitigation measures proposed in Table A2.5.

61. **Monitoring of the adherence of contractor vehicles to the Contractor's TMP is essential.** These **plans need to clearly define as a minimum**: (i) the approved haul routes for all construction traffic; (ii) maximum speed limits (which are often lower than the legal speed limit) at locations on the route (e.g. 40 km/h or 30 km/h when vulnerable users are present, such as during school hours starting 200m before to 200m after a school), and the hours at which vehicles operate and; (iii) Temporary Traffic Management (TTM) in work zones. The SE is to monitor and report on the contractor's adherence to the TMP. Due to their low cost, **GPS trackers** (see Annex 5) are an effective way of ensuring that project vehicles are operating on: (i) approved routes; (ii) at approved times; and, (iii) at appropriate speeds. Potentially, deducts could be used to penalize contractors for non-compliance. GPS trackers are recommended for all projects, particularly **Substantial/High-risk projects**.

62. The TMP and TTM requirements need to have been earlier defined in the project ESMP, and the TMP requirements included in the bidding documents. The TMP needs to be reviewed and cleared by the SE, with a technical review by the Task Team recommended.

63. **Construction vehicles and equipment on public roads** are specifically mentioned in the ESS4. This is because they are are often large and unwieldly and not well suited for operation in mixed traffic on normal roads. Examples include large, self-propelled excavators, cranes and graders. In energy projects, there is frequent use of large specialized vehicles which carry equipment and pre-fabricated elements.

64. Most road authorities and traffic police forces require operators of specialized, over-dimensioned vehicles, or those transporting abnormal loads, to obtain a permit to use the public highway. Typically, these relate to a specific journey, on a pre-determined route and travel at certain times of day to minimize disruption, particularly if road closures are required. Where no formal requirements are in force, every effort should be made to engage with relevant roads authorities and police forces so that an appropriate route is chosen and that adequate measures are taken to protect communities and other

road users. These requirements will need to be specified in the bidding documents and form a part of the works contract. Furthermore, the contractor's TMP and/or OHSP, which is approved by the Borrower, will need to provide the contractor's measures for the safe use of equipment.

65. Limiting speeds of travel is a key safety mechanism, especially for equipment with a higher center of gravity that a conventional vehicle, which increases roll-over risk. Pilot vehicles and prominent signage should be used for appropriately wide loads. Movement of construction equipment at night is only recommended with comprehensive lighting of the vehicles and equipment. It is this type of commitment that the Contractor is expected to propose in the TMP.

Road Safety Management

66. Attention should also be paid to ensuring that all road safety measures included within the design (e.g. line-marking, traffic signs, traffic management devices, footpaths, guard-rails), are in place before the road is opened to traffic, and prior to issuance of the Certificate of Substantial Completion. Until all road safety measures have been completed, then the road cannot be fit for purpose from a road safety perspective. **RSAs** prior to the completion of construction are a prudent idea, particularly for Substantial/ High-risk projects (see Annex 4). This will identify any road safety issues that may not have been properly addressed by the contractor, or which may have been missed/emerged since the design stage audits. If a post-construction audit is to be done, and it is required that any road safety deficits be addressed as a precondition for issuance of the Certificate of Substantial completion, then this should be included in the relevant provisions of the bidding documents.

Vehicle Maintenance

67. It is important that all vehicles receive regular maintenance in accordance with the manufacturer's guidance. Vehicle maintenance records should ideally be kept in electronic form, noting what and when maintenance activity and or repairs were carried out and by whom. These records should be monitored by an appointed Fleet Manager, or the project's SE. Good practice guidelines should be followed for decommissioning of vehicles at the end of their life-span.

Activities During Post-Project Operations

68. Both enforcement and post-crash care will usually overlap with the project Implementation Phase.

Enforcement

69. While not a focus of the ESF, as described in Annex 9, **enforcement** plays an important role in road safety during operations. There needs to be a general deterrence for traffic to obey regulations, as well as a specific deterrence to avoid certain risk behaviours. During the project Preparation phase, opportunities to improve enforcement (including procurement of equipment and training) should be considered as part of the capacity strengthening program. Key considerations are:

- **Speed and intersection enforcement:** where automated methods are becoming more common;
- **Impaired driving enforcement:** for alcohol and drugs, and for excessive hours of driving; and,
- **Overloading enforcement:** where trucks may have excessive and imbalanced loads, or passenger vehicles exceeding their capacity.

Post-Crash Care

70. FSIs are directly related to how injuries resulting from road traffic crashes are handled immediately after the incident occurs (see Annex 10). Around half of all road traffic deaths occur almost immediately at the scene of the crash. Poor post-crash care means victims may needlessly die at the scene or during the first few hours following the injury. Although not mentioned in the ESF, post-crash care opportunities should be considered in projects as appropriate. This requires the participation of a multi-disciplinary team with specialists from the Health GP. Annexes 7 and 10 discuss opportunities for post-crash care improvements on projects.

5. Road Safety Reporting

ESS4 Paragraph 11: "Where appropriate, the Borrower will undertake a road safety assessment for each phase of the project, and ***will monitor incidents and accidents, and prepare regular reports of such monitoring***. The Borrower will use the reports to identify negative safety issues and establish and implement measures to resolve them."

Incident Reporting

72. The provisions of the Bank's Environment and Social Incident Reporting Toolkit (ESIRT), as it relates to road safety, should also be adhered to by the IA—particularly when road safety or traffic management issues arise at the civil works site, or within facilities or sites associated with the project. To achieve this, the project SE should have their reporting requirements to the IA (based on ESIRT) clearly defined in their TOR. It is critical that the IA has the necessary information required to meet the ESIRT reporting requirements.

73. When a road safety or traffic management incident (even a 'near-miss') occurs on the works site it needs to be immediately reported to the IA (and by the IA to the Bank). Reporting is determined by the classification of the incident described in the ESIRT.

74. Upon receiving a report, the IA—through the SE—needs to ensure that:

- the Contractor takes all necessary actions to secure the safety of workers and the public, and provides immediate care; and/or;
- actions are taken to address the immediate consequences of the impacts of the incident; and,
- mitigation measures are implemented to avoid future similar incidents.

75. For all serious and severe incidents, the IA should prepare an Incident Report, incorporating the following information:

- Preliminary Incident classification (i.e. Serious/Severe).
- What was the incident? What happened? To what or to whom?
- Where and when did the incident occur?
- What were the conditions or circumstances under which the incident occurred (if known)?
- Is the incident still ongoing or is it contained?
- Is loss of life or severe harm involved?
- What actions have been taken by the Contractor to date?

Contractor Compliance Reporting

76. **Monitoring of the adherence of contractor vehicles to the Contractor's TMP is essential.** The TMP defines the **TTM** procedures which will be used to manage road users during construction, as well as other procedures such as how materials will be transported to and from the construction site.

77. A **work zone audit** should be done on a regular basis by the SE (see Annex 5)[24]. This will ensure that the TTM procedures are operating effectively, protecting workers and road users, and appropriately maintained.

78. For **haul routes,** as noted earlier and discussed in Annex 5, due to their low cost, construction vehicle **GPS trackers** should be considered for all projects and are of particular value for **Substantial/High-risk projects**. At minimum, the GPS tracker reporting should have the capacity to produce the following reports in pdf and/or excel format, which most providers automatically email to a list of recipients defined by the user (typically the client, contractor, SE, World Bank, etc.) at a timing (e.g. daily, weekly, monthly, etc..) defined by the user:

    - Number of cases of speeding in the period, speeds reached and locations where speeding occurred;
    - Speed restriction compliance statistics for each individual vehicle (i.e. the percentage of time the vehicle adhered to the TMP speed limit requirements);
    - The percentage of travel that was not on approved haul routes; and,
    - The amount of time that vehicles were operating outside of the agreed operating hours.

79. Contracts may potentially include target requirements for the performance of contractors to meet the above requirements with appropriate deducts for non-compliance or other remedies.

Road Safety Performance Reporting

80. ESS4 Paragraph 11 calls for the Borrower to report on road safety performance. This reporting should be done up to project closing and may be considered for inclusion in the Implementation Completion Report. Ideally, the reporting should continue into the post-project Operations Phase.

81. Crash data should be provided based on the 'International Traffic Safety Data and Analysis Group' (IRTAD) approach[25] in terms of fatalities (defined as a death within 30 days of the crash), injury crashes, hospitalized, and injuries by:

    - road type (motorways, urban roads, rural roads);
    - road user (pedestrians, cyclists, car occupants, powered two wheelers, others);
    - age;
    - gender; and,
    - seat position in the car.

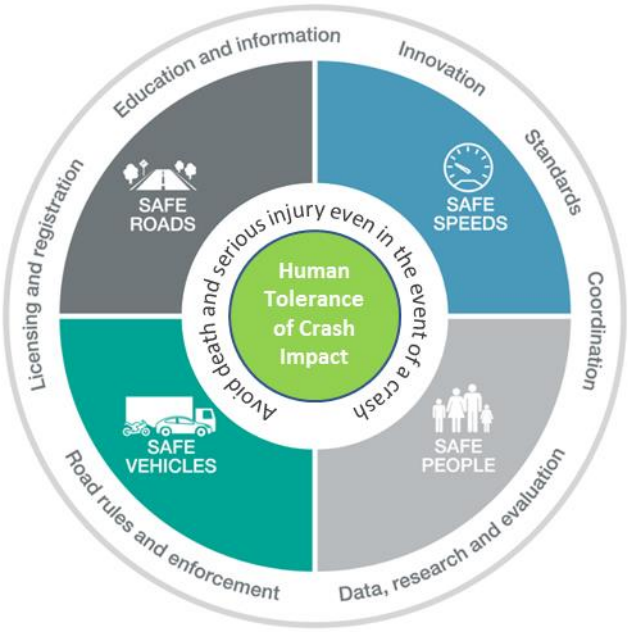
[24] For example see: https://www.workzonesafety.org/training-resources/fhwa_wz_grant/atssa_wz_rsa_guide/.
[25] See: https://www.itf-oecd.org/irtad-road-safety-database.

ANNEX 1: The Safe System Approach to Road Safety

82. As noted earlier, the World Bank's goals for road safety—particularly those embodied in the ESF—will only be achieved through a holistic and systematic approach towards road safety, as embodied in the 'Safe System' approach. The Safe System approach embraces a zero-harm goal and places a strong emphasis on road builder/operator and vehicle manufacturer accountability for road safety performance. In a 'Safe System', safe means safe–not partially safe–such as in the well accepted, zero-harm requirement for workplace safety. The genesis of this approach can be found in the Swedish *Vision Zero* and Dutch *Sustainable Safety* strategies of two decades ago that set a long-term goal for the road system to be free of deaths and serious injuries. This approach has been shown to improve road safety outcomes,[26] and has been adopted on World Bank financed projects, by the United Nations, the World Health Organization, the Organization of Economic and Economic Development (OECD), and in many national road safety strategies of successful road safety countries.

83. Figure A1.1 illustrates the core principles of the Safe System approach.[27] Box A1.1 discusses the ethical basis for a Safe System.

Figure A1.1: Portrayal of a Safe System



84. There are four key principles that form the basis of the Safe System philosophy:

- People make mistakes that can lead to road crashes;
- The human body has a limited physical ability to tolerate crash forces before harm occurs;

[26] Mooren, L, Grzebieta, R., Job, R.F.S. Williamson, A. (2011). Safe System – International Comparisons of this Approach. *A Safe System-making it happen: Proceedings of the Australasian College of road Safety Conference, Melbourne, September 2011*. http://acrs.org.au/wp-content/uploads/Mooren-et-al-Safe-System-%E2%80%93-Comparisons-of-this-Approach-in-Australia.pdf.

[27] Adapted from https://roadsafety.gov.au/nrss/safe-system.aspx . This figure does not explicitly include post-crash emergency response and care, although it is implicit under the 'safe people' element.

- A shared responsibility exists amongst those who plan, design, build, and manage roads and vehicles and provide post-crash care to prevent crashes resulting in FSIs (in a thorough Safe System, there may also be some small unavoidable residual responsibility on road users such as vehicle safety feature maintenance); and,

- All parts of the system need to be strengthened to multiply their effects; and if one part fails, road users are still protected.

Box A1.1: The Ethical Basis for a Safe System

- People should not die because of a mistake made during the operation of a motor vehicle or as a pedestrian or cyclist. This means that the overall 'system' should be 'forgiving' of mistakes being made, as mistakes are inevitable.
- Deaths and injuries in road crashes almost always involve a human error but also an unsafe system which allowed that error to generate a crash and allowed the crash to generate forces resulting in fatality or serious injuries.
- The Safe System approach is the opposite of the traditional approach where road crashes were often viewed as the responsibility of the user.
- We should design, build, and operate the road transport system to accommodate road user's mistakes, not use errors as an excuse to absolve ourselves of responsibility for the consequences.

85. The Safe System approach recognizes that road workers, community members and road users are error prone and physically vulnerable to force. Their safety in the road environment is assured by them not being exposed to forces that exceed their physical tolerance to injury, even in the event of a mistake.

86. Examples of the differences between the conventional approach to road safety and the Safe System approach are shown in Figures A1.2 and Table A1.1[28].

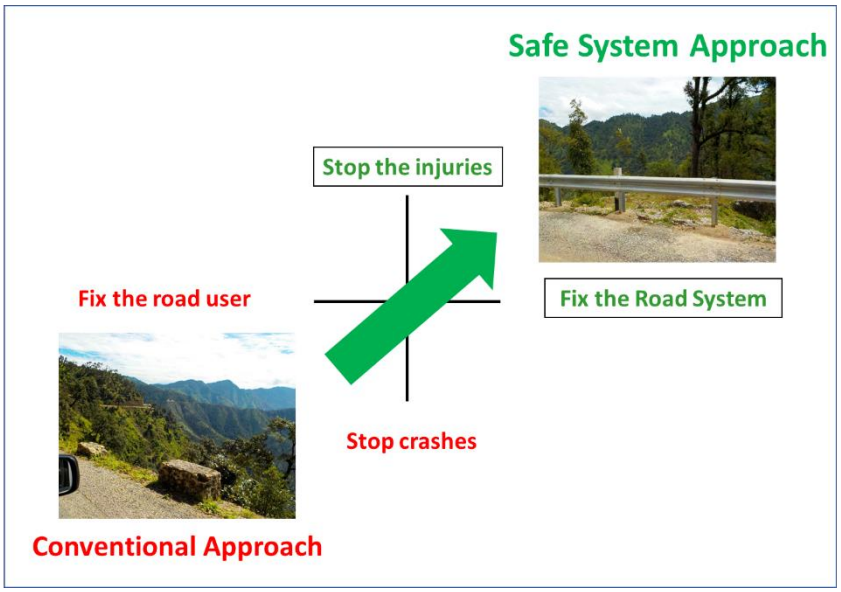


Figure A1.2: Rural roadsides – Example of the Conventional vs Safe System Approach (from a DFID Funded GRSF/World Bank project in Nepal)

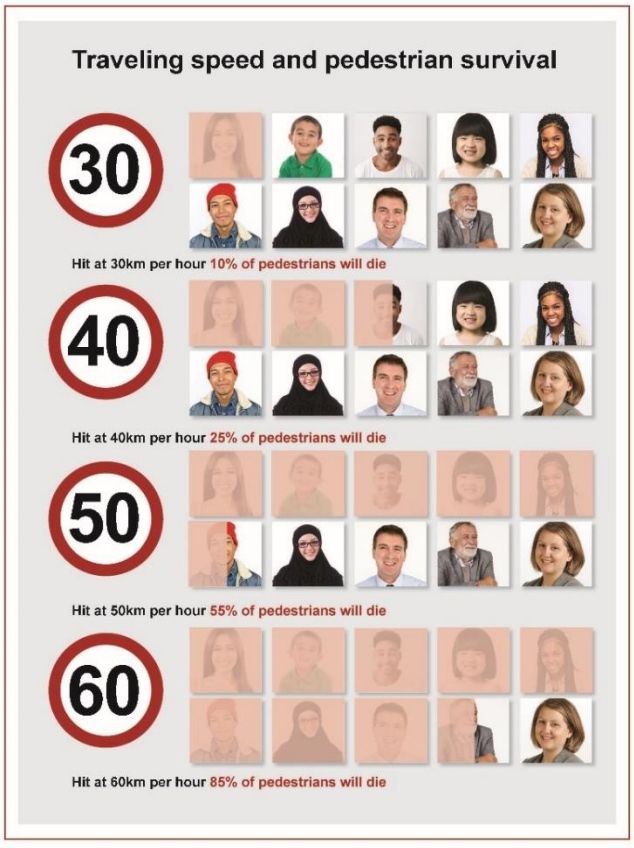
[28] Towards Safe System Infrastructure: A Compendium of Current Knowledge (2018). Austroads Report AP-R560-18.

Table A1.1: Contrasting the Conventional versus Safe System Approaches

Different Approaches to Addressing Issues in Conventional vs Safe Systems			Example: Applying the Safe System to Signalized Intersections		
Issue	**Conventional**	**Safe System**	**Issue**	**Conventional**	**Safe System**
What is the problem?	Crashes	Fatalities and Serious Injuries	Provisions for Turning Traffic	Ranges from unprotected to protected turns often governed by efficiency objectives	Default position is provision of protected turns
What causes the problem?	Mainly poor road user performance Speeding, impaired driving, inattention, deliberate risk taking	System failures	Speed Management	Rely on compliance with general speed limit; occasional use of safety cameras	Design features that guarantee survivable impact speeds
Who is ultimately responsible?	Individual road users	System designers and operators	Redundancy	Primary, secondary and sometimes tertiary signal locations; mast arms, advanced warning signs	Geometric design features that influence drivers who might otherwise inadvertently travel through a red light
What is the major planning approach?	Incremental approach to reduce the problem with an associated residual crash problem	A systemic approach to build a safe road system and minimize the harm	Points of Conflict	Maximize throughput by increasing the number of lanes (this creates more points of conflict).	Limit points of conflict
What is the appropriate goal?	Optimum number of fatalities and serious injuries based on competing objectives	Towards the virtual elimination of FSIs	Expectations of Road Users	Road users make the right decisions in all circumstances; the decision-making environment tends to be complex	Road users will make errors; the decision-making environment is simplified
What is the trade-off?	A balance between mobility and safety	Maximizing safe mobility	Collision Orientations	90-degree vehicle to vehicle impacts; right turn against offset frontal collisions	Collisions at acute angles
How is the effort coordinated?	Incremental gain within individual pillars (roads / speeds / vehicles / people)	Optimize solutions across pillars (roads / speeds / vehicles / people). Pillars compensate for each other where performance is poor	Obstructions from Moving Vehicles	Rarely considered	Considered in design process
What are the cultural manifestations?	Legal liability avoidance and risk aversion	Risk assessment, innovation, trials and demonstrations	Inattentional blindness (Looked but did not see)	Rarely considered	Compensated for with design that limits crash severity
Context of tools in use	Bias towards pre-existing crash history, understanding crash causes and likelihood, optimizing the network for motor vehicles	Risk analysis based on network design attributes supplemented by crash data, understanding crash consequence, optimizing the network for all road users and human frailty	Secondary Impacts	Rarely considered	Considered in design process
			Crash severity	Rarely considered	Considered in design process
			Pedestrians	Usually pedestrian/vehicle conflict can exist in a phase; occasional use of all pedestrian crossing phases	30 km/h speeds where pedestrian/vehicle conflict exists in a phase; segregation or all pedestrian phases for higher speeds
			Cyclists	Usually cyclist/vehicle conflict can exist in a traffic signal phase; occasional use of exclusive cyclist phases	Design features that support the vision of cyclists from vehicles and ensure slow vehicle speeds; segregation where speeds are high

Box A1.2: Safe Systems and Speed Management

Under a Safe System speed management is particularly critical for road safety, with higher speeds increasing both the risk of crashing and the severity of the crash—each 1% increase in speed results in around a 4% increase in deaths unless appropriate protective measures are taken.



The management of speed is central to the achievement of strong road safety improvements. It should be recognized that many road improvements will result in higher speeds, and even speed management alone may not be enough to fully mitigate the increased traffic and road safety risks. Thus, the assessment of road safety impacts of the project should always explicitly consider the safety impacts of increases in speeds, be they from improved road conditions, higher design speed, more powerful vehicles, or additional road capacity (even if these increases are within the speed limit).

In LMICs, most of deaths are of vulnerable road users: pedestrians, cyclists, motorcyclists. Specific consideration needs to be given to protecting these users, particularly when investment projects lead to increased speeds. As shown to the right, when hit by a vehicle travelling at 60 km/h, around 85% of pedestrians will be killed. The 15% who survive will most likely suffer major trauma and almost certainly permanent disability. At 30 km/h only 10% will die, and most injuries would be minor.

An extensive and irrefutable body of evidence exists showing that various means of reducing speeds have led to reductions in deaths and injuries, including examples across the pillars of road safety: changing speed limits, speed safety cameras and the promotion of enforcement, vehicle-based management of speed, and road engineering to reduce speeds.

(The figure in this box is an adaptation of a figure produced by the NSW Centre for Road Safety)

87. Table A1.2 presents a hierarchy of treatments that can be used as road safety interventions in a Safe System for different type of crash situations. The implementation of Safe System involves:

- Adopting '**primary**' solutions which eliminate occurrence of FSIs; or,
- If primary solutions are not feasible due to project constraints (e.g. site, budget), '**supporting**' solutions are the next safest option. Highest priority amongst the supporting solutions are treatments that allow future Safe System solutions (e.g. a wide central painted median with audio-tactile delineation may be installed with adequate width to allow a future wire rope barrier).

Table A1.2: Hierarchy of Safe System Interventions[29]

Area of Concern	Primary Safe System Intervention	Supporting Interventions		
		Compatible with Future Primary Options	Does not Affect Future Primary Options	Other Opportunities
Run-off Road Crashes	• Flexible roadside and median barriers (or equally/better performing future equivalent) • Very high quality compacted roadside surface, very gentle to flat side slopes and exceptionally wide run-off areas • Very low speed environment/speed limit • Road engineering to limit speeds	• Wide run-off areas, with well-maintained shallow drainage and gentle side slopes • Wide sealed shoulders with audio-tactile edge line • Lower speed limit	• Non-flexible safety barrier • Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Skid resistance improvement • Improved superelevation • Audio-tactile centerline • Audio-tactile edge line • Vehicle activated signs	• Speed enforcement • Rest area provision • Lane marking compatible with in-vehicle lane-keeping technology • Electronic stability control in vehicles • Intelligent speed adaptation in vehicles
Head-on Crashes	• One-way traffic • Flexible median barrier • Very wide median • Very low speed environment/speed limit • Road engineering to limit speeds	• Wide median • Painted median/wide centerlines	• Non-flexible barrier provision • Lower speed environment/speed limit • Ban overtaking • Skid resistance improvement • Audio-tactile centerline • Audio-tactile edge line • Roadside barriers • Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Overtaking lanes	• Speed enforcement • Rest area provision • Lane marking compatible with vehicle-lane-keeping technology • Electronic stability control in vehicles • Intelligent speed adaptation in vehicles
Intersection Crashes	• Grade separation • Close intersection • Low speed environment/speed limit • Roundabout • Raised platform • Other road engineering to limit speeds	• Left-in/left-out, with protected acceleration and deceleration lanes where required • Ban selected movements • Reduce speed environment/speed limit	• Redirect traffic to higher quality safer intersection • Turning lanes with sharp turns to limit speeds • Vehicle activated signs • Improved intersection conspicuity • Advanced direction signage and warning • Improved site distance	• Speed cameras combined with red light cameras • Intelligent speed adaptation in vehicles

[29] Based on Austroads Safe System Assessment Framework, report AP-R509-16 with additions.

