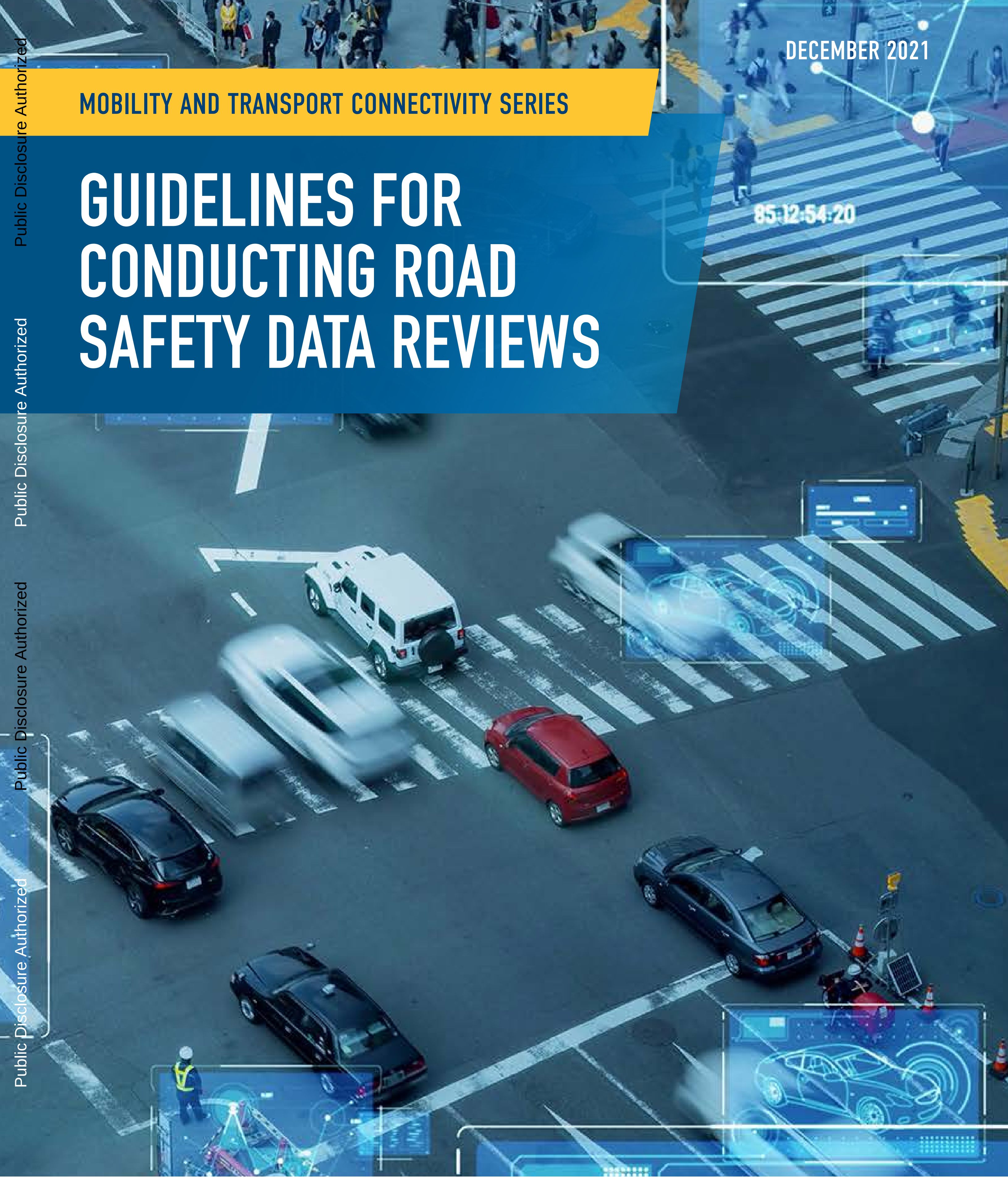

MOBILITY AND TRANSPORT CONNECTIVITY SERIES

DECEMBER 2021

GUIDELINES FOR CONDUCTING ROAD SAFETY DATA REVIEWS

WORLD BANK GROUP
GRSF Global Road Safety Facility
International Transport Forum
UKaid from the British people

MOBILITY AND TRANSPORT CONNECTIVITY IS A SERIES PRODUCED BY THE TRANSPORT GLOBAL PRACTICE OF THE WORLD BANK. THE WORKS IN THIS SERIES GATHER EVIDENCE AND PROMOTE INNOVATION AND GOOD PRACTICES RELATING TO THE DEVELOPMENT CHALLENGES ADDRESSED IN TRANSPORT OPERATIONS AND ANALYTICAL AND ADVISORY SERVICES.