			• Traffic signals with fully controlled right turns • Skid resistance improvement • Improved street lighting	
Other Rural Crashes	• Low speed environment • Road engineering to limit speeds	• Reduce speed environment/speed limit	• Variable message signs/managed freeway systems • Skid resistance improvement • Turning lanes • Overtaking lanes • Improved sight distance/conspicuity • Improved delineation • Improved street lighting	• Speed enforcement • Intelligent speed adaptation in vehicles
Pedestrian Safety	• Separation (footpath) • Separation (crossing point) • Very low speed environment, especially at intersections or crossing points • Road engineering to limit speeds	• Reduce speed environment/speed limit • Pedestrian refuge • Reduce traffic volume	• Pedestrian signals • Skid resistance improvement • Improved sight distance to pedestrians • Improved street lighting • Rest-on-red signals	• Speed enforcement • Intelligent speed adaptation in vehicles • Pedestrian safety sensors in vehicles
Cyclist Safety	• Separation (separate cyclist path) • Very low speed environment, especially at intersections • Road engineering to limit speeds	• Shared pedestrian/cyclist path • Cyclist lane • Reduce traffic volumes	• Separate cyclist signals at intersections • Cyclist box at intersections • Skid resistance improvement • Improved street lighting	• Speed enforcement • Enforcement of other regulations • Intelligent speed adaptation in vehicles
Motorcyclist Safety	• Separate motorcycle lane (e.g. on freeways) • Road engineering to limit speeds	• Shared motorcycle/bus/taxi lane (e.g. on freeways)	• Consistent design along the route (i.e. no out-of-context curves) • Consistent delineation for route • Skid resistance improvement • Motorcycle-friendly barrier systems	• Speed enforcement • Enforcement of other regulations • Intelligent speed adaptation in vehicles

88. The options provided in Table A1.2 are from Australia and should only be considered indicative as the priority and effectiveness of treatments may vary between countries. There are several toolkits which describe treatment effectiveness such as www.engtoolkit.com.au and https://www.roadsafety-dss.eu/.

Box A1.3: Case Study—Implementing a Safe System in Argentina

The World Bank financed Argentina Road Safety Project is one of the few standalone road safety projects that encompasses elements of the Safe System approach. The results have been promising primarily due to the project's focus on strengthening and sustaining the road safety management capacity in the country by using the Lead Agency Model – an approach advocated by the Bank. In Argentina, this was the National Road Safety Agency (ANSV), which took a pragmatic approach to the recommendations made, and implemented initiatives critical to transitioning the country to a Safe System Approach over a period of seven years.

Traffic deaths in Argentina had been rising steadily until 2011, with a mortality ratio of 12.4 per 100 thousand inhabitants, when they began to stabilize. This was about the same time that the Argentina Road Safety Project began. The project-built partnerships with local and regional governments by funding cost-effective road safety interventions, building capacity and leading the Federal Council for Road Safety. It also supplied the necessary tools to collect road safety data. Additionally, the project helped the ANSV promote a sustainable framework for policy and projects, for which ANSV remains accountable. Through this project, ANSV implemented:

- National drivers licensing system;
- Road safety communication and education campaigns;
- Delivery of training and workshops;
- Protocols and guidelines for improving first responders' speed and efficiency in case of emergencies; and,
- Mechanisms to strengthen the capacity of traffic control and road police.

Regulating and registering Argentinian drivers' licenses was no small task. By the close of the project, over 15 million drivers' licenses had been issued to 85 percent of the population. Before this, there were more than 1,800 distinct kinds of drivers' licenses available in Argentina, which were applied using different standards with zero national data sharing. This made it impossible to discipline wrongdoers by seizing their licenses since, in practice, they could just go to another jurisdiction and get a new one. ANSV also created a system for recording national traffic records and an infraction registry.

In terms of enforcement, traffic police working with the ANSV carried out over 180,000 inter-jurisdictional operations, through the project lifecycle and created educational campaigns, trainings and workshops, and well as a road injury information system for use in 50 hospitals.

The project also established the National Road Safety Observatory, which maintains and analyzes data to generate information on crashes, contributing human factors to crashes, and infrastructure safety. It now has data for all of Argentina's 24 provinces.

The project also created an incentive fund to implement road safety policies and projects with the aim of working with and through local and regional jurisdictions to devise road safety.

Preparation

Project Types[30] This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	**Yes**	**Yes**	**Yes**

Table A2.1: Mitigation Measures During Preparation

Number	Project Type	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level[31] Low	Moderate	Substantial	High
Preparation									
Promoting the Road Safety Agenda									
1	A, B, C	Continuously throughout Preparation **sensitize the IA, EA, and other key actors** as to the importance of addressing road safety, not only on the project, and the mechanisms that will be implemented.	• Hold discussions with all key actors to highlight existing road safety situation in country and opportunities for improvement, both on the project and for the wider sector.	• N/A	• Task Team	✓	✓	✓	✓

[30] A: Projects with road construction or rehabilitation or urban mobility on road (e.g., BRT); B: Other projects which change speeds, traffic mix or volume, vulnerable road user (pedestrians, bicyclists, motorcyclists) mix, volume, routes or facilities; C: Projects with road safety impacts during construction only; and, D: Projects with vehicle procurements as the only influence on road safety (e.g. fleets or even project vehicles).

[31] Legend: ✓ = Actions are recommended given the risk level; ○ = Actions that should be considered to be done, and adopted if appropriate, given the nature of the project and the associated risks; ⊗ = Actions are unlikely to be needed given risk level. **The size of the icon reflects the relative effort**, i.e.: the higher the risk, the more effort is required.

		2	A, B, C	Throughout Preparation, conduct **stakeholder engagement**[32] with NGOs and others who may be influenced by the project or the broader road safety agenda.	• Identify opportunities for improvement, both on the project and for the wider sector.	• N/A	• IA	✓	✓	✓	✓
		Road Safety Planning								
		3	A, B	**Review transport plan or development location** to identify if there is a more effective location which will reduce the need for (exposure to) road-based transport.	• Land use planning and approval policies which facilitate reduced road use, such as high density living, and limiting commercial developments to around public transport nodes. • Freight logistics planning with defined routes for heavy vehicles from ports to logistics hubs, and prevention of heavy vehicles from within urban/congested areas. • Provisions and promotion of non-road public transport options. • Incentivizing public transport use over private vehicle use.	• Compliance with development approvals process assuring road network safety and reduce the need for road-based travel. • Transport modal share and related road safety performance. • Adoption of a 'Movement and Place' strategic framework[33].	• IA with support from Task Team and/or consultants	○	○	✓	✓
		4	A, B	**Undertake planning RSA** (see Annex 4)[34] (also called a Road Safety Impact Assessment) to understand the safety implications due to new road infrastructure additions/modifications envisioned under the scope of the	• Understand the functionality of the proposed road infrastructure and confirm its consistency with the design features	• RSA report outlining key areas for focusing on during design. • Absolute road safety outcome	• IA with support from Task Team/consultants	✗	○	✓	✓

[32] See for example: https://www.nzta.govt.nz/safety/speed-management-resources/engagement-resources/.
[33] See for example: https://transport.vic.gov.au/our-transport-future/movement-and-place-in-victoria.
[34] See for example: https://austroads.com.au/publications/road-safety/agrs06 and https://www.piarc.org/en/order-library/6851-en-Road%20safety%20audit%20guidelines%20for%20safety%20checks%20of%20new%20road%20projects.htm.

				project, and the key road safety issues to be addressed during the design stage. This should be done early enough in project Preparation to clearly define the needs.	(e.g., is it primarily a freight corridor or intended to improve connectivity). • Identify opportunities, if any, to modify the route to minimize adverse effect on local communities. • Identify opportunities, if any, to mitigate the traffic and road safety risk on the project road by 'shifting' or controlling travel exposure.	metrics (e.g., fatalities/km with project design) • RSSAT metrics to understand relative change in fatality risk for each road user group (Type A projects only)					
		5	A, B	Undertake a road corridor assessment to identify road safety issues to be addressed on the project.	• Use iRAP or similar approach to assess key areas of risk and opportunities for improvement.	• Safety rating of corridor before and after project.	• IA with support from Task Team/consultants	⊗	○	✓	✓
		Road Safety in the Environmental and Social Documents									
		6	A, B, C, D	Ensure that the OPTRSR (and RSSAT results for Type A projects) are considered when the Borrower **develops the ESCP**.	• Confirm that the ESCP contains an appropriate level of commitment to address the likely road safety risks.	• N/A	• IA ESCP • Task Team for OPTRSR and RSSAT	✓	✓	✓	✓
		7	A, B, C	The **ESMF** and final **project ESMP needs to capture the road safety needs on the project** and mitigate the risks. To do this, ensure that: • The project maintains safety and ethical considerations related to road safety data collection • **Stakeholder engagements** capture the concerns around road safety with suggestions for addressing them. • The **project's social assessment** includes assessment of the underlying	• Confirm that road safety implications are addressed as part of the social assessment, and particularly during public consultations. • Have project ESMP include mitigation measures based on the technical needs, social assessment and consultations. • Update ESMP if project risks change.	• N/A	• IA for social assessment and ESMP • Task Team to review and clear ESMP • Task Team for OPTRSR and RSSAT	✓	✓	✓	✓

				traffic and road safety risks and social situation. • Road safety risks as identified and discussed at the PCN/QER/Decision Review are addressed in the final project ESMP.	• Include OHS standards related as part of ESMP ○ Incident reporting; ○ Personal protective equipment (PPE), particularly high visibility vests; and, ○ Safety training requirements. • Random alcohol and/or drug testing of drivers. • Use of GPS trackers to confirm compliance with TMP.						
		8	A, B, C	If there is resettlement on the project the **RAP** needs to include measures to ensure that there will be safe infrastructure provided to resettled beneficiaries.	• Ensure RAP contains appropriate provisions for safe infrastructure.	• N/A	• IA for RAP • Task Team to review and clear RAP	✓	✓	✓	✓

Implementation – Road Safety Capacity Strengthening

Safe Designs: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	Yes	Yes	No

Table A2.2: Addressing Project Traffic and Road Safety Risks Capacity Strengthening

Number	Project Type	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Implementation									
Road Safety Capacity Strengthening Opportunities									
9	A, B	Ensure that the IA has the **capacity** to effectively consider the project's road safety needs.	• Have a road safety specialist as part of the IA's team. May be either IA staff or consultant.	• N/A	• IA	○	○	✓	✓
10	A, B	Review the capacity of Government to **effectively provide, operate and manage safe roads**[35].	• Sound structures and processes for road safety leadership and management. • Development of a road safety lead agency. • Clear accountability for road safety performance. • Development of targets for improvement and strategic plans to deliver those targets.	• Development of an effective Lead Agency. • Compliance with safe design, safe construction and safe operations management plans. • Provision of adequate funding for road safety.	• IA with support from Task Team and/or consultants	✓	✓	✓	✓

[35] For example see: http://www.worldbank.org/en/topic/transport/publication/road-safety-management-capacity-review-guidelines.

					• Creation of sustainable funding sources for road safety. • Increase focus on road design and engineering measures if above not viable and effective.						
		11	A, B, C	**Provide Technical Assistance (see Annex 7)** to improve road safety outcomes in areas such as: (i) maintenance of safety features; (ii) knowledge and capacity of local institutions and contractors and fleet operators for road safety; (iii) legal environment; (iv) national road safety strategy and road safety action plan; (v) crash data recording and analysis system; (vi) manuals, specification, codes of practice, etc.; (vii) safety education programs (see Annex 6); (viii) police road safety enforcement; (ix) reduce overloading of trucks and passenger vehicles; (x) fleet management regulations and practices; (xi) driver licensing; (xii) vehicle safety standards and rules (Annex 1); (xiii) seat belt, motorcycle helmet and child restraint legislation and usage; (xiv) post-crash care (see Annex 10); (xv) legal framework for crash responders; (xvi) implications of imported vehicles and/or spare parts on road safety; and, (xvii) media campaigns.	• Provide Technical Assistance as necessary to build capacity.	• Varies depending upon technical activities.	• IA with support from Task Team and/or consultants	✓	✓	✓	✓

Implementation – Safe Designs

Safe Designs: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	Yes	No	No

Table A2.3: Addressing Project Traffic and Road Safety Risks Through Safe Designs[36]

Number	Project Type	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Implementation									
Safe Designs									
12	A, B	Use a **design RSA**[37] prior to designs being completed and procurement starting to confirm that road safety concerns are identified, positive practical safety features have been properly incorporated into the detailed designs, and that the road is safe for the changes in traffic volume and mix anticipated.	• Ensuring safety ratings and audits of designs are undertaken and recommendations for safety improvements are adopted. • Conduct SSA to confirm all Safe System opportunities are realized. • Identified issues should be addressed.	• Safety rating. • Safety audit compliance. • Crash fatalities and serious injuries.	• IA • Task Team to review RSA and SSA findings and confirm IA responds reasonably to all audit report recommendations	✓	✓	✓	✓
13	A, B	Project designs need to capture opportunities for **speed management**[38] through road	• Adopt speed management interventions aimed at controlling the operating	• Number of speed managing devices installed.	• IA through the design engineer	✓	✓	✓	✓

[36] See Table A1.2 for a hierarch of treatments for different crash issues.
[37] For example, see: https://austroads.com.au/publications/road-safety/agrs06.
[38] For example see: https://safety.fhwa.dot.gov/speedmgt/ref_mats/docs/speedmanagementtoolkit_final.pdf.

				design and traffic calming measures that limit speeds to safe operating levels. Operating speeds need to remain safe for any changes in traffic volume and mix anticipated. Review proposed **speed limits and designs** on project roads so that that the operating speeds are consistent with a Safe System and that speed limit signage is appropriate for compliance—given prevailing enforcement levels.	vehicle speed and not relying on the posted speed limit. • Identify opportunities to control operating speeds not just by speed through traffic calming features to manage speeds (such as speed humps, speed cushions, chicanes, raised platform crossings, roundabouts, narrowed lane markings). • Consider opportunities for automated speed management (see Annex 9). • Set limits to within Safe System principles (30km/h where vulnerable road users are present, 50km/h if side impact crashes are possible such as at non-roundabout intersections, 70km/h if head on crashes are possible, and 100 km/h for full expressway conditions depending on design and usage). • Speed limit signage needs to be prominent to increase compliance (e.g., gateway treatments).	• Percentage of pedestrian crossings at which speeds are managed down to 30km/h by effective speed managing infrastructure. • Safe crash impact speed thresholds. • Average vehicle operating speeds by road type, vehicle type, and season. • Percentage vehicle compliance with speed limit at operational detection sites.					
		14	A, B	Project designs should **minimize the risk due to roadside hazards** and create 'forgiving' roads[39].	• Provide roadside clear zones (ideally 10+ m rural and 1.8 m urban) and minimize any hazards in these clear zones. • Provide shoulders (> 0.5 m)—ideally sealed. • Relocate road side hazards (e.g. lighting poles, power poles, etc.) where practicable to reduce the number and/or	• Safety rating. • Safety audit compliance. • Safety features installed. • Crash incidents (injuries and fatalities; plus 'near misses' in traffic	• IA through the design engineer	✓	✓	✓	✓

[39] For example see: https://www.piarc.org/en/order-library/6458-en-PIARC%20Catalogue%20of%20design%20safety%20problems%20and%20potential%20countermeasures.htm .

					move them away from the road. • Light columns and signs are appropriate (i.e. frangible, hinged or collapsible). • Install safety infrastructure such as roadside crash barriers, median barriers, median separation. • Ensure that all bridge and barrier ends have appropriate attenuators to absorb impacts.	management environments).					
		15	A, B	Confirm that project designs **protect vulnerable road users** (i.e. pedestrians, cyclists and motorcyclists).	• Designs should include safe pedestrian crossing points, speed levels safe for pedestrians (30km/h maximum), traffic calming measures, footpaths, wide shoulders, lighting, bus stops, separate cyclist/motorcyclist lanes, etc.[40] • Consider vulnerable users at roundabouts where the risks are increased—if necessary do not adopt a roundabout solution if the risks cannot be adequately managed. • For railway crossings, designs should consider: (i) passive and/or active warnings, including visual and audio; (ii) lighting; (iii) fencing; (iv) physical separation; (v) barriers; and, (vi) physical calming[41].	• Number of vulnerable road user protections adopted.	• IA through the design engineer	✓	✓	✓	✓

[40] For example see: https://www.nzta.govt.nz/resources/pedestrian-planning-guide/docs/pedestrian-planning-guide.pdf.
[41] For example see: https://www.kiwirail.co.nz/uploads/Publications/RailXing-PedBikeXingDesign-RevisedGuide.pdf.

		16	A, B	Address the road safety needs of **persons with disabilities**[42].	In addition to the needs for vulnerable users above: • Footpaths need to be: (i) at least 1.2 m wide; (ii) continuous without obstructions or hazards; (iii) have appropriate ramps (minimum 1 m wide; 1:12 gradient maximum, and tactile indicators at curb edge); (iv) have a maximum camber of 1:50. • Designs should consider safer road crossings by: (i) speed management; (ii) ensuring that signal timing are enough for persons with disability to cross; (iii) footpath improvements—for example extending the footpath across the road. • Bus stops need accessible walkways, shelters and lights.	• Number of protections adopted for persons with disability.	• IA through the design engineer	✓	✓	✓	✓
		17	A, B	**Intersection designs** need to be as safe as possible, with clear visibility, minimizing side impact crash risk and pedestrian crash risk[43].	• Adopt appropriate designs for intersections: ○ **Roundabouts** preferred for cross roads and 'Y' intersections; ○ **Staggered 'T'** preferred for rural crossroads; ○ **Signals** may be best in urban areas to protect vulnerable users; • Use raised platforms for intersections (or pedestrian crossings) to reduce speeds. • Provide **protected turns** for signalized intersections.	• Percentage of intersections in project adopting roundabouts or staggered T.	• IA through the design engineer	✓	✓	✓	✓

[42] See the PRIF report on improving accessibility and the associated design checklists from: https://www.theprif.org/documents/regional/transport-land/improving-accessibility-transport-infrastructure-projects-pacific.

[43] For example, see: https://www.nzta.govt.nz/resources/high-risk-intersections-guide/.

					• Ensure that any design considers the needs of **vulnerable users** and **persons with disability.**						
		18	A, B	Manage traffic demand, conflicts and speeds on **urban roads and streets**[44].	• Review the design approach in the context of the road hierarchy to balance the needs for mobility against the role of roads where people congregate and dwell. • Use **local area traffic management** solutions to (i) enforce appropriate traffic flows; (ii) reduce speeds; (iii) restrict access (e.g. right in/right out safest)[45].	• N/A	• IA through the design engineer	✓	✓	✓	✓
		19	A, B	**Signs and delineation** should be used to maximize safety.	• Ensure pavement markings and signs are to standards for reflectivity. • Use edge and center lines to provide clear guidance. • Ensure signs are: (i) legible for the speed; (ii) positioned to maximize reflectivity opportunities; and, (iii) clearly provide information and appropriately identify all hazards. Use curve chevrons to maximize guidance. • Use edge marker posts to provide clear guidance as to the direction ahead. • Used raised reflective pavement markers, particularly for areas with poor weather. • Use audio-tactile profile (ATP) road markings	• N/A	• IA through the design engineer	✓	✓	✓	✓

[44] For example, see: https://healthystreets.com/
[45] For example, see: https://austroads.com.au/publications/traffic-management/agtm08.

		20	A, B	Provide **appropriate lighting** for road safety.	• Provision or upgrading of lighting to improve: (i) frequency; (ii) quality (illuminance, uniformity, brightness); (iii) reducing hazards by moving or replacing with frangible poles. • Replace sodium with high intensity LED lighting. • Pedestrian crossings should illuminate the crossing, footpaths and pedestrians on crossing. • Rural intersections need to be illuminated with 'flag' lighting to indicate the presence of the intersection or to highlight isolated localized conflicts, ensuring lights do not create a hazard.	• Implementation of upgraded lighting.	• IA through the design engineer	✓	✓	✓	✓
		21	A, B	Confirm that the pavement will have adequate **skid resistance**.	• Ensure pavement specifications cater for adequate microtexture, macrotexture and hysteresis to reduce loss of control crash risk.	• Corrective action to improve skid resistance.	• IA	✓	✓	✓	✓
		22	A, B	Confirm the designs have maximized the opportunities for improvement.	• Conduct a **Safe System Assessment**[46] on the designs and adapt as appropriate.	• SSA Score	• IA	✓	✓	✓	✓
		23	A, B	**Update the ESMP** (and RAP if necessary) as appropriate to reflect the final design.	• ESMP/RAP documents should be updated and redisclosed if there are any substantial changes based on the final design.	• N/A	• IA	✓	✓	✓	✓

[46] For example, see: https://austroads.com.au/publications/road-safety/ap-r509-16.

Implementation – Procurement

Procurement: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	**Yes**	**Yes**	**Yes**

Table A2.4: Addressing Project Traffic and Road Safety Risks Through Procurement

Number	Project Type	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Implementation									
Procurement – Civil Works									
24	A, B	**Bidding documents** need to fully capture the road safety needs of the project as reflected in the Environmental and Social documents (especially the ESMP).	• With many projects moving to post-review, Task Teams need to confirm prior to clearing bidding documents: ○ Implementation of RSA/safety assessment; ○ recommendations in designs; ○ Speed management approach; ○ Intersection design approach; ○ Protection of vulnerable users and the disabled; and, ○ Use of crash barriers.	• N/A	• IA • Task Team to review as part of bidding document clearance process	✓	✓	✓	✓
25	A, B, C	Bidding documents should contain clear requirements as to the **Occupational Health and Safety** to be applied during construction by the contractor, and what should be included in the traffic management plan.	• Requirements clearly defined in the project ESMP. • Include OHS standards related as part of ESMP ○ Incident reporting; ○ Personal protective equipment (PPE), particularly high visibility vests; ○ Safety training requirements; ○ Random alcohol and/or drug testing of drivers.	• N/A	• IA • Task Team to clear the ESMP	✓	✓	✓	✓

					• For Substantial/High-risk situations: ○ Workers should be trained and accredited in traffic management control traffic in work zones; ○ Establish an accreditation system referred to in contracts (especially in urban areas) to ensure that trucks select the safest routes / use the safest vehicles / have adequate driver training / appropriate incident management; and, ○ GPS trackers (see below).						
		26	A, B, C	Bidding documents should contain clear requirements as to the **temporary traffic management requirements** to be applied during construction by the contractor, and what should be included in the **traffic management plan**.	• Include TTM requirements as part of ESMP (e.g. include as an Annex Code of Practice setting the minimum standard[47]). This should clearly indicate that he C-ESMP must contain a detailed site specific TTM plan go guide the traffic management processes during construction as part of the TMP.	• N/A	• IA • Task Team to clear the ESMP	✓	✓	✓	✓
		27	A, B, C	Have contractor vehicles (particularly haul vehicles) to be outfitted with: ○ **GPS tracking devices and/or speed governors** to monitor and confirm compliance with traffic management plan (see Annex 5) ○ Appropriate safety devices such as flashing lights, reversing signals, mirrors, etc.	• Haul vehicles monitored for compliance with speed restrictions and following only agreed routes. • Haul vehicles with appropriate (and working) safety devices. • Contract should contain clear penalties for non-compliance.	• Percentage compliance with traffic management speed and/or route requirements. • Audit of haul vehicle safety devices.	• IA	○	○	✓	✓

[47] See for example: https://www.works.gov.pg/files/roads-bridges/IF003_PNGFieldGuide.pdf and https://www.adb.org/publications/carec-road-safety-engineering-manual-safer-road-works.

		28	A, B, C	Prior to award, ensure the contractor's **Management Strategies and Implementation Plans (MSIPs)** in the bidder's bid are appropriate, ideally including the TMP	• Task Team to undertake Technical Review as part of bidding review process to ensure that the projects safety requirements are met.	• N/A	• Task Team prior to issuing No Objection to bid award	○	○	✓	✓

Procurement – New Vehicles

		29	A, B, D	The **technical specifications for passenger (light) vehicles procured on project** should be the safest available in the country and that the vehicles will be maintained at their safety standard.	• Adopt NCAP 4 or 5 crash standards (or highest available in country). • As a minimum, all new vehicles should comply with UN regulation 94 (occupant protection in frontal collision), UN regulation 95 (occupant protection in lateral collision), UN regulation no. 13-H/GTR 8 (Electronic Stability Control). • Seat belt system that comply with UN regulation 14 and UN regulation 16 (see Annex 8). • Conduct regular safety maintenance and inspections. Seat belts need to be maintained and readily accessible, not pushed under seats or obscured by seat covers	• Adopted UNECE vehicle safety features. • NCAP (New Car Assessment program) Safety ratings of cars. • Compliance with vehicle safety certification and periodic inspection standards and rules. • Vehicle maintenance records.	• IA • Task Team	✓	✓	✓	✓
		30		When procuring **motorcycles** or other two-wheeled vehicles provide helmets.	• Helmets should comply with the safety standard, UN regulation no. 22 (or commonly referred to as ECE22). Comparable national standards that meet or surpass the UN regulation no. 22 can also be used.	• Helmet usage	• IA • Task Team	✓	✓	✓	✓
		31	A, B, D	The **technical specifications for trucks and/or buses procured on project** should meet the highest possible UN regulations available in the country and the vehicles will be maintained.	• Adopt highest possible UNECE regulations. • Conduct regular safety maintenance and inspections.	• Heavy vehicle and public transport industry compliance with	• IA • Task Team	✓	✓	✓	✓

						safety standards and rules.					
		32	A, B, D	**Vehicle related countermeasures** for speed control.	• Implement GPS trackers which allow for fleet management and driver speed monitoring. • Implement speed governors for trucks, public passenger cars, and motorcycle taxis.	• Percentage of vehicles with GPS trackers and/or speed governors.	• IA	○	○	✓	✓
		33	A, B, D	**Vehicle related countermeasures** for alcohol control.	• Buses and ambulances are recommended to have alcohol interlocks fitted, used and serviced. • Alcohol locks may be appropriate for vehicles operated by the Borrower, contractors and the SE.	• Percentage of vehicles with alcohol locks.	• IA	○	○	○	○

Implementation – Construction

Construction: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	Yes	Yes	No

89. Table A2.5 describes how to address construction related traffic and road safety risks. Poor traffic management during construction is a major source of road crashes and FSIs and so needs to be carefully considered and implemented—these recommendations reflect this. It is essential that these be reviewed in conjunction with the procurement recommendations in Table A2.4. This is because the procurement process will put in place the necessary contractual requirements that will apply on the project. It should be noted that some special project types—such as community driven development projects—may by their nature have greatly enhanced risks to workers due to the limited experiences with construction. In these cases, additional measures, or more in-depth efforts, may be necessary.

Table A2.5: Addressing Construction Traffic and Road Safety Risks

Number	Project Type	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Implementation									
Construction									
34	A, B, C	Contractor to prepare a **traffic management plan** in accordance with ESMP requirements which clearly shows how traffic (including speeds) will be managed during construction and implement project in accordance with plan (see Annex 5).	• The TMP should clearly define: (i) allowable routes; (ii) vehicle speed limits; and, (iii) TTM in work zones. • The TMP will be reviewed and cleared by the SE prior to contractor mobilization being completed to confirm that it: (i) complies with best practice; (ii) any standards in place in the country; (iii) the	• Crash outcomes and incidents (injuries and fatalities). 'Near misses' should also be recorded.	• Contractor • IA through the SE to review • Task Team recommended to undertake technical review of TMP and TTM.	✓	✓	✓	✓

					project ESMP; and, (iv) any specific conditions of contract. **Task Team should undertake a technical review of the TMP and TTM.** • TMP and/or TTM should be updated as necessary based on monitoring by the SE—particularly to reflect the findings of investigations of incidents (including near misses).					
		35	A, B, C	There needs to be **separation of work zones** and road users and pedestrians.	• Safe implementation of **temporary structures** (e.g. temporary roads, bus stops, pedestrian bridges) especially at night. • **Safe routes** through construction site for vulnerable users (i.e. pedestrians, elderly, persons with disability cyclists)—with a focus on night-time travel.	• Crash outcomes and incidents (injuries and fatalities). 'Near misses' should also be recorded.	• IA through the SE	✓	✓	✓	✓
		36	A, B, C	There needs to be safe **haul vehicle operations.**	• Select haul routes which are safe for the expected type and volume of traffic, paying attention to vulnerable users. • Specify appropriate speeds at vulnerable points on haul routes. • Haul vehicles are **not to be overloaded** or have unbalanced loads (the TMP should specify how this will be done). • Haul vehicle loads need to be appropriately secured and covered. • Ensure that there is the capacity to monitor and enforce weight limits.	• Overloading/cover failure non-compliance reporting. • Crash outcomes and incidents (injuries and fatalities). 'Near misses' should also be recorded. • Percentage of time tracked vehicles within speed limit. • Percentage of travel off haul route. • Percentage of trucks overloaded.	• IA through the SE	✓	✓	✓	✓

					• Contractor vehicles may be outfitted with GPS trackers (see below and Annex 8) and potentially speed governors						
		37	A, B, C	Contractor's **drivers to be trained** including knowledge of monitoring and penalties for non-compliance.	• Driver safety rules and policies should be defined and robust requirements for driver compliance established. • Risks to be managed be discussed in driver induction sessions, including the dangers of vehicle overloading and unsafe loading practices, compliance with safe travel speeds, wearing of safety belts, non-impairment by drugs and alcohol, avoidance of unsafe overtaking, not using mobile phones while driving, avoidance of fatigued driving by monitoring driving hours and achieving sufficient restful sleep between work shifts, and be aware of associated penalties for non-compliance. • Random alcohol and drug testing by the contractor as part of their OHSP. • Drivers need to have appropriate qualifications, training and experience for the vehicles each will drive. • For new drivers or existing drivers encountering new heavy vehicles to be licensed and given appropriate	• N/A	• Contractor • IA through the SE	✓	✓	✓	✓

					familiarization sessions with their operating and technology features. This should be carried out off-road. • Contractor's should ensure that there is a final in-vehicle, on-road check on safe driving competence for new drivers or drivers moving to more complex vehicles should be conducted to confirm that vehicle handling is competent						
		38	A, B, C	**Monthly/bi-monthly reports from SE to IA** provide information on the status of road safety initiatives.	• Supervision reports to include information on: ○ TMP Compliance; ○ Worker safety training; ○ Haul vehicle compliance; ○ OHS compliance and incidents; • Provision and maintenance of safe routes.	• N/A	• SE to IA • SE reports to be reviewed by Task Team	✓	✓	✓	✓
		39	A, B, C	Timely reporting on all **failures for compliance** with traffic management plan as part of project OHS management.	• Driver reporting requirements concerning incidents and road rule infringements, and other non-compliance with safe driving and vehicle policies should be made clear in the introduction training for drivers. • Processes should be established for the collection of data on incidents and crashes, road rule infringements, and vehicle defect notices issued.	• Crash outcomes and incidents (injuries and fatalities). 'Near misses' should also be recorded.	• IA through the SE	✓	✓	✓	✓

					• Crash outcomes and incidents (injuries and fatalities). 'Near misses' should also be recorded. • The risk/hazard register needs to be kept updated. • Root cause analysis on injuries and incidents to identify corrective actions that may be warranted, with updating of TMP and C-ESMP as appropriate. • Fatalities and serious incidents to be reported in accordance with the World Bank's Environment and Social Incident Response Toolkit (ESIRT) protocols.						
		40	A, B, C	Manage construction and other large equipment safely on **public roads**.	• Ensure contractor's TMP/OHSP includes appropriate measures for safe use. • Do not operate at night without comprehensive lighting. • Use a pilot vehicle as appropriate. • Obtain a permit (or agreement from authorities if one is not legally required) for the use of public roads, clearly defining the approved route, time of day, need for a pilot vehicle, road closures, etc. • Limit speeds	• N/A	• IA through the SE	✓	✓	✓	✓
		41	A, B	Use **work zone** safety audits to monitor compliance with TMP	• RSA report outlining key areas to address.	• Safety rating. • Safety audit compliance. • Crash fatalities and serious injuries.	• IA through the SE • Results reported to Task Team for monitoring	✓	✓	✓	✓

	42	A, B	Use **construction RSAs** to confirm that safety recommendations embodied in the design are appropriately implemented.	• RSA report outlining key areas to address.
				• Until identified issues addressed:
				  ○ No opening to traffic;
				  ○ Contractor should not demobilize;
				  ○ SE not to issue the completion certificate.
					• Safety rating.
					• Safety audit compliance.
					• Crash fatalities and serious injuries.
					• Completion certificate
						• IA
						• Task Team to review audit findings and confirm contractor responds reasonably to all audit report recommendations
							⊗	○	✓	✓

Implementation – Other Activities

Other Activities: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	Yes	No	Yes

Table A2.6: Addressing Other Implementation Activities

Number	Project Type[48]	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Implementation									
43	A, B	Conduct independent **post-construction/road opening safety audit** to check that the construction has been to specification, safety recommendations implemented, and has not introduced unrecognized risks	• Any new or substantially altered road should not be opened to traffic until a road opening audit by a qualified auditor has been conducted and identified safety issues are addressed. • Contractor should not be issued completion certificate by the SE until recommendations are implemented.	• Completed audit with recommendations implemented, before road is opened to traffic.	• IA	⊗	○	✓	✓
44	A, B	**Monitor road safety after opening** to identify any issues that may need to be addressed as part of the defects notice period. This would include ongoing monitoring of road safety infrastructure maintenance,	• Provide feedback to the IA on how to improve the safety.	• N/A	• IA	✓	✓	✓	✓

[48] A: Projects with road construction or rehabilitation or urban mobility on road (e.g., BRT); B: Other projects which change speeds, traffic mix or volume, vulnerable road user (pedestrians, bicyclists, motorcyclists) mix, volume, routes or facilities; C: Projects with road safety impacts during construction only; and, D: Projects with vehicle procurements as the only influence on road safety (e.g. fleets or even project vehicles).

			statistics, follow up on implementation of plans, etc.							
	45	A, B	Ensure that safety features are properly maintained and kept in service.	• Routine maintenance program which keeps signs clean and replaces damaged signs or barriers.	• Routine maintenance program funded and successfully implemented	• IA	✓	✓	✓	✓
	46	A, B, D	Vehicles procured by the project comply with Government's vehicle inspection requirements.	• Auditing of compliance as required by national regulatory frameworks or good practice (at least annually). • All vehicles should be inspected for roadworthiness by the operating organization at intervals of no more than 6 months and issued with a certificate of roadworthiness to be retained in the vehicle • The items inspected should cover all safety systems in accordance with Addendum 2—UNECE Rule No. 2—Uniform provisions for periodic technical inspections of wheeled vehicles with regards to their roadworthiness. Attention is to be given to inspecting bus body frames and seat legs and anchorages for rust damage or cracking and on all buses. • In the case of in-use commercial vehicles, it is critical that the vehicles are periodically inspected for safety and maintenance and should carry a certificate of inspection always during operation.	• Percentage of vehicles procured inspected	• IA • Task Team to review	✓	✓	✓	✓

					• An important consideration for high occupancy commercial vehicles is that body structure modifications comply with standards, or that any change in the structure that may compromise the safety or regular operational performance of the vehicle, and that seatbelts are provided and are in working order.						

Post-Project Operations

Post-Project Operations: Project Types This Applies To

Type A - Transport	Type B - Other	Type C - Construction	Type D - Vehicles
Yes	Yes	Yes	Yes

Table A2.7: Addressing Project Traffic and Road Safety Risks in Operations

Number	Project Type[49]	Action to Address Traffic and Road Safety Risks	Good Practice Activities and Mitigation Measures	Potential Results Indicators	Who is Responsible for Action	Should this Action by Considered by Risk Level: Low	Moderate	Substantial	High
Post-Project Operations									
47	A, B	Ensure that safety features are properly maintained and kept in service.	• Routine maintenance program which keeps signs clean and replaces damaged signs or barriers.	• Routine maintenance program funded and successfully implemented	• IA	✓	✓	✓	✓
48	A, B, C, D	• Control speeds so that they are appropriate for the road conditions. • Reduce traffic running intersections with red lights. • Reduce impaired (alcohol/drug) driving.	• Improve enforcement regulations. • Provide speed measurement equipment and training to police. • Implement automated speed and/or red light camera program (see Annex 9). • Provide equipment and training to monitor impairment.	• Improvements to compliance with speed limits • Reduction in number of vehicles running red lights at High-risk intersections	• IA	✓	✓	✓	✓

[49] A: Projects with road construction or rehabilitation or urban mobility on road (e.g., BRT); B: Other projects which change speeds, traffic mix or volume, vulnerable road user (pedestrians, bicyclists, motorcyclists) mix, volume, routes or facilities; C: Projects with road safety impacts during construction only; and, D: Projects with vehicle procurements as the only influence on road safety (e.g. fleets or even project vehicles).

		49	A, B, C, D	Control the overloading and imbalanced loading of trucks. Control passenger vehicles from exceeding their recommended capacity.	• Procurement of axle load equipment. • Support for enforcement.	• Percentage of trucks overloaded.	• IA				

ANNEX 3: Estimating the Overall Project Traffic and Road Safety Risk

90. Traffic and road safety risks arise from the interaction of many elements of the transport system: road/roadside design and engineering, travel speeds, the extent and type of road use, road user behavior, vehicle safety features (both active and passive), and post-crash care. Thus, the assessment of risk should consider all these factors. As shown in Annex 2, the mitigation of risk may be achieved through a myriad set of opportunities across all these arenas of action, as well as road safety management processes. **Consequently, estimating the risk is not an exact science: it requires judgement.**

91. A full assessment of risk needs to consider **workers**, affected **communities** and **road users**. Experience shows that most of FSIs will occur to road users—which are not just motorists in vehicles but pedestrians, cyclists, etc.—during the post-project Operations Phase of the project. **Road user risk is therefore the focus of the following risk assessment**. Even for local communities, road users are at the greatest risk[50]. For workers, road crash risk arises mainly from in effect being pedestrians near roads, and heavy equipment operations. As a result, the assessment of risk for road users will also inform risk for workers and communities, with the solutions such as bringing operating speeds down to a Safe System level for pedestrians (30km/h) or installing barriers to protect workers from traffic will be of major benefit to all parties.

92. For the purposes of this GPN the **Overall Project Traffic and Road Safety Risk** (OPTRSR) is estimated based on five principle criteria:

- Road Infrastructure;
- Operating Speeds (km/h);
- Road Users;
- Vehicle Standards; and,
- Post-Crash Trauma Care.

93. How one estimates the OPTRSR based on these five criteria varies by project type.

Type A – Transport Projects

94. Based on data availability, three methods may be used for assessing the OPTRSR for Type A - Transport Projects. They should be used under the following mutually exclusive conditions (see Table A3.1).

[50] Additional risks to communities may arise, such as from vehicles leaving the road and crashing into houses. While not common compared with road user risks, these risks may be managed through speed management or roadside barriers at elevated risk points such as curves. The extent of such management should be considered in assessing this risk.

Table A3.1: Methods for Estimating OPTRSR for Type A Projects

Conditions	Risk Assessment Method to Employ
Reasonable crash data are available for the road, or can be estimated from data available from similar road(s) in the country, and the road will not be changed so much by the project that the current conditions are irrelevant; or, The project involves major upgrades to the road such that current crash history is irrelevant and crash data from a similar road carriageway to the expected upgraded conditions can be obtained to inform the expected level of risk arising due to the project; or, Reasonable crash data are available for the road or can be estimated from data available from similar road(s) in the country and the main changes to the road are improved road surface and anticipated increases in speed.	Use Method I: Crash data-based risk assessment
The conditions for Method I regarding crash data are not met; and results of iRAP analysis of the existing road are available; and the road will not be changed so much by the project that the iRAP results for the current conditions are irrelevant.	Use Method II: iRAP results and estimated risks for other factors
The conditions for Methods I and II are not available.	Use Method III: Estimated road infrastructure risk and estimated risks for other factors

Method I: Crash Data Based Risk Assessment

95. This is the most reliable method for estimating the OPTRSR. It effectively captures the first three criteria (infrastructure, users and speeds), and will also reflect the other two criteria (vehicle standards and post-crash trauma care). Crash data from previous 3 to 5 years should be used to provide insight on the level of risk. Unfortunately, in many LMICs official crash data greatly under-represent the real level of FSIs. As a guide to the extent of this under-estimation consider the *WHO 2018 Global Status Report on Road Safety*[51], and if appropriate for the road(s) under consideration adjust the official data by the extent of omission for the country. The crash data should be complemented by an assessment of the vehicle standards and post-crash trauma care to adapt the overall risk as appropriate.

96. Examples of assessing risk as:

- Numerous FSI crashes have been occurring, the **OPTRSR** should be regarded as **High**.
- Rare, but still existing FSI crashes may indicate **Moderate** or **Substantial** risk. Since crash numbers and severity will increase with increased speeds, risk will increase if speeds increase after the project, and thus risk should be adjusted higher as appropriate.
- If there are no serious crashes and speeds will not increase, and other risk factors are not increasing (such as significant increases in traffic or pedestrians) the risk may be considered **Low.**

[51] https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/.

Methods B and C: Estimating Risks Without Crash Data

97. In the absence of crash data, Table A3.1 presents two options for estimating the OPTRSR. Both methods use the same approach for assessing the non-infrastructure risks; where they differ is on how to estimate the infrastructure risk.

98. **Method II** uses data from iRAP surveys on the existing road for the road infrastructure risk, and an assessment of the other criteria. For each of the five risk factors in Table A3.2, determine the appropriate iRAP score, with a maximum of 4 for each factor: the higher the iRAP score, the lower the risk.

Table A3.2: Method II: Using iRAP Data for Infrastructure Risk

Risk Factor	Low	Medium	Substantial	High
iRAP Star Rating of the existing condition for vehicle occupants	4/5	3	2	1-2
iRAP Star Rating of the existing condition for motorcyclists (if motorcycles are present on the road or likely to be present post-project)	4/5	3	2	1-2
iRAP Star Rating of the existing condition for bicyclists (if bicycles are present on the road or likely to be present post-project)	4/5	3	2	1-2
iRAP Star Rating of the existing condition for pedestrians (if pedestrians are present on the road or roadside or likely to be present post-project)	4/5	3	2	1-2

99. **Method III** subjective estimates the road infrastructure risk using the criterial in Table A3.3 based on the provision of infrastructure: 4 is the situation where there is a high level of safe infrastructure—leading to Low-risks; 1 is where there is a low level of safe infrastructure, leading to High-risks.

Table A3.3: Method III: Estimating Road Infrastructure Risk Without Crash or iRAP Data

Risk Factor	Low	Medium	Substantial	High
Extent of separation of pedestrians from traffic with provision of safe walking spaces and crossing locations (if pedestrians are present on the road or roadside or likely to be present post-project)	4	3	2	1
Extent of roadside safety barriers (omit this factor from consideration if the operating speed is < 40km/h)	4	3	2	1
Extent of median separation (omit this factor from consideration if the operating speed is < 60km/h for a rural road and <40km/h for an urban road)	4	3	2	1
Extent of separate well-designed motorcycle lanes (if motorcycles are present on the road or roadside or likely to be present post-project)	4	3	2	1
Extent of separate off-road bicycle lane (if bicycles are present on the road or roadside or likely to be present post-project)	4	3	2	1

100. For Methods II and III, the non-infrastructure risks are estimated using Table A3.4. As with Table A3.2 and A3.3, assign each of the elements a value from 1 – 4, weighting the considerations accordingly (e.g.

if it is only an urban road in a pedestrian area and speeds are > 60 km/h this would be given a score of 1; if 30 or below 4).