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Acknowledgments

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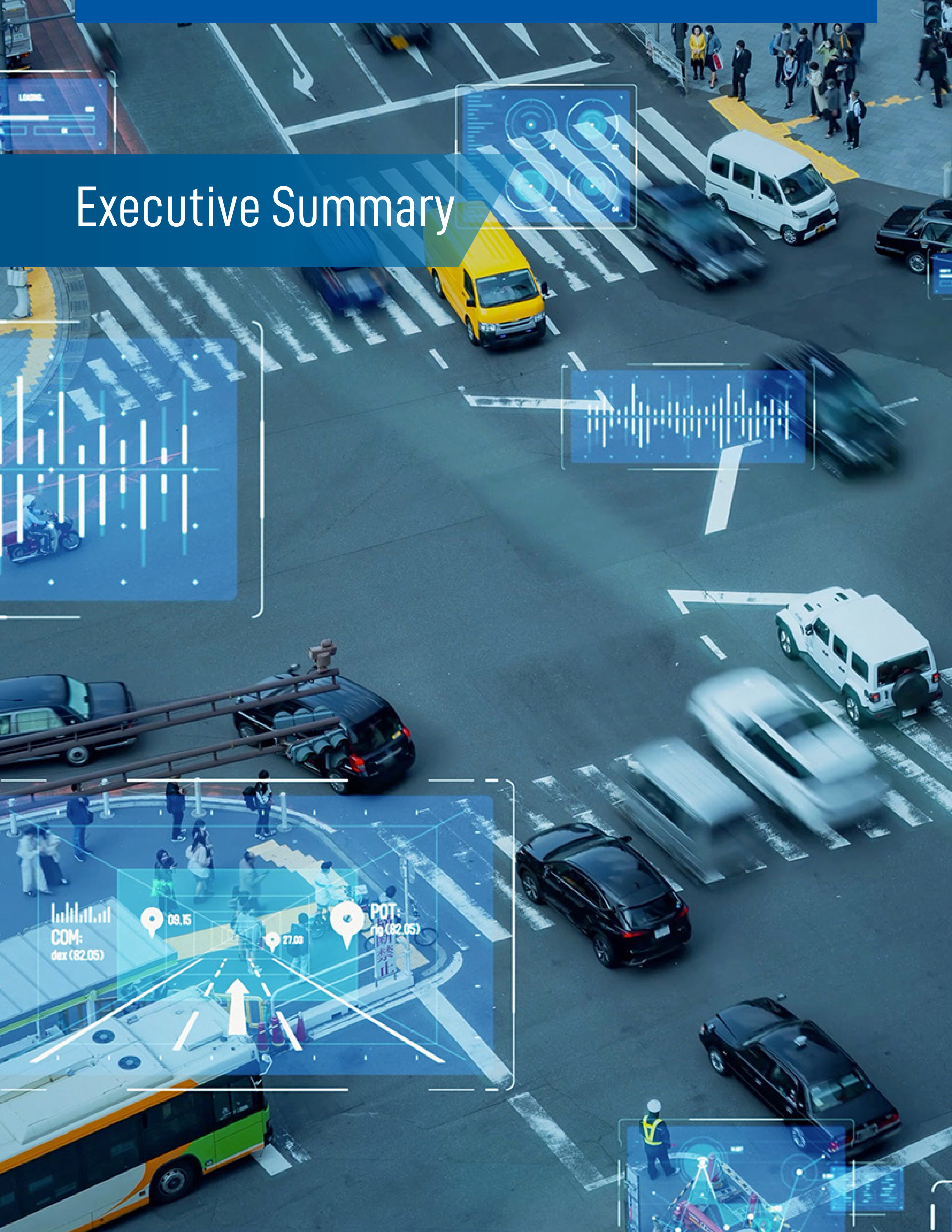
Executive Summary



Accurate road safety data are needed to understand road safety challenges in a country, design effective road safety policies, set appropriate targets, and monitor progress. However, many countries are still in the infancy of accurate data collection, analysis, and use (including related crash data systems), and not necessarily aware of weaknesses in their system, which could prevent them from making sound analysis of their road safety problems.