Table A3.4: Risk Factors for Non-Infrastructure Risks

Risk Factor	Low	Medium	Substantial	High
Non-peak hour (non-congested) Operating Speeds (not speed limit) in km/h in:				
Pedestrian areas	~ 30	> 40	> 50	> 60
Urban areas with no pedestrians	50	> 60	> 60	> 70
Open road, not median separated	70	80	90	100+
Open road, median separated	90	100	100	>100
Road Users				
Seat belt use for front passengers	> 90%	70%-90%	50%-70%	< 50%
Child Restraint use, and rear seat passenger seat belt use, combined	> 80%	70%-80%	50%-70%	< 50%
Motorcycle Helmet Use (all occupants combined)	> 90%	70%-90%	50%-70%	< 50%
Vehicle Standards				
Standardized regulations (UNECE WP29) for vehicle and motorcycle safety standards	Adopted	Adopted	Not Adopted	Not Adopted
Post-Crash Trauma Care				
Response time for qualified emergency services to arrive at crash scene (hours, including: no qualified emergency service attends as 2hours)	< 0.5	0.5 - 1	> 1	> 1

101. For each of the five risk criteria (i.e. infrastructure, speeds, users, vehicles and trauma care), calculate the weighted average score based on the project. For example, if the project is constructing a new motorway then for the infrastructure risk the bicycle and pedestrian scores would be set to zero—if there are no public transport users—and the calculations only based on the vehicle occupants and motorcyclists. Potentially, since there are no pedestrians or bicyclists, and few motorcyclists you may weigh the values 95% occupants and 5% motorcyclists.

102. For both Methods II and III, the **OPTRSR** is estimated based on the weighted average risk score from each of the five risk criteria, having assigned values of 1 to 4 for each of the weights (see Table A3.5 for the scores). The Total Risk Score is calculated on a scale of 100 to 400: projects that score less than 130 are considered 'Low' risk; 130 to 224 is 'Moderate' risk; projects that score 225 to 300 represent a 'Substantial' risk, and project that score over 300 are considered 'High' risk projects.

103. For example, if no iRAP data are available then Tables A3.3 is employed for infrastructure risk. In this hypothetical example, suppose the mean result for Table A3.3 was High (that is, there was generally little use of barrier and median separation, etc.) then the mean score for road infrastructure would be 4. Using Table A3.4, operating speeds may also result in a high rating (score of 4); road user behavior is generating a Substantial-risk rating (seat belt use is between 50 and 70%, etc.) resulting in a score of 3 on this factor; and both post-crash care and vehicle standards also produce scores of 4. Applying the weightings of 30%/30%/30%/5%/5% would give a total score of 370 meaning the **OPTRSR** is HIGH.

Total Risk Score = 4 * 30 (for infrastructure) + 4 * 30 (for speeds) + 3 * 30 (for road users) + 4 * 5 (for vehicles) + 4 * 5 (for post-crash care) = 370.

Table A3.5: Example of Weightings by Risk Factor

Area	Weighting (%) [a/]	Low	Moderate	Substantial	High
Road Infrastructure	30	1	2	3	4
Operating Speeds (km/h)	30	1	2	3	4
Road Users	30	1	2	3	4
Vehicle Standards	5	1	2	3	4
Post-Crash Trauma Care	5	1	2	3	4

Notes: [a]/ This weighting will vary between projects based on specific project considerations

104. Table A3.6 shows other scenarios leading to diverse levels of OPTRSRs.

Table A3.6: Example of Different Scenarios

	Different Scenarios with Risk Factors Scored from 1 – 4 and Resulting Overall Risk					
Road Infrastructure	1	1	1	1	1	2
Operating Speeds (km/h)	1	2	2	3	4	4
Road Users	1	3	4	4	4	4
Vehicle Standards	1	1	1	1	1	1
Post-Crash Trauma Care	1	1	1	1	1	1
Total Score	100	190	220	250	280	310
OPTRSR (as judged from the risk factors. This should be considered in combination with the baseline crash data if available and relevant, as described above.)	**Low**	**Moderate**	**Moderate**	**Substantial**	**Substantial**	**High**

Type B – Other Projects

105. Under this category, there can be either transport (non-road infrastructure related) or non-transport projects which change speeds, traffic mix or volume, vulnerable road user (pedestrians, bicyclists, motorcyclists) mix, volume, routes or facilities (see Chapter 2). These include any project which generates or relocates traffic (including bicycle or pedestrian traffic), influences roads or roadsides, travel speeds, travel modes, vehicles, and non-motorized users need to be assessed for road safety impacts.

106. The risks are estimated based on the information in Table A3.7. For each risk factor area (i.e. Traffic Volume Increase, Operating Speeds, Road Users, Vehicle Standards, Post-Crash Trauma Care), assign values of 1-4 based on the criteria in the table. Take a weighted average for each element.

107. As with Type A projects, the OPTRSR is calculated as the weighted average of each of the above risks, assigning values of 1 to 4 for each of the weights. The Total Score is calculated on a scale of 100 to 400: projects that score less than 130 are considered 'Low' risk; 130 to 224 is 'Moderate' risk; projects that

score 225 to 300 represent a 'Substantial' risk, and project that score over 300 are considered 'High' risk projects.

Table A3.7: Risk Factors for Non-Infrastructure Risk Components

Risk Factor	Low	Medium	Substantial	High
Traffic Volume Increase				
Increased traffic volume either from motorized or non-motorized (such as pedestrians and cyclists) users in any type of road environment (rural, urban or inter-urban)	0-10%	10%-30%	40%-60%	>60%
Non-peak hour (non-congested) Operating Speeds (not speed limit) in km/h in:				
Urban areas with pedestrians	~ 30	> 40	> 50	> 60
Urban areas with no pedestrians	50	> 60	> 60	> 70
Open road, not median separated	70	80	90	100+
Open road, median separated	90	100	100	>100
Road Users				
Seat belt use for front passengers	> 90%	70%-90%	50%-70%	< 50%
Child Restraint use, and rear seat passenger seat belt use, combined	> 80%	70%-80%	50%-70%	< 50%
Motorcycle Helmet Use (all occupants combined)	> 90%	70%-90%	50%-70%	< 50%
Vehicle Standards				
Standardized regulations (UNECE WP29) for vehicle and motorcycle safety standards	Adopted	Adopted	Not Adopted	Not Adopted
Post-Crash Trauma Care				
Response time for qualified emergency services to arrive at crash scene (hours, including: no qualified emergency service attends as 2hours)	< 0.5	0.5 - 1	> 1	> 1

Type C – Construction Activities

108. Construction activities in themselves should almost always be considered High-risk. Working on roads and roadsides poses significant risks to workers and motorists, because of changed roadway conditions, disrupted traffic flow, limited working space, and movement of construction and public vehicles near workers and worksites. The development of a TMP by the Contractor, based on the ESMP included in the bidding documents, is therefore essential. The TMP should be reviewed and cleared for use by the SE on behalf of the IA, is therefore essential. Task Teams should also undertake a technical review of the TMP to confirm that it is fully appropriate for mitigating the construction traffic risks.

Type D – Vehicles

109. Risk estimation and associated mitigation measures are different for vehicle procurements. This GPN (Table A2.4) calls for the following same measures to be applied to all vehicle procurements irrespective of the risk:

- The technical specifications for passenger vehicles procured on project should be the safest available in the country and that the vehicles will be maintained at their safety standard.
- The technical specifications for trucks and/or buses procured on project should meet the highest possible UN regulations available in the country and the vehicles will be maintained.

110. It is only regarding the recommendation to implement **vehicle related speed countermeasures** that there is a difference; with these being recommended only for Substantial/High-risk projects. In this context the decision as to whether or projects are of enough risk relate to the benefits from using this countermeasure. If there is a history of speed non-compliance, elevated levels of vulnerable users, etc. then these should be considered suitable candidates for these countermeasures.

ANNEX 4: Road Safety Audits and Safe System Assessments

Road Safety Audits

111. "A road safety audit is a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project's crash potential and safety performance. A road safety audit has the greatest potential for improving safety and is most cost-effective when it is applied to a road or traffic design before the project is built. It can be conducted on any design proposal that involves changes to the ways road users will interact, either with each other or with their physical environment. It is a formal process using a defined procedure."[52]

112. RSAs can be conducted at various stages in the project life including planning[53], preliminary design, detailed design and pre-opening or post-construction stages (see Table A4.1)[54]. **The earlier a road is audited within the design and development process the better**. This ensures that safety is fully integrated into all elements of the project's infrastructure, with minimal risk of redesign or physical rework. Despite this, it is typical for RSAs to be conducted only at the detailed design stage, if at all. Some countries apply different terms to RSAs at various stages of the project. For the purposes of this GPN, the terms RSA is used generically to apply to any formal examination to improve a project's road safety performance.

Table A4.1: Road Safety Audits in the Project Life Cycle

Project Phase	Project Stage	Activity
Preparation	Planning	RSA (and potentially RSIA) based on the project concept to identify the key road safety challenges to guide the designers. Site visits to assess current safety situations are recommended for road rehabilitation and improvement projects.
Implementation	Preliminary Design	RSA of preliminary design to identify deficiencies and guide detailed design. This serves to review the safety aspects of the alignment, cross-section and junction layouts, aiming to identify if those are safe for all road users.
	Detailed Design	RSA of design before issuing the bidding documents to confirm that safety elements are correctly captured. The RSA will aim to confirm that road safety concerns are identified, positive practical safety features are properly incorporated into the designs, and that the road is safe for the changes in traffic volume and mix anticipated.
	Construction/Pre-Opening	RSA carried out before the road is opened to traffic and aims to check for any unsafe feature not apparent at previous stages and check that all the design details have been correctly implemented or identify deficiencies that need to be corrected. The timing is important and can be done more than once. If issues are identified, it is best to do it part way through construction before the contractor demobilizes so that they can be properly addressed. Pre-opening audits do not allow for substantial changes as the contractor is largely demobilized but permit small issues to be resolved such as trees obscuring signs.
	Work Zone	RSA conducted to monitor safety during construction (see Annex 5).
	Post-Opening	RSA to assess the performance of the road under traffic and identify areas that require further attention. It is important that an evaluation /assessment of actual safety situation is made after some months

[52] Austroads Implementing Road Safety Audits (2019). https://austroads.com.au/publications/road-safety/agrs06A.
[53] At the planning stage the RSA examines the safety aspects within a scheme. In addition, a 'Road Safety Impact Assessment (RSIA) may be considered to look at the safety impact of a scheme on the safety of the surrounding road network (see EU Directive on Road Infrastructure Safety Management—often based on the pre-feasibility study. RSIA and RSA both work to improve the safety performance of new roads and existing roads that require modifications.
[54] See for example EU Directive 2008/96. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32008L0096.

113. It should be noted that if a post-construction audit is done, and requiring that any road safety deficits be addressed as a precondition for issuance of the Certificate of Substantial completion, then this should be included in the relevant provisions of the bidding documents.

114. The figures below[55] show examples of safety audits at each of these three phases of a project.

Figure A4.1: Example of Design Audit: Detailed Design for a 'Y' intersection

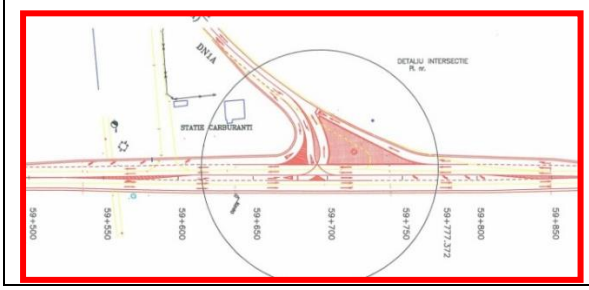
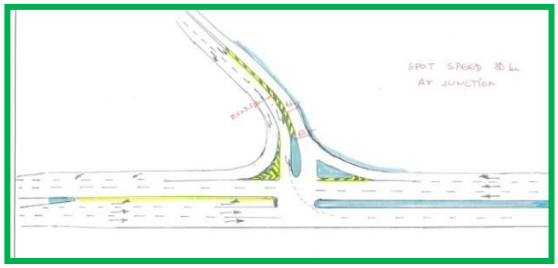
SAFETY CONCERN	RISK	RECOMMENDATION
For this specific junction, the road safety auditor identified a series of access and visibility problems, especially coming from the angle of the intersection, but also the way the islands were designed. A second problem identified was the high radius for the right turn, which could lead to an increased speed for vehicles joining the main traffic flow. 	High	• Change the angle of the intersection, in such a way that the secondary road will have an almost 90 degrees angle. This way, the high risks associated with an Y intersection (especially related to poor visibility) are eliminated; • Redesign the islands and the lanes directing the traffic flows, in such a way that all vehicles will have proper visibility ensured. 

Figure A4.2: Example of Construction Audit: Misplacement of a Road Sign

SAFETY CONCERN	RISK	RECOMMENDATION
Poor visibility in an intersection for vehicles coming from a secondary road, due to wrong positioning of a road sign. 	High	• Remove the road sign and post it where it does not affect visibility. 

[55] Adopted from Road Safety Audit Presentation. Search Corporation Ltd. (2012).

Figure A4.3: Example of Planning Audit: Choosing the Type of an Intersection

SAFETY CONCERN	RISK	RECOMMENDATION
The simple T junction might not be the safest solution, especially for this case, when priority is given to vehicles taking the curve and travelling to the right, and not going forward. This might lead to misperception from drivers regarding their right of way. The line of trees in front of the driver will lead to the impression that the road goes straight, especially during night time or bad weather, or if road signs are not properly maintained. 	High	• A well signalized roundabout is preferred to a simple T junction, as it improves the angles of impact in crashes and can act also as traffic calming measure. • At the same time, especially for secondary roads intersecting a main road in a curve, it is preferred a roundabout, rather than adding a yield sign for the secondary road when joining the main road. 

115. There are several RSA manuals and guides available, some of which are available for download from:

www.tinyurl.com/road-safety-resources

Safe System Assessments

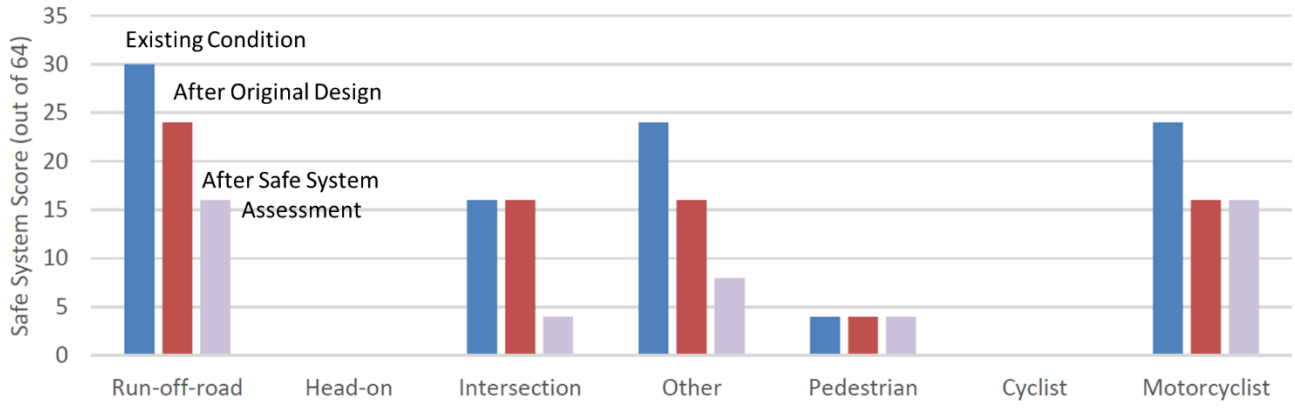
116. The goal of a 'Safe System Assessment' (SSA) is to assess how closely road design and operation align with the Safe System objectives, and to clarify which elements need to be modified to achieve closer alignment with these objectives. It is valuable since there are usually gaps between the design safety elements and what can potentially be achieved through the proper application of the Safe System approach. These gaps arise due to factors such as lack of experience, poor planning, inappropriate design standards, the business processes followed, etc. Figure A4.4 demonstrates an example of the benefits of an SSA from Australia[56] where the SSA resulted in major improvements to the original design in reducing run-off-road and intersection risks, as well as 'other' risks. There were no changes to motorcyclist risks over the design, and the road had no opportunities for head-on crashes.

117. Using the Austroads approach, SSAs are conducted by: (i) identify the objectives; (ii) setting the context; (iii) applying the 'Safe System Matrix'; and, (iv) applying a treatment hierarchy and selection process for interventions. The core of this SSA approach is the 'Safe System Matrix' framework which is essentially a risk assessment. This determines how well a given project, or part of the network, aligns with Safe

[56] Beer, K., Moon, N. and Strandroth, J. (2018). Safe System Assessment: Delivering Safe Outcomes. Paper to the ARSC Conference.

System principles. It assesses the different major FSI crash types against the exposure to the crash risk, the likelihood of it occurring, and the severity of the outcomes should it occur.

Figure A4.4: Example of Benefits from Conducting a Safe System Assessment



118. Table A4.2 shows the Austroads SSA framework. Key areas to note are:

- The major crash risk elements considered are: (i) run-off-road; (ii) head-on; (iii) intersections; (iv) other; (v) pedestrian; (vi) cyclist; and, (vii) motorcyclist;
- The **exposure** to each of these factors is a function of the total traffic flow, and the movements for vulnerable users;
- **Likelihood** is a function of the specific features and facilities of the infrastructure; and,
- The **severity** of the crash risk is a function of speed (and roadside features for run-off-road, impact angles for intersections).

119. The assessment is done by scoring the exposure, likelihood and severity from 0-4, with 0 being no exposure, minimal likelihood and minimal chance of an FSI through to 4 being very high volumes/exposure, high likelihood of a crash, and high likelihood of an FSI due to the level of kinetic energy in the crash. The product of the three scores for each of the seven elements gives a total score out of 448. This is illustrated in Table A4.3 which is for the replacement of a rural four-way intersection with a roundabout. The scores were reduced from 155 to 38, with major benefits in terms of head-on, intersection and motorcycle elements.

120. Since the scoring system is subjective, it can lead to validity issues when comparing sites, especially when these have been assessed by different individuals or teams. It is therefore usually suited to comparing options at a single site, identifying sources of risk and identifying solutions, rather than for comparing sites. It also does not give the relative risks between options, but rather whether the options are increasing or decreasing the overall risk. Thus, the score of 38 vs 155 in the example in Table A4.3 should not be interpreted as the 'After' option having only 25% of the risk of the original. Rather, low scores indicate good compliance with Safe System objectives and high scores poor compliance.

121. Specific treatments to address the risks should be identified based on a hierarchy of options (see Table A1.2). If high levels of risk were identified for one or more crash types, the solutions for that crash type should be reviewed (e.g. for run-off-road). If carried out as part of context-sensitive design, the solution hierarchy of will result in the net Safe System gain compared to simple selection of standard-compliant solutions. The reasons why options have been selected (particularly those that are not primary solutions from Table A1.2) should be documented.

Table A4.2: Infrastructure Project Safe System Assessment Framework

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	AADT; length of road segment	AADT; length of road segment	AADT for each approach; intersection size	AADT; length of road segment	AADT; pedestrian numbers; crossing width; length of road segment	AADT; cyclist numbers; pedestrians	AADT; motorcycle numbers; length of road segment
Likelihood	Speed; geometry; shoulders; barriers; hazard offset; guidance and delineation	Geometry; separation; guidance and delineation; speed	Type of control; speed; design, visibility; conflict points	Speed; sight distance; number of lanes; surface friction	Design of facilities; separation; number of conflicting directions; speed	Design of facilities; separation; speed	Design of facilities; separation; speed
Severity	Speed; roadside features and design (e.g. flexible barriers)	Speed	Impact angles; speed	Speed	Speed	Speed	Speed
Additional Safe System Components							
Pillar	**Prompts**						
Road user	• Are road users likely to be alert and compliant? Are there factors that might influence this? • What is the expected compliance and enforcement levels (alcohol/drugs, speed, road rules, and driving hours)? What is the likelihood of driver fatigue? Can enforcement of these issues be conducted safety? • Are there special road uses (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism), or risk-taking behaviors?						
Vehicle	• What level of alignment is there with the ideal of safer vehicles? • Are there factors which might attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed/existing road design? Is this route used by recreational motorcyclists? • Are there enforcement resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement of these issues be conducted safety? • Has vehicle breakdown been catered for?						
Post-crash care	• Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access stopping space)? • Do emergency and medical services operate as efficiently and rapidly as possible? • Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc. • Is there provision for e-safety (i.e. safety systems based on modern information and communication technologies, C-ITS)?						

Table A4.3: Example of Applying SSA to a Rural Intersection

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist	Total
				Before				
Exposure	3/4	3/4	3/4	3/4	1/4	2/4	3/4	
Likelihood	3/4	3/4	4/4	2/4	0/4	1/4	2/4	
Severity	3/4	4/4	4/4	2/4	4/4	4/4	4/4	
Product	**27**	**36**	**48**	**12**	**0**	**8**	**24**	**155/448**
				After				
Exposure	3/4	3/4	¾	3/4	1/4	2/4	3/4	
Likelihood	3/4	1/4	2/4	1/4	0/4	1/4	2/4	
Severity	2/4	1/4	¼	1/4	2/4	1/4	1/4	
Product	**18**	**3**	**6**	**3**	**0**	**2**	**6**	**38/448**

122. **Construction activities in themselves should almost always be considered High-risk**. Working on roads and roadsides poses significant risks to workers and motorists, because of changed roadway conditions, disrupted traffic flow, limited working space, and movement of construction and public vehicles near workers and worksites. Crashes often arise outside of working hours due to factors such as poor traffic control devices and illumination. Consequently, the safe and effective management of traffic and the processes needed to keep road-users safe during construction, is an essential requirement of any work undertaken on roads (whether on the roadway, shoulder or roadside). To achieve this, the following process is recommended:

- **Preparation:** The key traffic and road safety risks to be mitigated during construction should have been identified from the Project instruments, including the Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP), Resettlement Action Plan (RAP), and/or Consent Conditions from regulatory authorities. These should see the Contractor to use a risk management approach to ensure that all road safety related hazards are addressed and mitigated.

- **Procurement:** As part of its bid[57], the successful Contractor is required to submit various Management Strategies and Implementation Plans (MSIP) to manage the key identified ESHS risks. It is recommended that the IA ensure that the MSIP includes the requirement for bidders to prepare a preliminary TMP, which will ultimately form part of the C-ESMP.

- **Pre-Construction:** The Standard Procurement Documents (SPD) for International Competitive Procurement (ICP), requires a C-ESMP to be prepared. This C-ESMP—including the TMP—is to be submitted by the contractor **prior to civil works commencing** and should be reviewed and cleared by the SE on behalf of the IA. For Substantial/High Risk projects the Task Team may consider conducting their own technical review.