Effective road safety management requires a broad range of data, such as outcome data (observed crashes and injuries), data on the safety performance of the road-traffic system, and data on interventions to improve road safety. For greater impact, these data need to be combined with other traffic data, such as distances traveled and the split between different transport modalities; this approach could be used to identify road safety problems and inform policies and strategies to address them.

As an example, for some countries, an important gap exists between official road death statistics and estimates by the World Health Organization (WHO), an issue that has been thoroughly debated in various forums, especially in regional road safety observatories. Under-reporting and misreporting are due to a variety of reasons. Regional road safety observatories, for example in Latin America, Africa, Europe, and Asia-Pacific, are trying to address this gap and have been generating much-needed interest in the importance of good crash data systems. Several countries have already expressed interest in benefiting from the support of the international community to review and enhance their existing road safety data systems.

One way to help countries in understanding possible sources of under-reporting and misreporting, and therefore improve their road safety management, is to conduct a review of their road safety data. The scope of this review would be to identify weaknesses (and also strengths) of their current process and propose possible measures for improvement. An efficient way to conduct this review, as experienced by the World Bank and the International Road Traffic Data and Analysis Group (IRTAD), a permanent working group within the International Transport Forum (ITF), is to visit a country, meet with the people involved at different stages in the process of road safety data collection, analysis, and use, and assess the efficiency and effectiveness of road safety data management.

Following a step-by-step process, the current guidelines aim to support road safety data experts undertaking in-country data reviews. This common methodology will help reviewers prepare for their visit, structure their interviews and observations, and report on findings and recommendations for improvements. At the same time, these guidelines will help harmonize road safety data reviews across countries and regions, and the results of these in-country reviews will support the work of regional road safety observatories.

1. Introduction: Background and Objectives

In many countries around the world, deficiencies in data or data quality impair evidence-based road safety policy making. While many countries collect road safety data, the collection is not necessarily comprehensive. Further, many countries could be unaware of data gaps in their system, which prevents them from soundly analyzing their road safety problems. Therefore, road safety data definitions and collection methods must converge into standard international criteria, thus allowing for comparisons in space—across countries—and in time. This is the raison d'être of regional road safety observatories, which have been developed, for example, in Latin America (OISEVI), Africa (ARSO), and Asia-Pacific (APRSO). They present an opportunity for joint regional efforts to improve, in a harmonized way, road safety data collection and analysis. Regional road safety observatories promote the adoption of a common set of road safety indicators based on common definitions and serve as an avenue to assist countries in improving the management of their crash data systems.

Road safety data are not just about crash data (or outcome data—the observed crashes and injuries), but also about the safety performance of the road traffic system, and about interventions to improve road safety. These data are best used when combined with other information, such as traffic volumes and distances traveled, or split between different transport modalities. For an evidence-based approach to the management of road safety, these data can be used by policy makers, traffic engineers, police, the health sector, the research community, insurance companies, prosecutors, vehicle manufacturers, and others.

One way to help raise the quality of the most essential data and create awareness among policy makers on the importance of including core road safety indicators is to undertake a road safety data review. Such reviews are typically conducted during a visit to the country by a team of independent road safety data experts. The team should have an excellent knowledge of road safety data and offer sound perspectives on international good practice. Review teams should also have a solid understanding of the local context, which often leads to heterogenous teams with a mix of local and international experts.

The following guidelines are designed to support reviewers in the assessment of road safety data collection; the complete range of safety data should be considered. This task can be complicated because collection of road safety data is often not achieved by activities dedicated to this purpose, but rather through piggybacks on other sources. For example, activity reports from police or hospitals are used to provide material for legal or medical purposes. The routines involved frequently have a long history in which gathering reliable and complete statistics has had secondary priority, at best. The various actors involved reflect the complex structure of a country's judicial and executive system, which, generally, are not coordinated. Consequently, any review of the data collection process requires some "detective work."

The guidelines shared in this report address various aspects of the whole data collection process, such as road crash investigations, reporting and registration, checking completeness and consistency, storage, and accessibility—as well as analysis and use. By considering the experience from earlier data-review missions, the guidelines indicate typical problems for each of these aspects, along with examples and questions useful to the review team visiting a country. This guide briefly summarizes the importance of road safety data and the international standards for the most important indicators and describes typical problems in their application. Consequently, the guidelines can also be of wider general interest and serve as a useful self-evaluation tool for road observatories.

The guidelines will help harmonize road safety data reviews. Apart from questions to ask and potential problems to investigate, they suggest how to describe the strengths and weaknesses of current processes and how to formulate recommendations with respect to organization, methods, training, and communication. While much of this information is available in other documents, these guidelines present in a compact document the information most important to consider in a data review, and are intended to help the review team develop its analysis. More concretely, the guidelines describe the necessary preparations of both the reviewer and the country under review. They suggest people and organizations to meet during the visit and the preparation of questions based on the materials provided by the country. The guidelines address various aspects of the entire data collection process, such as crash investigations, reporting and registration, checking completeness and consistency, storage, and accessibility.

A data review should consider three main activities, namely

a. preparatory activities, such as conducting research and developing preliminary assessments;

b. conducting interviews; and

c. drafting the report.

The next chapter opens with a general description of road safety data, its role in decision making, and other important aspects worth considering.

2. Road Safety Data

Road safety data are important for evidence-based decision making. This chapter sets a foundation by explaining why road safety data are important. In addition, international standards and issues to consider for different types of road safety data are discussed. In particular, crash and casualty data, mobility data, safety performance indicators, and intervention indicators are addressed.

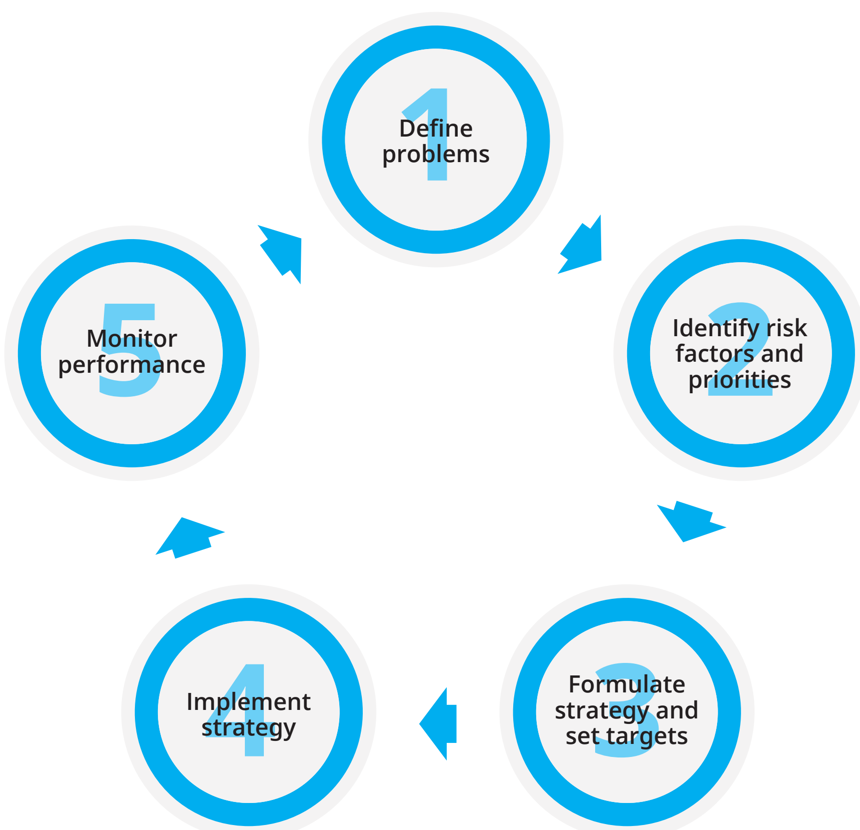
An evidence-based approach to road safety management starts with the definition of the problem: risk factors must be identified and prioritized for treatment. On this basis, the actions and targets need to be defined during the initial stage of the diagnostic.

The implementation of the countermeasures must be monitored and their impacts evaluated. The process is then repeated in a cyclical way, as shown in figure 2.1 (WHO 2010; PIARC 2019; ITF 2016).