- **Construction:** The SE monitors the compliance of the contractor with the TMP and has the Contractor implement changes as appropriate to ensure a safe environment for workers, the local community, and road users—particularly vulnerable users. **Owing to the importance of public safety and the need to act immediately to correct unsatisfactory TTM measures, SE's need to use the contract's provisions to ensure that unsatisfactory work is to be rectified immediately.**

123. **Effective Traffic Management Plans.** The objectives of the TMP are to clearly define how the contractor will:

- Provide a safe environment for all persons working on, and traffic travelling along, roads through the work zone by adopting appropriate TTM measures[58];

- Minimize the impact of the works on traffic and adjacent communities;

- Minimize delays and access to public transport operations;

[57] Under the Standard Procurement Document for Works October 2017.
[58] TTM standards existing in many countries. When they do not, examples of good practices are: https://www.works.gov.pg/files/roads-bridges/IF003_PNGFieldGuide.pdf and https://www.adb.org/publications/carec-road-safety-engineering-manual-safer-road-works.

- Cater for the needs of all road users (including pedestrians, persons with disabilities, cyclists, motor-cyclists, heavy vehicles etc.); and,
- Communicate the arrangements for, and impacts of, any activities affecting traffic and road safety.

124. TMPs must identify reasonably foreseeable hazards that could give rise to health and safety and adopt measures to ideally eliminate the risk, or minimize them as far as reasonably practicable through appropriate control measures. This is best achieved by physically separating works from road users. It is important that the TTM adopted avoids, or at least minimizes, inconvenience or delays to road users whilst providing safe conditions for road users and workers. Table A5.1 is an example of how risks are identified and addressed in a TMP.

125. TMPs should be risk based and reflect the traffic flows to be encountered: a TMP for a road carrying 200 veh/day will be much simpler than for a motorway with 20,00 veh/day. For example, as shown below, New Zealand defines five classes of roads by traffic volume for governing TMPs[59], with the default requirements for 'Level 1' roads. The forthcoming Austroads guide uses volume as well as speeds.

Low-Volume/Low Risk Road	< 250 veh/day
Low-Volume Road	< 500 veh/day
Level 1 Road	< 10,000 veh/day rural or < 15,000 veh/day urban
Level 2 Road	> 10,000 veh/day rural or > 15,000 veh/day urban
Level 3 Road	High volume/high speed multilane road or motorway > 10,000 veh/day

126. Extra care needs to be taken when there are increased levels of hazards, for example:

- Activities at or near intersections or areas with many turning and maneuvering movements;
- Where there are many vulnerable users (i.e. pedestrians, cyclists and motorcyclists);
- On or off ramps to motorways;
- Roads with hills and corners;
- At locations where contractors vehicles enter or exit the construction zone from or to the main road network;
- Where normal traffic conditions change as a result of the temporary roadworks (eg, constrained carriageway or lane width; where traffic converges from multiple lanes into a lesser number of lanes; or on carriageways where there is un-separated contra-flow); and,
- Adjacent to railway crossings.

[59] https://www.nzta.govt.nz/resources/code-temp-traffic-management

Table A5.1: Example of Risk Table for Managing Traffic During Construction[60]

Safety Hazard / Risk Factors	HIERARCHY OF SAFETY CONTROLS Consider the practicability of control measures, from left to right Select the most predictable given the circumstances and level of hazard Record the reason if a higher-level control measure is not considered practical		
	Elimination / Substitution	Isolation / Engineering	Administrative (Behavioral)
• Clearance to Traffic • (clearance between the edge of a lane carrying traffic and the worksite, roadworks vehicles, equipment and pedestrians	• Road closure • Detour onto other roads • Side track past the works	• Safety barriers • Lane closure adjacent to work area • Vehicle-mounted attenuators	• Speed reduction • Warning signs / VMS • Delineation of travel path
• High speed through worksite	• Road closure • Detour onto other roads • Side track past the roadworks	• Safety barriers • Lane closure adjacent to work area • Portable traffic signals • Vehicle mounted attenuators	• Speed reduction • Warning signs / VMS • Traffic controller • Temporary road humps
• Poor advance sight distance to worksite (<200 meters)	• Road closure • Traffic diversion past the works	• Vehicle mounted attenuators • Lead and/or tail vehicle(s)	• Extra advance warning signs / VMS • Speed reduction • Delineation of travel path
• Poor observance by motorists of directions / instructions	• Road closure • Traffic diversion past the works	• Lane closure adjacent to work area • Portable traffic signals	• Speed reduction • Police presence • Extra signs / VMS • Temporary road humps • Re-assess information provided
• Narrow pavement width with no escape route (<2.9 meters width)	• Road closure • Traffic diversion past the works	• Safety barriers	• Speed reduction • Delineation of travel path
• Presence of workers at the worksite	• Road closure • Traffic diversion past the works	• Safety barriers • Increased separation from vehicular traffic	• Speed reduction • Warning signs • Delineation of travel path and worksite
• Excavation adjacent to traffic	• Road closure • Traffic diversion past works	• Different construction method • Safety barriers	• Speed reduction • Delineation of travel path

127. The TMP should provide for:

- the safety of the workers at the worksite and the public passing through or adjacent to the worksite;

[60] Code of Practice for Temporary Traffic Management Part 7. https://austroads.com.au/publications/traffic-management/cop-feb19.

- overall strategy for the management of traffic, including traffic staging methodology during various stages of the work;
- TTM arrangement for each stage of the works;
- arrangement and number of traffic controllers required for each stage of the works;
- emergency access – for both workers and any emergency services vehicles travelling through the worksite any unusual hazards or job specific requirements e.g. nearby school or access to shops;
- use of alternative routes or detours as required;
- provision for over-dimensional vehicles;
- the use of GPS trackers for monitoring and reporting (see Box A5.1);
- provision of safe passage for pedestrians, cyclists and people with disabilities;
- provision for, and impact on, public transport (e.g. delay to buses/trams, restrictions on passenger access to bus or tram stops, potential for traffic to queue across an adjacent railway crossing), including where possible, priority for public transport;
- provision for access to abutting properties;
- duration and times for conducting the works (e.g. day or night operation);
- traffic management arrangements at the worksite outside normal working hours or when workers are not present at the site (after-care);
- arrangements to address and monitor the risk of end-of-queue collisions due to a build-up of traffic at worksites;
- emergency response procedures and contact details;
- the actions to be taken to address crashes – including the requirement for root-cause analyses as a means to understand if further traffic management needs to be put in place to mitigate the risks and to help prevent that situation re-occurring; and,
- communication arrangements.

128. The TMP should be prepared by a person who is suitably experienced and competent in traffic management, having regard to the nature and complexity of the works, and the type of TMP required. Consultation with workers who have experience in working on trafficked worksites can be beneficial in ensuring that a practical TMP is prepared.

129. The TMP should contain details on what records will be kept by the Contractor, to verify that the provisions of the TMP are being adhered to. Such records should include details on the types of inspections and audits that will be conducted, and the frequency of those inspections and audits. Inspections and audits should also be conducted at night-time. Records should be kept updated by the Contractor and provided to the SE at least on a weekly basis. The SE should conduct its own audits to satisfy itself that the provision of the TMP are being adhered to, and report on any non-compliance

trends in their monthly/bi-monthly reports to the IA. Where non-conformances are occurring, then corrective actions should be put in place immediately, to avoid unsafe situations developing.

Box A5.1: GPS Trackers for TMP Compliance Monitoring

A key element of ensuring road safety on any civil works project is ensuring that vehicle operators comply with the TMP. TMPs typically define approved haul routes and maximum speed limits on vehicles at locations on the route (e.g. 50 km/h), with other restrictions—such as 30k m/h during school hours starting 200m before to 200m after a school.

In practice, it is very difficult to monitor the adherence of the drivers to the TMP. Responding reactively via feedback from community on speeding, or in response to crashes are not ideal approaches. Spot checks are one method of adherence, but these are hard to do on a regular basis and the drivers can be informed in advance that they are going to happen. A better method is to have vehicles fitted with GPS trackers which provide real time data and summary reports on TMP compliance. They are also of value for broader fleet management by clients, passenger transport operators, and others.

Vehicles are fitted with GPS trackers which use GPS satellite and (optionally) mobile data reception to transmit GPS location information at specified intervals to a server where it is stored. The Contractor and SE can easily view the data on the server via an interactive online application where the user can set speed limits and create customizable summary reports and graphs to interpret the location data collected. At minimum, the GPS server/analysis web application should have the capacity to produce the reports on:

- Number of cases of speeding in the period, speeds reached and locations where speeding occurred;
- Speed restriction compliance statistics for each individual vehicle (i.e. the percentage of time the vehicle adhered to the TMS speed limits;
- The percentage of travel that was not on approved haul routes; and,
- The amount of time that the vehicle was operating outside of the agreed operating hours.

Contracts may potentially include target requirements for the performance of contractors to meet the above requirements; with appropriate deducts for non-compliance or other remedies.

The requirements for the use of GPS trackers needs to be clearly defined in the procurement documents[61].

Most countries now have specialist companies who can provide some/all the elements as a charged service, or alternatively the GPS tracking could feasibly be established from scratch. The choice of which approach to take will depend largely on the number of vehicles that require GPS tracking and the budget available[62].

130. **Work zone Safety Compliance Audits** should be done on a regular basis by the SE to confirm that the TMP is being properly implemented. This sees the work site reviewed for: (i) sign and delineation device

[61] The following paragraphs are examples of what could be added to procurement documents to require GPS tracking:
- **Contractor.** "The contractor will be required to install GPS trackers in all project vehicles which will operate on public roads and maintain software which will track compliance by those vehicles with safe speed limits and other requirements of the Traffic Management Plan. The software will send regular automated reports to project stakeholders, at a frequency to be defined by the Client. The system should be maintained for the life of the construction works and provide data for all vehicles when in operation."
- **Supervision Engineer.** "The contractor will be required to install GPS trackers in all project vehicles which operate on public roads and maintain a software which will track compliance by those vehicles with speed limits and other requirements of the Traffic Management Plan. The software will send regular automated reports to project stakeholders, at a frequency to be defined by the Client. The supervision engineer will be required to ensure that the contractor maintains accurate GPS tracking of vehicles for the life of the construction works, evaluates the results of the reporting and uses that information to direct the contractor to make improvements to the safe operations of their vehicles. The supervision engineer will be required to provide statistics from the speeding reports as part of their regular reporting to the Client".

[62] A list of identified providers as of April 2019 is available at: https://rebrand.ly/OHS-GPScompanies

compliance and effectiveness in both day-time and night-time operating conditions; (ii) effectiveness of TTM implementation; (iii) use of personal protective equipment; (iv) any defects in barriers or equipment; (v) effectiveness of provisions for vulnerable users; and, (vi) other factors which could influence safety[63].

[63] A complete guide for Work Zone audits is available from: https://www.workzonesafety.org/training-resources/fhwa_wz_grant/atssa_wz_rsa_guide/. Another approach is in Annex E3 Appendix C of the New Zealand Code of Practice for Temporary Traffic Management, with forms available for download from: https://www.nzta.govt.nz/resources/code-temp-traffic-management.

ANNEX 6: Experiences with Some Road Safety Interventions

131. This annex presents some examples of road safety interventions which have been found to be effective and ineffective. It is not meant to cover all interventions, but rather to highlight some successful interventions, and identify ineffective interventions that should be avoided in projects.

Infrastructure Interventions

132. There are a wide array of infrastructure investments which have successfully been used as interventions to address road safety. For example, the iRAP Toolkit (www.toolkit.irap.org) provides details on 42 different types of interventions, along with an assessment of their costs, how long the treatments can be expected to last, their effectiveness—as well as implementation issues.

133. The resource library at www.tinyurl.com/road-safety-resources contains a variety of documents, manuals and guidelines on road safety interventions. Attention is drawn to the resources below which provide detailed guidance on successful safety system interventions:

- Austroads Towards Safe System Infrastructure: A Compendium of Current Knowledge – Report AP-R560-18 (https://austroads.com.au/publications/road-safety/ap-r560-18)
- Austroads Best Practice in Road Safety Infrastructure Programs –Report AP-R562-18 (https://austroads.com.au/publications/road-safety/ap-r562-18)
- European Road Safety Decision Support System (https://roadsafety-dss.eu/#/measure-search)
- FHWA Speed Management Toolkit (https://safety.fhwa.dot.gov/speedmgt/ref_mats/docs/speedmanagementtoolkit_final.pdf)
- Minnesota's Best Practices and Policies for Safety Strategies on Highways and Local Roads (https://lrrb.org/pdf/201121.pdf)
- Minnesota's Best Practices for Pedestrian/Bicycle Safety (https://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf)
- New Zealand Transport Agency Speed Management Guide and Toolbox (https://www.nzta.govt.nz/safety/speed-management-resources/)
- PIARC Catalog of Design Safety Problems and Potential Countermeasures (www.piarc.org)

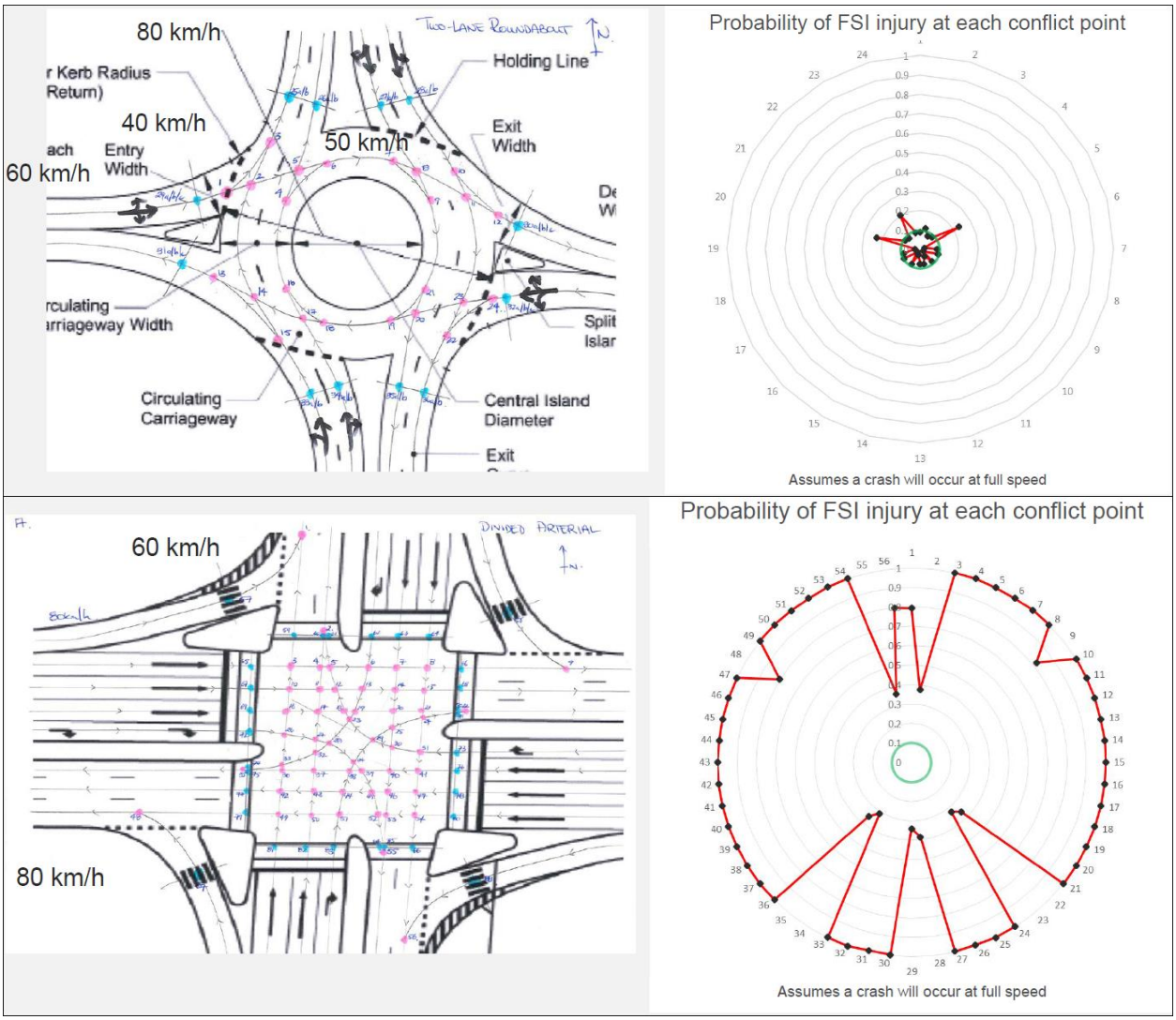
134. In assessing interventions, the Safe System focus is on reducing FSI by reducing the energy arising from a crash. This principle of energy reduction benefits is illustrated in Figure A6.1 which contrasts the FSI likelihood of having a roundabout compared to a signalized intersection at the same location[64]. Roundabouts serve to reduce the speed of vehicles entering the intersection, as well as eliminating the possibility of two vehicles crashing at a 90° angle—thereby greatly reducing the crash energies. They also have the advantage of reducing the number of conflict points[65] from 56 to 24, thereby reducing the

[64] Note that this figure is from Australia and is based on vehicles driving on the left. It is for a high-speed situation, such as an urban arterial, and the focus is on vehicle-vehicle crashes. When there are many pedestrians and/or cyclists an intersection with traffic lights or other controls may be safer.

[65] A conflict point arises when two movements intersect. They are represented by the pink dots in Figure A6.1.

probability of a crash[66]. For the intersection, 45 of the 56 conflict points have a probability of 100% of an FSI in a serious crash. By comparison, the highest probability of an FSI is 25% for the roundabout, with almost all conflict points having an FSI probability of 10% or less.

Figure A6.1: Implications of Roundabout vs Signalized Intersection on Vehicle-Vehicle Crash FSI[67]



Interventions

135. Tables A6.1 and A6.2[68] summarize some key proven interventions for urban and rural roads, and how they can be expected to influence speeds and crash risk. The tables should be read in conjunction with Table A1.1 which presented a hierarchy of primary and secondary interventions. For urban roads, the benefits in terms of increased pedestrian and cyclist safety, as well as reduced traffic volumes are also given—recognizing that separately to these, any reduction in speeds is of great benefits to vulnerable

[66] Studies have indicated that roundabouts have a 37% reduction in overall collisions; 90% reduction in fatalities and a 75% reduction in injury collisions (https://www.wsdot.wa.gov/Safety/roundabouts/benefits.htm).
[67] Austroads Webinar 'Towards Safe System Infrastructure', May 10, 2018 (www.austroads.com).
[68] Based on the New Zealand Speed Management Guide and other sources.

users. The urban interventions are listed for local roads and arterials, with some interventions applying to both. Local urban roads can benefit from a range of local area traffic management (LATM) interventions[69], but the actual interventions will need to be carefully assessed based on local conditions.

Box A6.1: Safe System and Motorcycles

For safe travel motorcycles need to: (i) stay in control and upright; (ii) stay in the carriageway; (iii) avoid collisions with other users; and, (iv) avoid collision with roadside objects to minimize trauma if fallen from a motorcycle. A safe road environment should have no surprises in road design or traffic control and should[70]:

- warn the driver or rider of any substandard or unusual features;
- inform the driver or rider of conditions to be encountered;
- guide the driver or rider through unusual road sections;
- control the driver or rider's passage through conflict points or conflict sections; and,
- forgive the driver or rider's errant or inappropriate behavior.

Key interventions to achieve this are:

- consistent and appropriate design standards for alignment, particularly on approach to and through curves;
- well maintained roads with effective delineation and signs, proper skid resistance, smooth surface with no potholes or rutting, good shoulders—particularly on curves, effective removal of old paint markings, and removing debris;
- infrastructure and speed management measures to reduce impact speeds to survivable limits such as delineation, speed activated warning signs, audio-tactile profile (ATP) markings, widened pavements;
- physical separation of motorcyclists from other vehicles; and,
- removal of roadside hazards, safety barriers, clear zones and roundabouts.

[69] LATM examples are given in the Austroads Guide: https://austroads.com.au/publications/traffic-management/agtm08.
[70] https://www.nzta.govt.nz/resources/safer-journeys-motorcyclists/

Table A6.1: Urban Road Interventions

Measure		Applies to Local and/or Arterial Roads	Reduce Speeds	Reduce crash risk	Increase pedestrian safety	Increase bicycle safety	Reduce traffic volume
Vertical deflection devices	Road humps	L	✓	✓	✓	✓	-
	Road cushions	L	✓	✓	✓	✓	-
	Flat top road humps	L	✓	✓	✓	✓	-
	Zebra crossing on a platform	L / A	✓	✓	✓	✓	✓
	Raised intersections/pavements	L / A	✓	✓	✓	✓	-
Horizontal deflection devices	Lane narrowing	L / A	✓	✓	-	-	✓
	Curb extension at intersections	L / A	✓	✓	✓	-	✓
	Slow points	L	✓	✓	-	✓	-
	Centre blister islands	L / A	✓	-	✓	✓	✓
	Driveway links to residences	L	✓	✓	✓	✓	✓
	Mid-block median treatments	L / A	✓	✓	✓	-	✓
	Roundabouts	L / A	✓	✓	✓	✓	-
Diversion devices	Full road closure	L	-	✓	✓	✓	✓
	Half road closure	L	-	✓	✓	✓	✓
	Diagonal road closure	L	-	✓	✓	✓	✓
	Modified 'T' intersection	L	✓	✓	✓	✓	✓
	Left-in/ left -out islands	L	-	✓	-	✓	✓
Signs, line marking and other treatments	Speed limit signs	L / A	✓	✓	✓	✓	✓
	Reallocate road lanes to other modes	L / A	✓	✓	✓	✓	-
	Prohibited traffic movement	L / A	-	✓	✓	✓	-
	One-way (street)signs	L	-	✓	-	✓	✓
	Give Way signs	L	✓	✓	✓	✓	✓
	Stop signs	L / A	✓	✓	✓	✓	✓
	Marked pedestrian crossings	L / A	-	✓	✓	-	✓
	Pedestrian crossing lighting	L / A	-	✓	-	-	✓
	Pedestrian islands	L / A	-	✓	-	-	✓
	Traffic signals with leading pedestrian interval	L / A	-	✓	-	-	✓
	Shared zones	L	✓	✓	✓	✓	✓
	School zones	L / A	✓	✓	✓	-	✓
	Threshold treatments	L / A	✓	✓	✓	✓	-
	Tactile surface treatments	L / A	✓	✓	-	-	-
	Footpaths	L / A	-	✓	✓	-	✓
	Bicycle facilities	L / A	-	✓	✓	-	-
	Grade separated crossings	L / A	-	✓	✓	-	✓
	Bus facilities	L / A	-	-	-	✓	-
Combination	Integrated road treatments	L / A	✓	✓	✓	✓	✓
	Shared street space	L	✓	✓	✓	✓	✓

Table A6.2: Rural Road Interventions

	Measure	Short /Medium or Long Term	Reduce Speeds	Reduce crash risk	Reduce crash energy
Loss of Control Crashes	Advisory Speeds	S	✓	✓	✓
	Increased skid resistance	S	-	✓	-
	Shoulder widening/paving	S	-	✓	-
	Hazard removal	S	-	✓	✓
	Clear Zones	S	-	✓	✓
	Guardrails and end treatments	S	-	✓	✓
	Safety edges	L	-	✓	-
	Realignment/improve geometry	L	-	✓	-
Intersection Crashes	Reduce approach speeds by signs and visual measures	S	✓	✓	✓
	Enforcement	S	✓	✓	✓
	Reduce and removal of movements	S	-	✓	-
	Improved lighting	S	-	✓	✓
	Provision of turn lanes	S	-	✓	-
	Grade separation	L	-	✓	-
	Replacing controlled intersections with roundabouts	L	✓	✓	✓
Head-on Crashes	Lower speed limits	S	✓	✓	✓
	Centerline treatments	S	-	✓	-
	Enforcement	S	✓	✓	✓
	Median barriers	L	-	✓	✓
	Median separation (e.g. concrete median)	L	-	✓	✓
	2+1 roads	L	-	✓	-
Overtaking Crashes	Marked median treatments	S	-	✓	-
	Audio/tactile pavement markings	S	-	✓	-
	Improved signs/markings	S	-	✓	-
	Active signs	S	✓	✓	-
	Increased skid resistance	S	-	✓	-
	Median Barriers	L	-	✓	✓
	2+1 roads	L	-	✓	
Cyclist and Pedestrian Crashes	Lower speed limits	S	✓	✓	✓
	Improved signs/markings	S	-	✓	-
	Improved lighting	S	-	✓	-
	Enforcement	S	✓	✓	✓
	Dedicated facilities	S	-	✓	✓
	Shoulder widening/paving	S	-	✓	
	Traffic calming	S	✓	✓	✓
	Separate Facilities	L	-	✓	✓
Other	Access management for new developments	L	✓	✓	✓
	Improve to Higher Standard	L	✓	✓	✓
	Additional lanes	L	✓	✓	✓

Non-Infrastructure Interventions

136. As shown earlier in Table 4, non-infrastructure interventions need to be those which are evidenced-based: i.e., those for which there is proven evidence that they will reduce FSIs. Many commonly used interventions have had been found to be ineffective (or even negative) for reducing FSIs. The effectiveness of these interventions to reduce FSIs are fundamentally absent or highly contingent on the context in which they are applied as well as on supporting interventions that are necessary to make the implementation effective. Therefore, the design of such interventions should be done based on consultation with good relevant road safety experts and a thorough understanding of the local context.

137. Non-evidenced-based and less effective interventions are adopted for assorted reasons, including: mistaken beliefs that they will work based on common sense or poor evaluations, low cost, and popularity. It is of profound importance that resources are not wasted on these actions on behalf of road safety and that evidence-based road safety interventions are the model delivered by World Bank projects. The scientific evidence for these failures to deliver safety benefits is briefly identified in Table 4 to avoid doubt regarding these failures and provide evidence for use in persuading IAs and EAs.

138. There are several factors behind these consistent and surprising failures. Training is well recognized to work in many areas of human behavior, so why not in road safety for car drivers and motorcycle riders? A minimum of training/knowledge is needed for safety: red lights mean stop, where the brakes are on the car, etc. However, it is rare to find a driver who does not have these basics, and so evaluations of driver training are about going beyond these basics and determining whether more skill and more knowledge helps. Not only is more skill only marginally relevant to many key causes of crashes and deaths,[71] but also more skill leads to more driver over-confidence, more risk taking, and so more crashes. There is independent evidence supporting these causal steps: driver skills training is shown to increase confidence[72] (making existing general over-confidence[73] worse) and increased confidence is associated with increased risk taking.[74] In addition, a classic study showed that on public roads the most skilled drivers (licensed race car and rally drivers) have much higher crash rates than normal drivers.[75]

139. Claims contrary to this scientific evidence by providers of training or others, should not be accepted as contradictions of the evidence base against these interventions. There are hundreds of new slightly different versions of these interventions all over the world, and sound evaluation studies take time and significant resources which cannot be expended evaluating every version. Testimonials are often offered as evidence for safety successes: participants in training programs report that they were improved by

[71] Critical unsafe behaviors which contribute to large numbers of deaths, such as speeding, not wearing a seat belt, not wearing a helmet, drink driving, and drug driving are all motivational issues not driver skill issues. Job, RFS (1999). The psychology of driving and road safety. *Current Issues in Road Safety Research and Practice*. J. Clark (Ed.). (pp21-55). EMU Press, Armidale.

[72] Katila, A, Keskinen,O Hatakka,M. Laapotti S. (2004). Does increased confidence among novice drivers imply a decrease in safety? The effects of skid training on slippery road accidents. *Accident Analysis & Prevention*, *36 (4)*, 543–550

Gregersen, N. P. (1996). Young drivers' overestimation of their own skill: An experiment on the relation between training strategy and skill. Accident Analysis & Prevention 28 (2), 243-250.

Ker, K., I. Roberts, T. Collier, F. Beyer, F. Bunn and C. Frost (2005). Post-licence driver education for the prevention of road traffic crashes: a systematic review of randomised controlled trials. *Accident Analysis & Prevention* 37(2): 305-313.

[73] Job, RFS (1990). The application of learning theory to driving confidence: The effect of age and the impact of random breath testing. *Accident Analysis and Prevention, 22*, 97-107.

DeJoy, D. M. (1989). The optimism bias and traffic accident risk perception. *Accident Analysis & Prevention* 21(4): 333-340.

[74] Weinstein, Neil D. (1988). The precaution adoption process. Health Psychology, Vol 7(4), 355-386.

Prabhakar, T., Lee, S.H.V., & Job, RFS (1996). Risk Taking, optimism bias and risk utility in young drivers. L. St. John (Ed.), *Proceedings of the Road Safety Research and Enforcement Conference.* (pp.61-68). Sydney, NSW: Roads & Traffic Authority of NSW.

[75] Tillman, W. A., & Hobbs, G. E. (1949). The accident-prone automobile driver. *American Journal of Psychiatry*, 106, 321–331.

the training and are better drivers. This is not evidence for safety benefits but completely the opposite- evidence for increased over-confidence. The general principles of broad failure to deliver safety should be accepted over methodologically unsound interventions or sincere faith in untested versions.

140. The ineffective interventions listed in Table 4 should not be adopted, with a few quite specific areas of exception, which have been uncovered in evaluations. The narrow circumstances in which safety benefits may occur are also described in Table 4. Box A6.2 discusses an example of an exception: the effectiveness of driver training in BRT projects.

Box A6.2: Benefits of a Safety Culture on BRT Driver Training and Safety

While many evaluations have shown an apparent lack of safety benefits of car driver training, the impact of driver-focused training programs on road safety for bus drivers has been difficult to determine. The lack of standardized approaches to training and measurement of the impact make it difficult to compare results across multiple operators, particularly in commercial bus operations. While research in high income countries commonly reveals failures of training to improve safety outcomes (see Table 4), there is research on commercial and occupational drivers which shows positive impacts from stand-alone training programs[76]. There are studies which show links between training and reductions in risky driving behavior[77], and others that show positive impacts from transit bus driver training programs, particularly defensive driving training, but recognize that several other factors can influence training outcomes[78].

For operators such as public transit and BRT, a strong case can be made for the overall approach to safety taken by the organization and its management. There is a clear relationship, between an organization's culture as it pertains to safety and the safety performance of the organization. **The safety behavior of drivers is influenced primarily by their motor carrier's safety culture**[79], and this culture can be influence by driver education. Comprehensive safety engagement at all levels of the company, from higher management to drivers, is necessary to achieve long lasting and effective safety impacts[80]. The experiences of 'successful' agencies that have achieved improvements in safety performance also indicate that it is a combination of cultural, management, driver, vehicle and journey factors as well as societal-based factors that are necessary rather than stand-alone interventions that target primarily drivers.[81] [82] Training provided consistently within such an environment is more likely to yield safety benefits. Conversely, training provided without a comprehensive safety management systemin place is less likely to be effective in the long-term.

Because many BRT projects often take place in countries and cities where road safety management is deficient and where their road safety culture is poor, training and management requirements will be higher. Creating BRT agencies or operators that put in place comprehensive safety management and prioritize safety, is also necessary from the outset. If not, there is a risk that managers and drivers will bring in, or revert to, the prevailing (weaker) safety culture. A poor safety culture from the beginning of the project will take more time and resources to rectify in the long-term and will also lead to negative public opinion of the project.

A strong safety management program will also ensure that training is sustainable and ongoing. In the absence of a comprehensive approach, training is only provided at the launch of the project with little follow up or requalification needed which reduces long-term benefits of training. This problem is made worse when driver retention rates are low, as trained drivers leave and replacement drivers need to be trained. A comprehensive safety management approach will therefore also include the driver recruitment process and retention, including working conditions and incentives. In

[76] Gregersen, Nils Petter, Brendt Brehmer, and Bertil Moren. 1996. "Road Safety Improvement in Large Companies. An Experimental Comparison of Different Measures." Accident Analysis and Prevention 28 (3): 297-306.
[77] Dorn, Lisa, and David Barker. 2005. "The effects of driver training on simulated driving performance." Accident Analysis and Prevention 63-69.
[78] TCRP. 1996. Bus Occupant Safety- A Synthesis of Transit Practice. Washington DC: Transportation Research Board.
[79] Federal Motor Carrier Safety Administration. 2007. The Role of Safety Culture in Preventing Commercial Motor Vehicle Crashes- A Synthesis of Safety Practice. Commercial Truck and Bus Safety-Synthesis 14, Transportation Research Board.
[80] Nævestad, Tor-Olav, Ingeborg Storesund Hesjevoll, and Ross Owen Phillips. 2018. "How can we improve safety culture in transport organizations? A review of interventions, effects and influencing factors." Transportation Research Part F 28-46.
[81] Murray, Will, Stephen Ison, Paul Gallemore, and Harnam Singh Nijjar. 2009. "Effective Occupational Road Safety Programs- A Case Study of Wolseley." Transportation Research Record 2096: 55-64.
[82] Guilherme, José. 2017. "CTT Road Safety Program." European Road Safety Charter. November. http://www.erscharter.eu/sites/default/files/resources/wrrs_-_ctt_web_2.pdf.

developing countries, regulations on commercial driver working conditions may be weak and safeguards can ensure that new agencies meet a higher standard.

Good practice priority areas to be considered as part World Bank BRT operations include:

1. Building a Safety Management System:
    - Formal, agency-wide, top-down, data-driven approach to managing safety and coordinating safety interventions.
    - Visible commitment from management and accountable leaders are critical factors for high safety performance on the road.
    - Systematic policies, procedures, and practices for the management of safety risk and driver training programs.
    - Drivers should be engaged, empowered and effective stakeholders in the system. Operators should examine recruitment, working conditions, incentives, and satisfaction to ensure drivers are motivated to be safe.
2. Monitoring, data collection, and evaluation:
    - Safety performance should be proactively monitored and assessed regularly. Recent technologies allow in-vehicle monitoring of driver behavior and vehicle handling such as acceleration, braking, swerving, etc.
    - Data based safety mitigation efforts with clear communication of results and impacts.
    - Establish reporting lines to ensure that safety issues are communicated up and addressed**.**
3. Vehicle safety:

Investment in vehicles usually occurs at the beginning of BRT and transit projects and vehicle stocks are expected to last for several years or decades. This makes it important to procure vehicles that do not compromise on standards and safety technology. Buses need to provide drivers with a wide field of vision, mirrors that minimize blind spots, and where possible, safety technology such as collision avoidance, lane departure avoidance, pedestrian/bicyclist sensors.

Car driver training:

- **What works well?** Evidence indicates that driver training can be effective in improving road safety when, and only when: novice drivers are being trained and the training involves many hours of on-road supervised driving.[83] Box A6.2 explained another scenario with specialized training for drivers of BRTs.
- **What does not work well?** Despite faith in education and training, **general passenger car driver training** is proven repeatedly to be ineffective, or harmful, for road safety. The highly credible Cochrane Library has published expert methodologically rigorous reviews of the evidence which have shown no safety benefits of driver training. The review of post-license driver training evaluations concluded: "This systematic review provides no evidence that post-license driver education is effective in preventing road traffic injuries or crashes. …. Because of the large number of participants included in the meta-analysis (close to 300,000 for some outcomes) we can

[83] Gregersen, N. P., Nyberg, A., & Berg, H. Y. (2003). Accident involvement among learner drivers—an analysis of the consequences of supervised practice. *Accident Analysis & Prevention*, *35*(5), 725-730.

exclude, with reasonable precision, the possibility of even modest benefits."[84] The analysis of the evidence also found that: "No one form of education … was found to be substantially more effective than another, nor was a significant difference found between advanced driver education and remedial driver education."[85] More recent reviews have demonstrated increases in crash rates from vehicle handling skills based training such as skid training.[86]

Motorcycle rider training

- **What does not work well?** Motorcycle rider training has no road safety gains, with benefits absent in systematic reviews of the evidence[87] and in a more recent well controlled evaluation of post-license training.[88] There are no known exceptions.

School based driver training

- **What does not work well?** Despite the value of education and training in other aspects of life, a comprehensive review of many scientific evaluations of school-based driver training demonstrated clearly negative results. The study concludes that the results "provide no evidence that driver education reduces road crash involvement and suggest that it may lead to a modest but potentially important **increase** in the proportion of teenagers involved in traffic crashes."[89] No sound evidence exists for road safety benefits arising from school-based driver training. [90] No exceptions are identified.

School based education for road safety

- **What works well?** Based on changes in safe behavior, teaching children how and where to cross the road safety appears to provide benefits.[91] However, this should only be applied to children of a suitable age (8 to 10 years old) so as not to encourage more independent (unsupervised) road crossing by younger children. Regular refresher training is also important. Even then, the hope that these changes behavior will produce real safety benefits remains unproven.[92]

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[84] Ker K, Roberts IG, Collier T, Beyer FR, Bunn F, Frost C. Post-licence driver education for the prevention of road traffic crashes. *Cochrane Database of Systematic Reviews* 2003, Issue 3. Art. No.: CD003734. DOI: 10.1002/14651858.CD003734.

[85] Ker K, Roberts IG, Collier T, Beyer FR, Bunn F, Frost C. Post-licence driver education for the prevention of road traffic crashes. *Cochrane Database of Systematic Reviews* 2003, Issue 3. Art. No.: CD003734. DOI: 10.1002/14651858.CD003734.

[86] Elvik, R. et al. (2009). The Handbook of Road Safety Measures.

[87] Kardamanidis, K., Martiniuk, A., Ivers, R. Q., Stevenson, M. R., & Thistlethwaite, K. (2010). Motorcycle rider training for the prevention of road traffic crashes. *The Cochrane Library*.

[88] Ivers, R. Q., Sakashita, C., Senserrick, T., Elkington, J., Lo, S., Boufous, S., & de Rome, L. (2016). Does an on-road motorcycle coaching program reduce crashes in novice riders? A randomised control trial. *Accident Analysis & Prevention*, *86*, 40-46.

[89] Roberts IG, Kwan I. (2001). School-based driver education for the prevention of traffic crashes. *Cochrane Database of Systematic Reviews* 2001, Issue 3.

[90] Any possible benefits are overcome by increased driver over-confidence and possibly the earlier age of beginning to drive. There is direct evidence for the benefit of starting to drive at an older age, with effects of age on risk independent of driving experience. This relates to fundamental brain development. See:
Casey, B.J., Jones, R. M. and Hare, T. A. (2008), *The Adolescent Brain*. Annals of the New York Academy of Sciences, 1124: 111–126. doi: 10.1196/annals.1440.010
Johnson, S. B. and V. C. Jones (2011). Adolescent development and risk of injury: using developmental science to improve interventions. *Injury Prevention* 17(1): 50-54

[91] Oxley J, Congiu M, Whelan M, D'Elio A, Charlton J. (2008). Teaching young children to cross roads safely. *Ann Adv Automot Med.*, 52, 215-23.
Schwebel, D. C., Shen, J., & McClure, L. A. (2016). How do children learn to cross the street? The process of pedestrian safety training. *Traffic injury prevention*, *17*(6), 573-579.

[92] Duperrex, O., Roberts, I., & Bunn, F. (2002). Safety education of pedestrians for injury prevention. *The Cochrane Library*.

- **What does not work well?** While studies show the education on road safety in schools does improve knowledge,[93] there is no evidence that this knowledge changes the safety level of on-road behavior. Again, there is a risk that increased knowledge increases confidence and risk-taking, as noted earlier.

Public education or promotion not based on general deterrence

- **What works well?** Provision of real enforcement general deterrence or real (and well researched) social pressure.

- **What does not work well?** Promotions of changes in on-road behavior based on enforcement and general deterrence often succeed in improving safety whereas promotion of change based on the risk of a serious crash generally does not improve safety. For most of us this makes little sense because death or serious injury is a far worse outcome than a fine, so the former risks should be more effective. There is practical evidence and a psychological explanation.[94]

Improving road surfaces (fixing potholes and reducing roughness)

- **What works well?** Safety benefits from improving road conditions only arise when speeds are not allowed to increase. Safety benefits may arise where other factors such as speed humps and other speed limiting engineering or excellent general deterrence (which rarely occurs in LMICs) prevent any increase in speeds after the road surface improvements.

- **What does not work well?** A common misconception is that poor road conditions are a major contributor to crashes and that by improving road condition these will be eliminated. While this may cause a small reduction in crashes if nothing else changes, at the same time poor road conditions usually constrain speeds and so that the resulting crashes are less likely to result in FSIs. Improving road surfaces leads to increases in travel speeds. The increase in speeds generally causes an increase in crashes and in FSIs due to the 1% increase in speeds typically resulting in a 4% increase in deaths.[95] See Box 4 in the main text for measures that were implemented in Kiribati to reduce the negative road safety impact that would arise from increased speeds after road improvements.

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[93] Meehan, G. (2009). School student recognition of in-school road safety education. Proceedings of the Australasian Road Safety Research Policing Education Conference, 2009, Sydney, New South Wales, Australia, 2009. Sydney: NSW Roads & Traffic Authority

[94] The practical evidence shows compellingly that education based on crash risk has weak effects compared with promotion based on enforcement risk. For example, seatbelt use in the state of New South Wales, Australia was only pushed up slightly from baselines to over 20% by strong advertising of the risks of injury and death, yet good advertising of impending enforcement of seatbelt use resulted in a sudden increase in usage rate to over 95%, which with further refinement of enforcement and promotion is now over 99%. The fear of a fine is clearly more effective [see: Job, RFS (1988). Effective and ineffective use of fear in health promotion campaigns. *American Journal of Public Health, 78*, 163-167]. Similarly, the benefits of random alcohol breath testing enforcement and the promotion of the enforcement threat worked much better that advertising based on drink-driving crash risk [see: Job, RFS (1990). The application of learning theory to driving confidence: The effect of age and the impact of random breath testing. *Accident Analysis and Prevention, 22*, 97-107]. The reasons for this include the extensive over-confidence and feeling of invulnerability of most drivers, which result in crash risk being a problem for others but 'not for me' [see: DeJoy, D. M. (1989). The optimism bias and traffic accident risk perception. Accident Analysis & Prevention 21(4): 333-340; Job, RFS (1990). The application of learning theory to driving confidence: The effect of age and the impact of random breath testing. *Accident Analysis and Prevention, 22*, 97-107; Weinstein, Neil D. (1988). The precaution adoption process. Health Psychology, Vol 7(4), 355-386]. Part of the power of enforcement is that it overcomes this illusion of invulnerability: it does not matter to the speed camera or the police how good a driver you are or think you are, you will still be fined.

[95] Nilsson, G. (2004). Traffic Safety Dimension and the Power Model to describe the Effect of Speed on Safety, Lund Institute of Technology, Sweden.

ANNEX 7: Potential Technical Assistance Activities

141. This Annex contains an extensive list of the types of Technical Assistance activities that may be carried out to improve the overall capacity and effectiveness of road safety. Specific project activities should be selected based on the nature of the project and the local situation. As noted in the main text (see Figure 1), these activities are generally undertaken during implementation, with the design done during project Preparation. However, when time and resources allow, the reviews and some activities may be undertaken during Preparation which often leads to a more effective Implementation.

Potential Areas for Providing Support	Potential Activities	Potential Indicators
Improve the capacity of the road agencies to maintain the safety features of the road environment, (e.g. signs, markings, crash barriers, traffic calming, etc. Increase focus on road design and engineering safety measures if not effective.	• Allocation of a budget and development of procedures to check for maintenance needs. • Provide Technical Assistance as necessary to build capacity.	• Safety audit compliance. • Safety maintenance plan. • Implementation of monitoring program.
Improve the level of knowledge and capacity of local institutions regarding road safety engineering; contractors for road safety during construction; fleet operators for safe operations.	• Provide Technical Assistance as necessary to build capacity, including secure funding. • Establish training capacity within academic and/or engineering institutions with the goal of improving long-term sustainability. • Increase focus on road design and engineering measures if not effective.	• Outcome of capacity building program (e.g. implementation of training program)
Review road safety legal environment to identify areas of potential improvement.	• Provide Technical Assistance as necessary to improve regulations, changes to penalties, etc. • Consider the various pillars: safe speed, safe roads, safe vehicles, safe road user behavior, post-crash care and reduced exposure. • Increase focus on road design and engineering measures if other measures are not effective.	• Appropriate legislation prepared (NOTE: The project cannot require legislation to be adopted). • Increased general deterrence. • Funding level for road safety.

Improve the national road safety strategy and road safety action plan (if available) to determine what updates or revisions are necessary.	• Key elements of a successful action plan include:
	  ○ Plan is concise with an achievable number of actions;
	  ○ There is allocated funding for its implementation;
	  ○ Clear monitoring and evaluation framework;
	  ○ Political and institutional support
	• Provide Technical Assistance as necessary to prepare appropriate results focused strategy and plans.
		• National road safety strategy under implementation.
		• Road safety action plan under implementation.

Improve the crash data recording and analysis system to identify what, if any, data is recorded and stored (electronically or manually).	• Provide Technical Assistance as necessary to:
	  ○ improve crash data collection processes.
	  ○ improve data accuracy, especially crash locations.
	  ○ train users on application of crash data for improving safety outcomes.
		• Implementation of improved crash data recording and analysis system.
		• Capacity building of users.
		• Adoption of DRIVER or similar data tool.