To better understand risks and assist in the monitoring of progress in road safety, crash data are important, but alone are not enough; they must be combined with other types of data.

When setting priorities, the number of casualties must relate to the share of this group in traffic. As an example, to address pedestrian casualties it is important to know whether the numbers are high because many people walk, or because walking is

Figure 2.1. Policy-Making Cycle for Road Safety



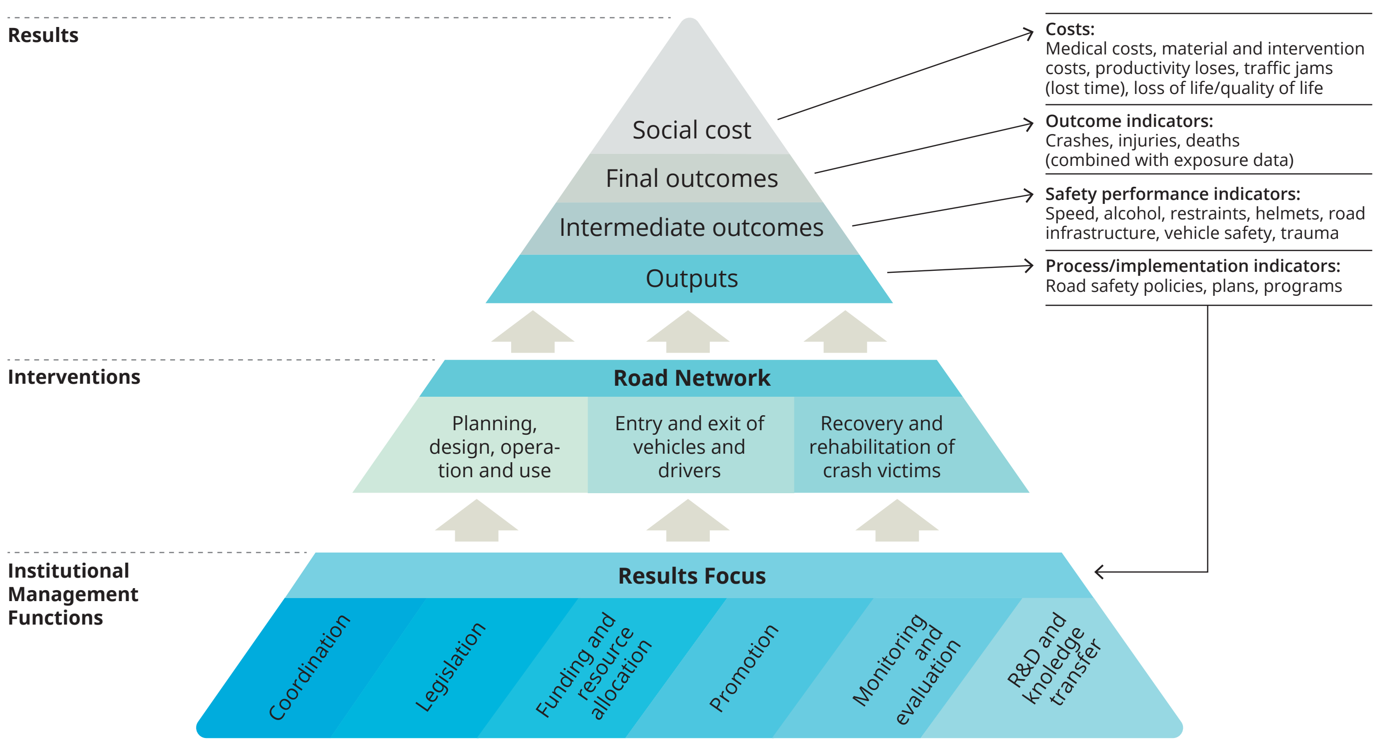
Source: Adapted from WHO 2010.

particularly unsafe (or both). For this, one needs exposure data specifically on the number of users per travel mode. Moreover, it is important to distinguish between modifiable and nonmodifiable risk factors. As an example, the age-structure of a country's population cannot be changed. So, statistics on these issues are most useful if they also indicate specific group concerns that can be modified (for example, statistics might look at the share of crashes involving children crossing the road).

Risk factors should be selected for treatment if they are modifiable. For example, the population structure is given, and road safety policy should focus on the most promising aspects to change, such as the usage of seat belts or the layout of roads.

If a modifiable risk factor has been selected for treatment, it should be measured. These road safety measurements are known as road safety performance indicators (SPIs) and examples include the proportion of car occupants who do (not) wear a seatbelt or the proportion of drivers who drive sober. For target-setting and monitoring it is often better to consider the SPI addressed directly rather than evaluating the number of casualties related to it. This is especially important if the risk factor cannot be reliably identified in the crash data (for instance, whether the seatbelt was worn). Note, however, that SPIs are only valid tools if their link with the desired outcome (that is, reducing casualties) has been previously proven. Figure 2.2 provides a summary of all road safety data types and how they are linked to effective road safety management (PIARC 2019).

Figure 2.2. Overview of Road Safety Data and Their Function for Evidence-Based Management



Source: PIARC 2019.

The desired results or outcomes of road safety management should be expressed as goals and targets at different levels of the data pyramid: (a) Interventions that have been implemented; (b) intermediate outcomes; and (c) final outcomes. Moreover, contextual data, such as the road network and the volume and type of traffic, are important for prioritization. These latter factors do not only inform policy making, but could also be addressed by it—such as a policy on accessible and safe cycling and pedestrian infrastructure to influence shifts from cars to more sustainable modes of transport.

As an example, for this process, a program to address the injury risk of motorcyclists and increase the usage of helmets would be evaluated in terms of numbers of motorcyclists checked (program output: interventions), percentage of motorcyclists with helmets (SPI, intermediate outcome), the severity of motorcycle crashes (final outcome), and (if possible) the percentage of motorcycle casualties who did and did not wear their helmet. The size of the motorcycle fleet would be included in an analysis to correct for other trends (for example, an increase in motorcycle traffic). For more background information on road safety data and their use to reduce road traffic casualties, see for example, Papadimitriou and Yannis (2018) and Wegman (2016).

Note, however, the **cost to information**. All recommendations should consider the specific data points actually needed to take decisions. Only those data that will change decisions are worth the investment in data collection. A huge amount of knowledge about road safety interventions can be formulated and implemented without gathering any new data. The focus should be on **using the available data—** even if they are not perfect. The recommendations for collecting new data should be based on careful consideration of the benefits as well as associated costs.

Road safety data include outcome data (the recorded crashes and injuries), data on the safety performance of the road-traffic system, and data on interventions to improve road safety (see figure 2.2). To interpret crash data, traffic and other contextual data are also important. In a good management system, these data are used to analyze risks, plan interventions, evaluate efficacy, and guide development by setting targets for outcome and performance indicators in monitoring their progress. To allow for this, not only is the quality of the data important, but also their accessibility and use. All these aspects should be addressed in a data review.

Road safety data do not only exist at the local and national levels, but also at the regional and global levels, including those from regional road safety observatories. A major aim of regional observatories is to address issues on data by assessing how national statistics and database information on road crashes can be improved by reporting better quality information. This, in turn, facilitates more appropriate solutions and results in better cross-country comparative data between countries. Looking at the outputs then of regional observatories can also guide and further contextualize the data review.

The remainder of this chapter lists different types of road safety data and discusses international best practices and minimum standards for each type.

2.1. Crash and Casualty Data

Crash and casualty data should give the full picture of road risk. Crucially, completeness depends on the notification of crashes occurring, the capacity to attend the crash scenes, and the registration and transmission of data. Usability of the data also depends on the variables registered, correct registration of the crash location, storage, and accessibility as well as linking different data sources to check for completeness and augment the data. Data on the most severe crashes (fatal and serious injury) are the most important.

The count of road traffic crashes and their casualties should include every crash of the specific severity being captured (for instance, all fatal crashes or all injury crashes). Whether the crash is reported should not depend on the types of road users involved, or where and when the crash took place.

Data collection should be prioritized according to the severity of the crashes. Data on fatal crashes have the highest priority, followed by data on severe injuries. Data on minor crashes or property damage only crashes—while important—have lower priority.

To be in line with international definitions, fatalities should include deaths up to 30 days after the crash. Severe injuries are typically defined as resulting in a hospital stay of 24 hours or more (see Azzouzi 2019; CARE Team 2018, 133). Slight injuries are defined as those needing medical treatment (Eurostat, ITF, and UNECE 2019). This also requires coordination among government agencies, particularly of the police and the health department, to standardize definitions and forms, update crash data with injury data, and possibly even integrate the health database with the crash database.