	• improve the recording and analysis, potentially implementing the World Bank's Data for Road Incident Visualization, Evaluation and Reporting (DRIVER) or similar system. • Link health data to improve overall reporting[96].	
Improve the manuals, specifications, codes of practice, etc. related to road safety addressing safe speed, safe roads, safe vehicles, safe road user behavior, post-crash care and reduced exposure.	• Provide Technical Assistance as necessary to update manuals. Adapt existing manuals from elsewhere if practicable.	• Adoption of updated manuals.
Improve the safety education programs in schools, including school safety policies for travel (i.e. safe routes to school for walking/cycling).	• See Annex 6 for evidence on what works and what does not work.	• Updated training program on how and where to cross the road.

Improve police road safety enforcement to identify if it is effective to act as a deterrence for speeding, impaired driving, enforcing vehicle standards—particularly heavy vehicle monitoring.	• Provide Technical Assistance as necessary to improve effectiveness, for example:
	  ○ Increasing enforcement (including automated enforcement);
	  ○ Increasing penalties;
	  ○ Reducing avoidance of penalties;
	• Public promotion of these changes.
		• Enforcement hours, infringement notices and warnings issued, and paid.
		• Percentage of the road network which is covered by speed enforcement.
		• Community attitudes to speeding and speed limit compliance.

Improve overloading and operating enforcement for trucks, buses, taxis, motorcycle taxis, mini-buses to check compliance with safe loads (goods and people), driving hours and vehicle safety standards and rules.	• Provide Technical Assistance as necessary to improve effectiveness.	• Reduction in truck overloading rates. • Public transport vehicles do not exceed passenger capacity.
Improve regulations and practices for fleet management, such as employment conditions, driver fatigue management, etc.	• Provide Technical Assistance as necessary to improve effectiveness.	• Appropriate legislation prepared (NOTE: The project cannot require legislation to be adopted). • Implementation of effective monitoring program with appropriate penalties for non-compliance.
Improve specific aspects of driver licensing, particularly for specialized or heavy vehicles, the provision of opportunities for deterrence contingencies on behavior,	• Driver licensing systems in which drivers should take and pass appropriate tests (which cannot be circumvented) to obtain a license. • Supervised on road driving experience as a pre-requisite for licensing.	• Appropriate driver licensing system is adopted. • Driver licensing industry compliance with safety standards and rules.

[96] For an example see https://austroads.com.au/publications/road-safety/ap-r599-19 on Australia's efforts in this area.

and for managing the age of drivers.	• Graduated driver licensing systems allow for gradual release of restraints on novice driver limits, as maturity and experience increase. • Policies which limit the age at which driving is allowed (ideally to 18 years or older) due the benefits of maturity even independently of experience. • Ensure drivers of specialized equipment and commercial vehicles are properly trained for the equipment they operate, with training updates as appropriate.	• Heavy vehicle industry compliance with safety standards and rules. • Public transport industry compliance.
Improve vehicle safety standards and rules against relevant UN standards, or similar (see Annex 8), and promote NCAP safety ratings, to improve active and passive safety features of vehicles.	• Adopt relevant UN standards, or similar, and promote NCAP safety ratings (minimum 4 star recommended) to improve active and passive safety features of vehicles. • Adopt regular inspection program (especially for the safety of heavy vehicles and public transport vehicles). • Create general deterrence for safety of heavy vehicle maintenance, loading and operation. • Create general deterrence for safety of passenger vehicles.	• Appropriate legislation prepared (NOTE: The project cannot require legislation to be adopted). • Adopted UNECE or similar vehicle safety features. • NCAP (New Car Assessment program) Safety ratings of cars. • Compliance with vehicle safety certification and periodic inspection standards and rules. • Vehicle maintenance records. • Heavy vehicle and public transport industry compliance with safety standards and rules.
Improve seat belt, motor cycle helmet, and child restraint legislation and usage to identify opportunities for improving usage. In addition, confirm product compliance for helmets and child restraint systems, including other after-market safety products, with international or national level standards as applicable.	• Provide Technical Assistance as necessary to: • improve upon existing legislative framework • improve usage through media/educational campaigns • create general deterrence through effective enforcement and unavoidable penalties (including rear seat occupants). • Controlling the sale of non-certified after-market safety products (helmets and child seats). • In the absence of local certification standards for the above products, policies directing at compliance with UN standards (see Annex 8) should be encouraged.	• Appropriate legislation prepared (NOTE: The project cannot require legislation to be adopted). • Percentage use of seat belts, helmets, and child restraints. • Prevalence of uncertified safety products in the market.
Improve post-crash care to identify opportunities for improvement. This should consider the immediate response (i.e. first response and pre-hospital care), transport to the treatment facility; in facility treatment, and potentially post-treatment follow up.	• Provide Technical Assistance as appropriate, e.g.: ○ Single national emergency notification number (including potentially improving telecommunications coverage) ○ Provide immediate response emergency resources along the project road as needed, or require provision of emergency services as part of contracts for toll/concession roads; ○ Facilitate and support emergency and medical systems which treat emergency patients regardless of ability to pay.	• Proportion of victims transported to hospital by ambulance. • Emergency medical services response times. • Effectiveness of emergency services at preventing serious injuries dying. • Compliance with good practice pre-hospital and

	○ Potential for follow up treatment such as rehabilitation and disability management. • See Annex 10 for details.	trauma care service standards.
Improve the legal framework for crash responders	• Support legislation so that there is no personal liability that would be an impediment to responding (e.g. a 'Good Samaritan' law).	• Appropriate legislation prepared (NOTE: The project cannot require legislation to be adopted).
Improve the implications of imported vehicles and/or spare parts on road safety.	• Provide Technical Assistance as necessary to improve certification process with safety inspections done for all import vehicles (new cars, used-cars, Complete Knock Down – CKDs). • Import criteria for used-cars needs to focus on crashworthiness at the time of manufacturing and current periodic safety inspection. • Link passing safety inspection as a prerequisite criterion for the registration of an import vehicle. • Inspection of second-hand tires for basic safety standards.	• Import vehicle certified for safety based on compliance with UN standards or NCAP 4 star or better (if NCAP available in the country of origin).
Improve media campaigns and other activities to identify opportunities to increase their effectiveness.	• See Annex 6 for evidence on what works and what does not work. • Media campaigns should be associated with a specific evidenced based intervention (e.g. increased enforcement). • Provide Technical Assistance as appropriate.	• Media coverage frequency and reach with enforcement or general deterrence messaging. • Target audience recall of social marketing messages. • Reductions in FSI in targeted crash types
Addressing fatigue as a factor in road crashes	• Fatigue is a challenging issue to manage but can be address for commercial drivers with regulation of maximum driving and work hours, combined with technology such as smart licenses and PGS tracking of vehicles to monitor hours.	• Adoption of driving and work hour regulations and means of enforcement. • Reduction in FSI in heavy vehicle crashes.

ANNEX 8: Vehicle Specifications

Crashworthiness test standards

142. Vehicle safety performance for light vehicles is defined using safety star ratings from regional New Car Assessment Programs (NCAP), under the umbrella of Global NCAP. These programs are expanding in reach, by region and country, and provide valuable information to consumers, which places market pressure on vehicle suppliers to meet improved safety star ratings to remain competitive. Wherever possible, the procurement under the World Bank project should aim for 4-star or 5-star passenger vehicles, when available (see Table A2.4).

143. In the absence of NCAP 4-star or 5-star vehicles being available, all new light duty vehicles should comply with the minimum crashworthiness test standards as defined by the UNECE 1958 Agreement for the World Forum for Harmonization of Vehicle Regulations. At a minimum all new vehicles should comply with UN regulation 94 (occupant protection in frontal collision), UN regulation 95 (occupant protection in lateral collision), UN regulation no. 13-H/GTR 8 (Electronic Stability Control).

Vehicle identification

- All vehicles should have a license plate recognized in the country where are being used and in accordance to their category. If the category of vehicle is not enforced to have a license plate, the Borrower should provide the appropriate means to unambiguously identify each vehicle.
- The borrower should provide for each vehicle the documents related to the registration of the vehicles, including the data of their license plates and VIN (Vehicle Identification Number or chassis number) that should fit with those in the vehicle.
- The borrower should provide for each vehicle the appropriate insurance policy covering its civil liability vis-à-vis third parties and the protection of the driver and passengers.
- The borrower should provide a document with the technical features of the vehicle.
- Vehicles undergoing conversion should have an up-to-date document with its technical features. After modification, the vehicle should continue to comply with all the requirements of this GPN.

Vehicle technical requirements

144. Vehicles should comply with the requirements listed below, allowing the described functions in any circumstance.

- Vehicles used for the transport of dangerous goods should fulfil ADR provisions or equivalent.
- The fulfilment of the features and state of the vehicle may be demonstrated by the periodical vehicle inspection report of the country of operation when it may be considered equivalent to the provisions of the UN 1997 Agreement “Concerning the adoption of uniform conditions for periodical technical inspections of wheeled vehicles and the reciprocal recognition of such inspections”.
- General requirements to vehicles:

- Vehicles should be equipped and maintained to ensure all the time their safe and clean operation toward drivers, passengers and any user of the road.
- Construction and agricultural machinery and their trailers may have different requirements only if absolutely justified because of their use.
- Vehicles should require the use of a key or any other device to ensure non-authorized use.

- Brakes:
  - All vehicles except trailers with a GVW (Gross Vehicle Weight) up to 750 kg should be equipped with service breaks in each axle, capable to safely stop the vehicle.
  - All vehicles, except two-wheelers, should be equipped with parking brake capable of keep the vehicle still. In the case of brakes operated with air, the parking brake should apply without air pressure. Two wheelers should be fitted with a stand instead.
- Steering:
  - All motor vehicles should have a steering system in good state that can be operated from the driver's normal position and allowing to change the direction of the vehicle in a controlled way.
- Engine:
  - Engine, clutch, gear box and any other component of the driven gear should be in good state protected from no-adverted contact.
  - Oil or any fluid leakage, except air conditioning water, should be avoided.
  - The engine should be equipped with the appropriate means, i.e. isolation, intake and scape mufflers to reduce noise.
- Lighting and acoustic devices:
  - All vehicles should be equipped with the following lighting devices: front and rear position lamp, turning lamp, reverse lamps with buzzer (except two-wheelers), hazard warning signal, side marker lamps (only need to be considered if the length is 6 m or more), stop lamps, rear fog lamps, front retroreflective devices (only if low-dipped bean headlamps are not installed or not visible all the time), rear retroreflective devices and side retroreflective devices.
  - Furthermore, motor vehicles should be equipped with low-dipped bean headlamps with adjustable aiming to avoid dazzling other drivers and an audible warning device with a continuous tone.
  - Those devices should be visible during the operation of the vehicle and in effective use.
  - Additional lighting and audible devices may be installed if necessary for the vehicle and provided they don't interfere with the normal use of the devices described above.
- Tires and wheels:
  - Vehicles should be equipped with inflatable rubber tires with appropriate thread in all wheels.

- Wheels should be firmly attached to the axles and protected with mudguards.

- Body and powertrain:
  - All the elements of the vehicle should be firmly attached and in good state.
  - Fuel tanks should not be exposed to crashes, including their feeding pipes. Fuel feeding pipes should always be protected with a cap.
  - Oil or any fluid leakage, except air conditioning water, should be avoided.
  - Batteries should not be exposed to crashes.
  - Electric wiring should be well protected. The isolation should be in good condition.
  - The external part of a vehicle should be smooth and should not have sharp parts or components that may increase the risk of injuries in case of crash.
  - Motor vehicles with four wheels or more should have front, side and rear bumper adapted to their weights. Trailers should have side and rear bumpers likewise.
  - All mobile elements of the powertrain, except for the wheels, should be protected from unexpected contact by users or operators.
  - All motor vehicle not intended to be used astride should have doors operated from inside and outside the vehicle. Busses and coaches should have emergency exits that, besides the normal doors, may be roof traps or breakable windows.

- Vehicle interior:
  - All the components in the driver's and/or passengers' compartment(s) should be firmly attached to the body and in good conditions.
  - The vehicle should be fitted with seats for the driver and all passengers rigidly attached to the structure of the vehicle. All seats should be fitted with a three-point safety belt for the driver and passengers. The requirements of this paragraph don't apply to urban buses and vehicles designed to be driven astride.
  - Vehicles designed to be used astride should have the appropriate supports for the feet and hands of the driver and passengers.
  - The area of the driver and passengers should be separate from the load area by means of a rigid component. The cargo area should not be used to transport passengers.
  - The internal parts of the vehicle in the driver and passenger zone should have smooth and soft parts and components.
  - Only articulated buses should transport passengers in their trailers. Other kind of passenger transport in trailers is not accepted.

- The load area should have the appropriate means to fix the load. Vehicles intended to transport granular materials or materials that may come off during circulation, should have elements to cover them, such as canvases.
- Vehicle should have the appropriate number of operable fire extinguishers.

- Visibility and control:
  - The driver should have all the elements to normally control, operate and monitor the vehicle at his reach, in a normal seated position.
  - Vehicles with a maximum speed of 25 km/h and more should be fitted with speedometer.
  - The field of vision should be clear and direct 180º in front of the driver, apart from the pillars.
  - Motor vehicles, except those conceived to be driven astride, should have a transparent windshield with motorized wipers and washers.
  - Motor vehicles should have at least two external rear-view mirrors usable from the driver's normal seat. Additional rearview mirrors may be required to ensure the complete visibility around heavy-duty vehicles.
  - All glazing surfaces should be such that, in the event of shattering, the danger of bodily injury is reduced as far as possible. Windshield and glazing in the area of 180º in front of the driver should not distort colors and shapes.

References to vehicle standards

145. The following standards are those of the UN ECE. Equivalent standards may be accepted. The mention of the standards intends to be a reference; the fulfilment of all requirements set in the standards is a complex activity requiring in some cases highly sophisticated facilities and expert staff.

- Definition of categories of vehicles: Consolidated Resolution on the Construction of Vehicles (R.E.3) http://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29resolutions/ECE-TRANS-WP.29-78r6e.pdf
- Transport of Dangerous Goods (ADR) http://www.unece.org/trans/danger/danger.html
- Harmonized Technical United Nations Regulations according to the 1958 Agreement http://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2017/E-ECE-TRANS-505-Rev.3e.pdf
- Regulations by number:

  From Reg 0 to 20 http://www.unece.org/trans/main/wp29/wp29regs0-20.html
  From Reg 21 to 40 http://www.unece.org/trans/main/wp29/wp29regs21-40.html
  From Reg 41 to 60 http://www.unece.org/trans/main/wp29/wp29regs41-60.html
  From Reg 61 to 80 http://www.unece.org/trans/main/wp29/wp29regs61-80.html
  From Reg 81 to 100 http://www.unece.org/trans/main/wp29/wp29regs81-100.html
  From Reg 101 to 120 http://www.unece.org/trans/main/wp29/wp29regs101-120.html
  From Reg 121 to 140 http://www.unece.org/trans/main/wp29/wp29regs121-140.html

From Reg 141 to 145 http://www.unece.org/trans/main/wp29/wp29regs141-160.html

- List of the most relevant Regulations by number and subject:

Lighting and signaling
- Reg 28 – Audible warning devices
- Reg 48 – Installation of lighting and light signaling devices

Instrumentation and controls:
- Reg 39 – Speedometer equipment
- Reg 121 – Controls, tell-tales and indicators

Visibility:
- Reg 43 – Safety glazing materials and their installation in vehicles
- Reg 46 – Rear view mirrors

General safety:
- Reg 105 – ADR vehicles
- Reg 107 – Busses and coaches

Passive safety:
- Reg 11 – Door latches and door retention components
- Reg 12 – Steering wheel protection
- Reg 14 – Safety belt anchorages
- Reg 16 – Safety belts and restraint systems
- Reg 17 – Seats, seat anchorages and head restraints
- Reg 21 – Interior fittings
- Reg 26 – External projections of passenger cars
- Reg 42 – Front and rear protective devices (bumpers)
- Reg 58 – Rear underrun protective devices
- Reg 73 – Lateral protection devices
- Reg 94 – Side collision
- Reg 95 – Frontal collision

Active Safety
- Reg 13 and Reg 13H – Brakes
- Reg 30 – Tires for passenger cars and their trailers
- Reg 54 – Tires for commercial vehicles and their trailers
- Reg 75 – Tires for motorcycles/mopeds
- Reg 106 – Tires for agricultural vehicles

Environmental protection
- Reg 24 – Engine power, smoke and emissions
- Reg 41 – Nose for motorcycles
- Reg 51 – Noise
- Reg 83 – Emissions
- Reg 101 – Emissions of CO_2 and fuel consumption

Security
- Reg 18 – antitheft devices
- Reg 116 – Protection against unauthorized use

ANNEX 9: Enforcement

146. Enforcement is a key element for reducing FSIs, and projects should look at opportunities to enhance enforcement. Implementation of intensive police programs—focused on: (i) speed; (ii) impaired driving (drug and alcohol); and, (ii) seat belt usage—is associated with average reductions varying between 23 and 31 per cent of road crashes with injuries.[97] Safety cameras, driving license suspension and a zero blood-alcohol content (BAC) limit for young drivers are very cost-effective measures (Elvik, 2009).

What is the purpose of traffic regulation enforcement?

147. The main objective of traffic regulation enforcement is road safety. Police activities should primarily serve as deterrence for drivers inclined to commit traffic offences through increasing the road user's perception of the risk of being caught. By targeting drivers engaging in risky and unsafe behavior, this reduces the chances for them to harm themselves and others.[98]

148. Unfortunately, many enforcement activities are still too often directed towards detecting and apprehending the offending driver or generating revenue through infringement notices. Consistent deterrence strategies, which typically comprise highly visible police and/or safety camera activity can bring about lasting changes in road user behavior and, consequently, changes in road users' attitudes which reinforce these behavioral changes.[99] This is termed '**general deterrence**'.

Enforcement resources

149. The Global Road Safety Partnership provides a manual[100], which is a road policing tool-kit using a six-step process designed for the traffic police to adapt using local knowledge, experience and up-to-date data. The aim of is to use the evidence available to develop and improve police law enforcement performance, activities and current practices. Simple, useful and practical measures are provided as pathways towards improvement.

150. Effective enforcement strategies aim to increase the road user's perception of being apprehended if they continue with high risk behaviors or do not comply with the law. Education is critical to support enforcement. maximum success will be achieved by combining education and enforcement. Once a driver or rider is convinced of the safety value of disciplined road user behavior, they will be encouraged to consistently comply with the law rather than comply through the fear of enforcement.

151. Manuals exist to guide the process generally and for the targeting of specific behaviors with enforcement as part of a broader program to improve road use behavior. Examples are listed below from the well-recognized 'green manual' series developed by WHO, the World Bank, GRSP, and the FIA Foundation:

Speed:
http://www.who.int/roadsafety/projects/manuals/speed_manual/en/

[97] Dupont B., Blais E. (2015) *Assessing the Capability of Intensive Police Programmes to Prevent Severe Road Accidents: A Systematic Review.* British Journal of Criminology 45(6).
[98] Porter, Bryan E. (2011) *Handbook of Traffic Psychology*. Academic Press, London, United Kingdom.
[99] European Transport Safety Council. (1999) *Police enforcement strategies to reduce traffic casualties in Europe*.
[100] Global Road Safety Partnership. *Enforcement Planning Guide for Road Police, Decision Makers and Enforcement Bodies in Low to Middle-Income Countries.*

Motorcycles:
http://www.who.int/violence_injury_prevention/publications/road_traffic/ptw_manual/en/

Pedestrian Safety:
http://www.who.int/roadsafety/projects/manuals/pedestrian/en/

Legislation:
http://www.who.int/violence_injury_prevention/road_traffic/countrywork/legislation_manual/en/

Helmets:
http://www.who.int/violence_injury_prevention/publications/road_traffic/helmet_manual.pdf?ua=1

Alcohol Impaired Driving:
http://www.who.int/roadsafety/projects/manuals/alcohol/drinking_driving.pdf?ua=1

Cost effectiveness of traffic regulation enforcement

152. The costs of traffic safety enforcement are low in comparison to the potential number of lives saved, and often offset by the revenue generated. Increasing enforcement of existing traffic safety norms can prove to be an extremely cost-effective public health intervention in low-income countries[101], even from a government perspective.[102]

Components of enforcement

153. Three components make up the enforcement system:

- **Legislation:** It is essential that the appropriate regulatory framework and penalties be in place;
- **Enforcement**: Police officers use the law to cite violators with tickets and arrests; and,
- **Courts:** Review cases, with judicial outcomes carrying out the sentences, dismissing the charges or providing some decision in between (reduced sentencing). These three components make up the enforcement system (Bryan E., 2011).

154. Successful behavioral change for road safety, and thus reduction in FSI due to targeted behaviors, is achieved through development of strong general deterrence. Rune (2009)[103] describes 13 measures in police enforcement and sanctions. Some measures are directed towards specific law violations: speeding, non-wearing of seatbelts, red-light running and driving under the influence of alcohol (DUI). Sanctions are largely issued in the form of punishments, but also to some extent in the form of reward

[101] Study in Uganda offered primary data showing a 17% reduction in traffic fatalities in the year after the Ugandan government began a program to scale up traffic enforcement on the main roads around the capital. The program cost $72,000 per year, which amounts to roughly $27 per life year saved, making it one of the most cost-effective public health investments in a low-income country like Uganda. Such empirical studies are needed in the developing world to inform national and local policy choices that prioritize road safety investments for national health and development.

[102] Bishai D., Asiimwe B., Abbas S., Hyder A. A., Bazeyo W. (2008) *Cost-effectiveness of traffic enforcement: case study from Uganda, Injury Prevention*, Vol 14. No. 4.

[103] Elvik, R.; Vaa, T., The handbook of road safety measures. (2004) Elsevier, Amsterdam.

and motivational measures (motor vehicle insurance). The 13 measures and their effects on crashes from different studies are shown in Table A9.1.