The data should be complete, of good quality, and collected uniformly throughout the country. The following aspects should be considered to ensure this is the case.

COMPLETENESS AND NOTIFICATION

In many countries not all crashes are reported. This is particularly problematic if some types of crashes are much less likely to be reported than others, because it creates a skewed picture of the situation. A typical example concerns crashes with no motor vehicle involved. For instance, a study on hospitalized cyclists in 17 countries showed less than one-third of cyclists crashed with a motor vehicle and among the others (cyclists who fell, hit an object, crashed with another cyclist or with a pedestrian) less than 20 percent reported their crashes to the police (Shinar et al. 2018). Often insurance payments are the main reason to report crashes to the police; crashes where no payment can be collected would be reported less often. Additionally, citizens who lack trust in the police are more likely not to file reports. In addition, the lack of staffing and resources can also impede police and emergency response, especially in rural or far-flung areas. To investigate possible sources of under-reporting, it is important to know how the police are notified of crashes and if some crashes are typically not reported to them. Furthermore, in certain contexts, culture, and social customs influence the reporting of crashes—specifically of crash fatalities. In Vietnam, for example, a person who is about to pass away is usually brought home from the hospital. This, in turn, prevents hospitals from recording complete fatality data. Alongside internal checks, the numbers should be compared to other sources to ensure completeness.

UNIFORMITY

Often, death and injury registration are not recorded by the same institution. In such cases, hospitals, police, and the civil registry are the usual actors. These different actors must coordinate with each other to standardize and align data reporting requirements and data sharing arrangements to validate respective agency data. This does not only concern different types of institutions (hospitals and police, for instance), but also different levels and entities within the same institution. For example, some countries have different police units for different administrative or jurisdictional regions of the country. In other instances, the police from the local, regional, and national levels will not be able to store and share their data in a single repository. The recording systems of different entities should be sufficiently similar. All institutions should apply the same definitions related to crash injuries.

ATTENDANCE AT THE CRASH SCENE

To give a complete picture of road crashes in a country, the police should ideally attend every crash scene—at least for crashes resulting in serious or fatal injuries. This should apply even to challenging situations (for example, remote areas, night-time, or multiple crashes happening at the same time). Otherwise, crash types somehow difficult to attend to are structurally under-reported. Officers must have enough time at the scene and have the technical means—such as sketching the scene, using an alcometer to measure blood alcohol levels, among other factors—to document the crash thoroughly and register all variables in the crash report form.

Ideally, causation and aggravation factors should be recorded, such as speeding, driving under the influence, seatbelt use, and other violations. Importantly, the review should investigate whether the police in fact have the requisite tools and resources for identifying such factors.

The severity of the victims' injuries should be reported. Officers at the scene can use several techniques to determine injury severity. One of these is to give subjective assessment, but this does not necessarily agree with the medical diagnosis. The initial assessment of the officer at the scene should therefore be updated later based on medical records. These updates, however, do not always happen. Special attention should be paid to victims who die in hospital. Their inclusion in the fatality count must be ensured.

In some countries the police do not investigate all crashes. Where possible these events should still be documented, together with recorded information about any crash characteristics, and how that information was gathered.

VARIABLES REPORTED

In addition to the data police collect for prosecution purposes, a minimal set of data must be collected that gives information about the location, the infrastructure, road users, and vehicles involved as well as variables characterizing the maneuvers and the consequences of the crash. The African Road Safety Observatory (ARSO) has adopted a set of variables derived from the common Accident Data Set (CADaS) of the European Commission (Azzouzi 2019; CARE Team 2018). In its minimal form (miniCADaS), the protocol indicates a set of 28 variables that should be recorded for every crash (see table 2.1). For information about the possible values that should be foreseen for these variables, see for example CARE Team (2018).