Table A9.1: Enforcement Measures and Effects on Road Crashes and Injuries

Measures	Effective? (Yes/Mixed /No)	Impact on Road Crashes and Injuries
Automatic speed enforcement	Y	• Significant reduction in number of road crash injuries of about 16%, with a greater effect for fatal crashes than for others.
Red-light cameras	Y	• Side collisions, which are the target road crashes of red-light enforcement, were found to be reduced. • Found to lead to an increase in rear-end and total number of road crashes at junctions.
DUI laws	Y	• The two laws that have the greatest and best documented effect on road crashes are an increase of the minimum legal drinking age from 18 to 21 and a blood alcohol concentration (BAC) level of 0.02 for young drivers.
Stationary and mobile speed enforcement	Y	• Found to reduce crashes. • No effects on crashes when combined with general police patrolling.
Seat belt enforcement	Y	• Found to increase seat belt use by about 20%.
DUI enforcement	Y	• Found to reduce road crash numbers, especially during the first months after the implementation of a new enforcement program or an increase in the amount of enforcement. Use of highly visible checkpoints where many drivers are tested, have been found to be most effective.
Restrictions for DUI-convicted drivers	Y	• Restriction for DUI convicted drivers include license suspension, vehicle impoundment and alcolock. License suspension was found to be effective in reducing road crashes while the license is suspended, but not after the license has been reinstated. • Vehicle impoundment was found to have greater and more long-lasting effects than license suspension, both among drivers who have a vehicle impounded and among drivers who are in danger of vehicle impoundment (e.g. because the license is suspended).
Demerit point systems and license suspension	M	• Demerit point system not found to reduce road crashes. • Warning letters and courses for drivers with critical numbers of penalty points may reduce the road crash involvement for respective drivers. • License Suspension was found to be effective only among drivers whose license has been suspended, and only while the license was suspended. • No effects were found on drivers in general or on drivers whose license was reinstated.
Fixed penalties	M	• Fixed penalties for non-use of seat belts were found to increase the use of seat belts. • No effects on speeding were found because increased fixed penalties for speeding.
Treatment of DUI-convicted drivers	M	• This includes educational measures with a focus on behavior changes, and therapeutic measures with a focus on alcohol problems. Results from evaluation studies are inconsistent. • Educational measures may be effective in reducing recidivism among drivers without alcohol problems. Among alcoholics, education has no effect. • Treatment seems to be most effective in combination with sanctions. Some studies found increased crash involvement among drivers who had chosen treatment as an alternative to license suspension.
Patrolling	N	• No effects on road crashes found on most types of police patrols.
Motor vehicle insurance	N	• Stringent laws requiring liability insurance appear to have led to increase in road crash numbers. • Introduction of no-fault insurance and lower compensation limits also appear to lead to more road crashes.

		• Policyholders who have collision insurance have the same claims frequency as policyholders who do not have this kind of insurance. • Paying accrued bonuses in cash (reverse bonus system) has been found to be associated with a reduction of about 22% in crashes.

Automated Traffic Enforcement through Safety Cameras

155. One of the most effective investment programs that can be done is through the establishment of automated traffic enforcement through safety cameras which enforce speed limits ('speed cameras') and compliance with traffic signals ('red light cameras'). They automatically detect traffic violations and identify the vehicle. Identification is based on photographs of the vehicle (and sometimes the driver), usually from the front, but sometimes from the rear. **Point-to-point speed enforcement,** which involves the installation of a series of cameras at multiple locations along a section of the road network, is very effective[104] and generally viewed more positively by motorists than point speed cameras: acceptance is reported above 70% in most jurisdictions (Lee, 2007[105]; Crawford, 2009[106] and Schwab, 2006[107]).

Figure A9.1: Safety Camera in Italy

156. Safety cameras are best used as part of a general deterrence approach to road safety (i.e. increasing the overall level of compliance) where motorists recognize the risk of enforcement at any time, while also being useful as a specific deterrence at locations with known traffic and road safety risks. Safety camera enforcement is most appropriate if crashes are clearly concentrated on specific road sections and are related to excess speed, or intersections and are related to running of red lights.

157. **Effectiveness of Automated Traffic Enforcement:** Several studies have shown that automatic speed enforcement has an average benefit cost ratio of 2.5. By comparison, a recent study (Lynch, 2010)[108] estimated the cost benefit ratio of point-to-point speed enforcement between 7.4 and 12.5. A study by Elvik (2007) found FSI reductions as high as 39% through automated speed enforcement. For red light cameras, they have been found to significantly reduce the crashes due to red light running— for example by 63% in Auckland New Zealand[109]. At the same time, there can be an increase in minor 'rear end' crashes where following vehicles had anticipated the preceding vehicle to run the light.

158. For automated enforcement to succeed, the violator needs to be promptly notified of a violation, and there needs to be a mechanism for enforcement. It is good to view the entire automated traffic enforcement process as **a chain** with various separate and interdependent links, i.e. detect; measure; decide on violation; register; transfer; store evidence; process evidence, issue and send ticket; receipt of ticket by violator; provide evidence upon violator's request; collect fine; remind violating party and court

[104] Reductions in road crash fatality and injuries between 33 – 85% according to studies carried out in Italy, Austria, UK and Netherlands.
[105] Lee, S. (2007). Study on the Introduction of Speed Enforcement System Using Point-to-point Speed Measurement. Not in English.
[106] Crawford, E. (2009). Beyond 2010 - A Holistic Approach to Road Safety in Great Britain. London: Parliamentary Advisory Council for Transport Safety.
[107] Schwab, N. (2006). For a better safety and traffic flow optimisation during peak periods: Speed control experimentation on the A7 motorway. France: Autoroutes du Sud de la France.
[108] Lynch, M. (2010). Forward Design Study: Introduction of Point to Point Speed Cameras in the ACT. Canberra: AECOM Australia.
[109] Auckland Transport. July 2011. Auckland Red Light Camera Project, Final Evaluation Report. Auckland, New Zealand.

process if the violator decides to challenge it.[110] **Unless the entire process is viable and efficient, automatic traffic enforcement should not be considered.** The GRSF are currently developing a tool together with the Global Road Safety Partnership (GRSP) to assess country readiness for automated enforcement. This is anticipated to be released in 2020.

159. **Automatic traffic enforcement should not be used as a revenue-raising activity**. This blurs the line for the public as to whether governments use the device for safety or for fiscal reasons and may harden attitudes towards their use. As an example of how to counter this, Swedish authorities only activate speed safety camera enforcement for about 10% of the time even though the radar-based speed measuring system works continuously. This enables the Swedish Transport Administration to monitor actual vehicle speeds without drivers feeling they will be penalized for every minor speed violation. They ensure that cameras are positioned where they are required, and not only on major roads just because vehicles travel at higher speeds to identify where there are problems on the road[111].

160. Some people view the introduction of automated enforcement cameras as a violation of their civil liberties. Legal issues, such as whether the owner or the driver of a vehicle is responsible for the speeding violation, also arise. The arguments for and against speed safety cameras have been highlighted in British Columbia, Canada when the trial by (Chen 2000)[112] concluded that the introduction of cameras had reduced speeding, with a corresponding decrease in crashes, injuries and fatalities. Nevertheless, in June 2001, the speed safety camera program was discarded by the incoming government. However, most countries that have introduced automated safety cameras have tended to expand their use over time. This is particularly noticeable within the United Kingdom and Australia.

Figure A9.2: New Zealand Red Light Awareness Poster

161. **Logistical Requirements:** In line with this some considerations that need to be made before introduction of automated traffic enforcement tools as stated by the WHO Speed Management Manual, 2008 are:

- Availability of funds for purchasing necessary equipment/resources;
- Willingness of the police force to be trained to use the equipment;
- Upgrading capability of the infringement processing system to process camera infringements quickly and efficiently;
- Political and community support for automated traffic enforcement;
- Possibility of supplementing fixed cameras with mobile patrols and other strategies to ensure compliance across the whole of the network;

[110] Wijers P. (2017). The Automated Enforcement Chain, Making Traffic Safer. https://making-traffic-safer.com/automated-enforcement-chain/

[111] Media article: Sweden winning over doubters http://www.itsinternational.com/categories/enforcement/features/sweden-winning-over-doubters/

[112] Chen G, Wilson J, Meckle W, Cooper P. Evaluation of photo radar in British Columbia. Accident Analysis and Prevention 2000.

- Existence of accurate and readily accessible data systems for licensing and vehicle registration;
- Sufficiency of legislation that can be put in place to assure successful prosecutions; and,
- Owner onus or other supporting legislation/technology to identify and track the drivers of the violating vehicles.

The study by Malin (2009) on the successful implementation of automated traffic enforcement in Finland concluded that these considerations are key in selecting automatic enforcement sites:

- There is an external cause for enforcement at the site such as a pedestrian crossing or a lot of pedestrians;
- It is not appropriate to improve traffic safety at the site with other measures such as structural interventions;
- The site is heavily trafficked, but enforcement is still technically feasible;
- The camera equipment's installation and maintenance work can be done safely; and.
- The flash of the camera equipment does not disturb the nearby housing.

ANNEX 10: Post Crash Care

Why does Post-Crash Care Matter?

162. The manner, in which injuries resulting from road traffic crashes are handled immediately after the incident occurs, determines the injured 's chances and quality of survival. In many countries, few victims receive treatment at the scene, and fewer still can hope to be transported to the hospital in an ambulance, let alone one staffed by trained paramedics. First response and transport, when available, is usually provided by relatives, untrained bystanders, taxi drivers or truck drivers, or a police officer. As a result, many victims may needlessly die at the scene or during the first few hours following the injury. Although around half of all road traffic deaths occur almost immediately at the scene of the crash, the outcome for the survivors at the crash site could be affected by the quality of the medical care that they receive.

163. Deaths due to severe injury from road traffic crashes occur in one of three phases:

- immediately or quickly: death occur due to overwhelming injury;
- during the intermediate or sub-acute phase: deaths occur within several hours of the event and are frequently the result of treatable conditions; or,
- delayed: deaths during this phase often occur days or weeks after the initial injury and are the result of infection, multi-system failure or other late complications of trauma.

164. The key elements of post-crash support are: (i) emergency care and rehabilitation for injury; (ii) mental health care; (iii) legal support; and, (iv) data on crashes and injuries. These are divided into three phases: (i) at the scene; (ii) at the treatment facility; and, (iii) post-treatment facility follow-up. The full consideration of post-crash support thus calls for a multi-sector response including the Health Global Practice.

The Golden Hour

165. A key concept in post-crash care is 'the Golden Hour'. This is universally defined as the: 'period lasting for one hour, or less, following traumatic injury being sustained by a casualty, during which there is the highest likelihood that prompt medical treatment will prevent death.' The Golden Hour essentially comprises a chain and sequence of events, namely:

- Response and scene assessment;
- Emergency casualty care;
- Disentanglement and Extrication;
- Transportation;
- Emergency room stabilization; and
- Surgical intervention.

166. The outcome of critical trauma patients not receiving treatment during the Golden Hour is often at best permanent disability, or more commonly death. This is because most deaths in the first hours after

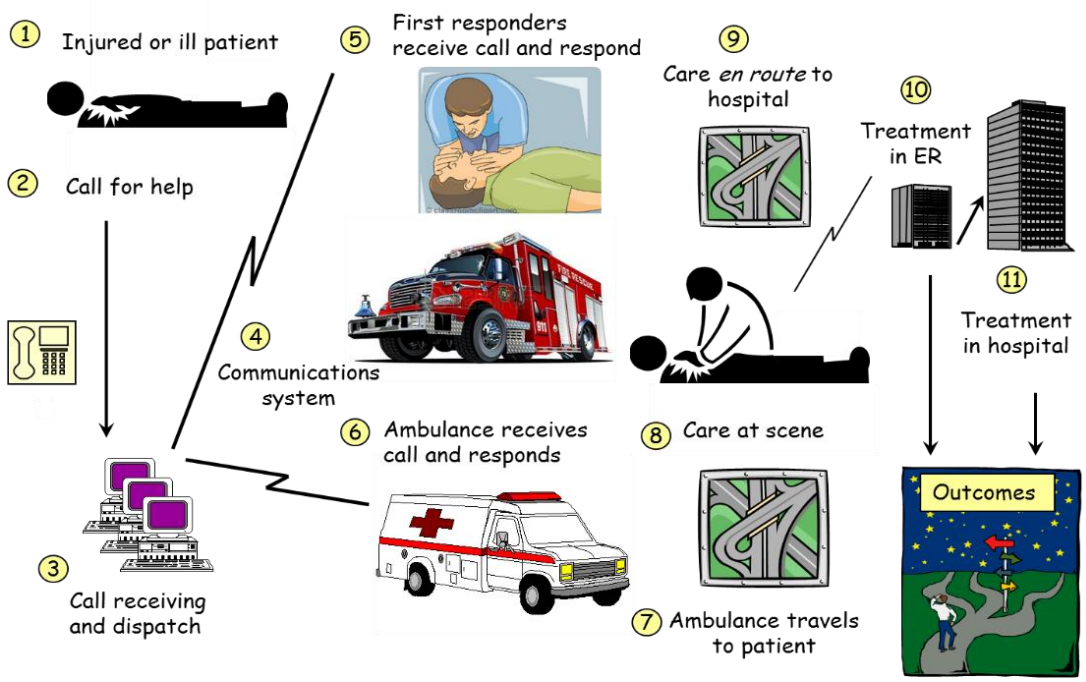
injury result from: (i) heart failure; (ii) respiratory failure; or, (iii) massive bleeding. Few of these three conditions can be treated using first aid measures.

Emergency Medical Services (EMS)

167. The provision of effective Emergency Medical Services (EMS) is a key component of post-crash care. Timely action in response to injuries and medical emergencies and injury is an essential health service. In developing countries, trauma and medical emergencies account for significant morbidity and mortality. However, efforts to improve comprehensive emergency systems globally have not achieved much attention. Currently, many national health systems are oriented to specific diseases rather than cross-cutting 'systems' interventions that might have a larger long-term effect by strengthening system wide capacity. EMS systems could potentially address 54 percent, or 24.3 million, of the approximately 45 million deaths in Low Middle Income Countries each year. This loss translates into 1,023 million Disability-Adjusted Life Years, or 932 million Years of Lives Lost to premature mortality, or 91.4 million years lived with disability.

168. To attain its objectives, EMS requires an effective communication between the various parts of the system throughout the episode of care (see Figure A10.1). It is important to highlight that effective communication and dispatch systems are critical to EMS functions and activities. These two aspects transversally link up all EMS provision stages.

Figure A10.1: Emergency Medical Care System Elements and Process



Source: Dominic S. Haazen, Lead Health Policy Specialist, HNP Global Practice

First Response

169. Most deaths that occur in the first hours after injury can be treated by basic first aid measures. This basic level of prehospital trauma care is provided by ***First Responders.*** These are people trained (formally or

voluntarily) to render basic emergency care and first to arrive on a crash scene. Any member of the public, i.e. community members, taxi, bus or truck drivers, traffic police, students or workers who recognize an emergency, should be able to call for help and provide basic treatment until more formally trained rescuers arrive.

Box A10.1: Case Study—Improving Emergency Response in Malawi

While much of the World Bank's road safety work aims to make traffic crashes less frequent and less severe, crashes do happen. How quickly and efficiently emergency teams can help victims is at the core of a pilot project in Malawi through the Southern Africa Trade and Transport Facilitation Program.

In Malawi, the pilot serves a 300 kilometer stretch of the M1, also known as the North-South Corridor, between Blantyre and Lilongwe. The objective of the pilot is to build strong emergency response and trauma care along the M1, then test it and scale it up for the rest of the country and, other countries in the region. It includes community first responders, rescue services, pre-hospital EMS and hospital emergency receiving areas. There are 6 sites participating in the pilot: 2 central hospitals (Kamuzu Central and Queen Elizabeth Central), 3 district hospitals (Dedza, Ntcheu, and Balaka), and 1 community rural hospital (CRH Risungwe).

In 2018 the training of 443 community first responders and 45 ambulance drivers was completed, and training of 90 EMS providers commenced. The procurement processes for medical equipment and refurbishment of trauma care facilities started, along with the procurement of 12 ambulances.

Pre-Hospital Trauma Care (Basic Life Support)

170. Many fatal injuries may be prevented, or their severity reduced by adequate prehospital trauma care. This more advanced level of care is provided by others trained in basic ***Pre-Hospital Trauma Care*** or **Basic Life Support**. These people have extensive formal training in prehospital care, scene management, rescue, stabilization and transport of the injured. They are familiar with measures for preventing deaths in this phase such as proper wound and burn care, adequate immobilization of fractures, support of oxygenation and blood pressure during the first hours after a traumatic brain injury, and other measures that reduce the likelihood of complications developing later.

171. The major benefits of prehospital care are realized during the second phase of trauma when the timely provision of care can limit or halt the cascade of events that otherwise quickly lead to death or lifelong disability. Without prehospital care, many people who might otherwise survive their injuries may die at the scene or in-route to hospital.

172. Ensuring that an injured person is taken as soon as possible to a hospital with the right equipment and personnel to provide the needed care is crucial. Many seriously injured people are seen in and then transferred from lower-level clinics and hospitals to a facility equipped and able to provide the level of care needed. This delay causes the loss of critical time, which may result in worse outcomes and avoidable deaths. Clear protocols direct prehospital providers to take seriously injured persons directly to these higher-level facilities for treatment, while those with minor injuries may be treated at closer, lower-level facilities. Matching injury severity to facilities allows for an effective use of limited resources, reduces delays in life-saving treatments, and has been shown to improve patient outcomes overall.

Triage

173. Triage is the process of classifying patients according to injury severity to determine the urgency of care. (Triage is typically rated as minor, immediate, delayed and deceased). Careful triage is needed to ensure

that available community resources are appropriately matched to the needs of each victim. For example, regional hospitals (able to provide higher levels of care) can be overwhelmed if too many patients regularly bypass a local clinic. Alternatively, if severely ill or injured patients are seen at local clinics instead of being promptly stabilized and transferred to regional hospitals, needless deaths will result. When the nearest hospital is more than a day's travel away from a crash location, victims with devastating injuries (and their families) might be better and more compassionately served by palliative care at the local level, instead of being subjected to the discomfort and rigors of a transfer that may not be survivable.

In-Facility Injury Care

174. Effective emergency care at a hospital requires a dedicated emergency area or unit, a core of non-rotating medical staff assigned to the unit. These people should be trained in the care of injuries, protocols, and checklists to ensure that a systematic approach to every injured patient, and essential equipment for diagnosis and treatment of injuries. Operative care is an essential part of emergency care for injuries, and any facility that is certified to care for the seriously injured should have 24-hour access to surgical, anesthesia and critical care services.

175. One aspect of importance to in-facility injury care—although it applies to pre-hospital care and transport as well—concerns the payment for services, and potential negative consequences if patients are turned away because they cannot pay. Countries are increasingly prioritizing Universal Health Coverage (or UHC, currently a goal in 193 countries); and it is therefore important to include emergency care for trauma from road traffic crashes in the 'Basic Benefit Package', which should be available to everyone. Issues of ability to pay and financial sustainability therefore need to be explicitly addressed as part of scale-up and sustainability plans when moving from pilot interventions to national scale for post-crash care interventions. Moreover, in terms of sustainability, it makes sense to focus on developing a comprehensive emergency care service, which handles not just vehicular trauma, but also other trauma as well as medical and obstetrical emergencies. This will allow wider coverage to be maintained, resulting in faster response times and improved readiness of emergency care staff. Since in mature EMS systems, trauma calls represent 10-20 percent of the total call volume, it is not cost-effective to develop a post-crash response system in isolation from other emergency needs.

Project Opportunities to Improve EMS Services

176. As noted above, EMS systems consist of elements designed to provide early and effective treatment to victims of injuries, acute medical emergencies or serious obstetrical conditions (both in and out of hospital). EMS entail: (i) securing the scene and extracting the injured; (ii) providing initial first aid by lay first responders; (iii) providing life-sustaining or life-saving care and transport by trained medical or paramedical prior to arrival at the hospital; (iv) providing definitive care in a hospital environment. Table A10.1 summarizes potential project activities to improve EMS services.

Table A10.1: Potential Activities for Improving EMS Services

Activities	Potential Sub-Activities	Key Considerations
Coordination of EMS activities and planning	• Establish a National Multi-Stakeholder Steering Committee for Pre-Hospital (EMS) Emergency Medical Services – Meeting Regularly at National level • Establish Emergency Committees at District Level- Meeting Regularly at District level • Ensure delivery of all necessary supplies.	For effective coordination of the project, there is need to have a National Multi-Stakeholder (stakeholders from different organizations who are involved with emergencies/trauma) Steering Committee to guide implementation of the project.

Develop pre-hospital EMS	• Procurement of well-equipped ambulances and ensure their availability to crash victims.
	• Respond rapidly to all emergency cases of trauma by the EMS ambulance teams.
	• Procure Medical consumables for ambulance medical services
	• Recruit and training of EMS Paramedical Staff to cover ambulances 24/7.
	  ○ Train staff in Pre-hospital Emergency Care (perhaps starting with existing medical staff such as nurses and Clinical Officers;
	  ○ Orient ambulances drivers in basic first aid and emergency driving.
	• Train Community First Responders
	• Study tour on Emergency Medical Services to another country (benchmark/study what other countries are doing)
		• The ambulances to be providing EMS will need to be ready always and equipped with medical consumables such as intravenous fluids, giving sets and cannulas for effective management of victims in transit to health facilities. The ambulances will also need accessory equipment to assist in the rescue of victims affected in crashes.
		• Drivers are very crucial to transporting victims of accidents to hospitals. They need to have basic knowledge of first aid and how to prevent themselves from blood-borne diseases and handling of patients. It is therefore important to give them an orientation on handling issues around emergencies.
		• Provision of pre-hospital care that meets the needs of the community will need the engagement of the community, a particularly key stakeholder is the medical community receiving and assisting patients involved in crash and emergency.

Develop effective communication systems for EMS	• Establishing and maintaining a short-code/toll-free number. • Procure Radio Frequency Telephones. • Establish Dispatch Center(s) for Ambulances. • Training of Dispatchers. • Raising public awareness on the appropriate use of the toll-free number Promote the use of the EMS number.	Communications is critical to all emergency service functions and activities. There is need to have a center for reception of all emergency calls and sending appropriate information to the ambulances. The center to be covered by a trained dispatcher 24/7 to be able to respond and address emergencies.
Improve emergency departments at central and district hospitals	• Renovate and Improve Trauma Facility Infrastructure in Central Hospitals, District hospitals and Rural Community Health centers. • Strengthen existing facilities with capacity by refreshing staff in Advanced Trauma Life support. • Procure Equipment for trauma facilities. • Procure consumables of laboratory equipment at trauma facilities.	The trauma units in the health facilities to provide Emergency Medical Services lack appropriate equipment for the treatment and investigation of patients involved in trauma. Sometimes, the equipment might be there but lacking the necessary reagents to run such equipment. This activity will include purchase of essential equipment and reagents for the facilities.

	• Secure Contract service agreements for equipment. • Develop minimum Standards for hospital trauma units.	
Monitoring and Evaluation of EMS, including research	• Development of standard M & E tools. • Improve data collection and utilization. • Evaluate the implementation of National EMS Plan. • Conduct general supportive supervision. • Analysis of trauma research gap specifically RTAs. • Conduct research around trauma.	• Appropriate planning needs to be guided by data. It is necessary to develop tools and data collection instruments for monitoring trauma activities. Therefore, every facility doing trauma activities need to have health facility-based trauma registries. • Research is a very powerful tool to inform decision and policy.
Carry out studies to assess potential financing options to ensure the EMS System's sustainability		

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