Table 2.1. Minimum Set of Crash Variables

Crash	Traffic unit	Person
Crash ID		Person ID
Date	Traffic unit type (e.g., pedestrian, cyclist, passenger car)	Date of birth
Time	Special function of vehicle	Gender
Weather conditions	Registration year	Road user type (pedestrian, driver, passenger)
Lighting conditions (daylight, dark, with/without lighting, dusk/dawn)	Country of registration (e.g., foreign, national)	Injury severity (slight, more than 24 hours in hospital, fatal)
Crash type (e.g., with pedestrian, single, two vehicles turning, two vehicles NO turning)	Vehicle maneuver (e.g., turning, overtaking, etc.)	Alcohol test (not tested, not applicable, positive, negative, unknown)
Location: X coordinate (latitude) and Y coordinate (longitude)		Drug use
Road type (e.g., motorway, expressway, national road, local road)		Safety equipment
Section type (e.g., bridge, tunnel, bend, gradient, straight)		Nationality (national, foreigner—possibly by relevant country grouping)
Junction type (not at junction, crossroad, roundabout)		MAIS injury severity (Maximum (M) Abbreviated Injury Scale (AIS) rated from AIS 0 – no injury, to AIS 6 – death) (AAAM 2016).
Speed limit		
Surface conditions (dry, snow/ice, wet, slippery)		
Crash severity		

Source: Adapted from AAAM 2016; Azzouzi 2019; and CARE Team 2018.

Additional variables in other minimum datasets include, for example, curvature, division, surface (sealed or not), junction control and its functioning for the road and license type, airbag state, and seating position for the persons involved (Austroads 1997). In addition, it is also helpful to include a description of the reporting agent and a diagram showing the crash in relation to local road features, the direction of travel of different vehicles and road users, and what happened in the crash.

Some types of data elements can be derived by integrating the crash database with other database systems. This integration can simplify reporting and validate the information collected at the scene. For example, data regarding the person (such as date of birth and nationality) can be derived if the crash database is integrated with the license register or social security data. Vehicle information can be added via the vehicle registration database. Road infrastructure data (including junction type and road type) can be derived if crash data contain georeferenced information and are connected to a geospatial road database (see the **"Crash location"** section, below). The Asia-Pacific Road Safety Observatory (APRSO) has recommended specific core crash data elements to be collected at the crash scene and data elements that could be derived from other sources, such as an inventory of roads and bridges, licensing and vehicle registration database systems, and injury surveillance systems.

CRASH LOCATION

The location of a crash is a critical data point and one of the minimum requirements in effective data collection and use for identifying potential road safety interventions. The availability of crash locations on an electronic database (together with the other minimum requirements) enables the use of modern tools, such as geographic information system, or GIS-based crash data processing for the automatic pre-calculation of black spots. Without reliable knowledge of crash locations, opportunities for solving local deficiencies remain limited.

Missing or inaccurate reporting of road crash locations is one of the most pressing challenges in road safety analysis aimed at improving safer road systems. The availability of an exact road location reference method is therefore seen as the most essential element of a traffic information system:

- **Road authorities need to pinpoint crash locations accurately to tackle hazardous locations effectively;** police need this to efficiently allocate enforcement resources, and hospitals need this to optimize their emergency response. Missing or inaccurate location of crashes might not only preclude the identification of the worst sites, but could also hinder the ability to evaluate the effectiveness of any countermeasures.

- **The location reference system can provide a link between various files (crashes, traffic data, and roadway inventory).** To successfully merge these files, the location reference methods used in each of them should be identical or, at least, compatible.

Each road crash relates to a specific location in the road network. The two major options for identifying crash locations are via GPS (global positioning system) or through road-based identification:

- **Use of GPS:** GPS is the fastest and most exact way of obtaining reliable data about crash locations everywhere on earth. Localization can be performed at the road crash location—mobile GPS devices have sufficient accuracy to obtain location data (geographic coordinates). Even if GPS coordinates cannot be obtained at the crash location (due to malfunction of the GPS-device, for example), the coordinates could be determined ex post by using available data on a national geographic information system (GIS) platform or from the internet.

- **Road-based identification:** Depending on location, two different systems could be used for this:
    - *Stationing in countryside areas:* This is the traditional and most commonly used method for road location identification in the countryside. The road identification code or number and the stationing data (mileage of the road) describe each road location. Each road has an original station (zero point) and the distance from this point defines each location. Distances are normally indicated by kilometer post markers, available during crash data recording. A disadvantage of this system is its inadaptability to infrastructural changes that result in a change of the road length, along with the difficulty of making a unique link with XY coordinates. Another difficulty is that in some countries station points do not exist, or do not exist everywhere depending on road status.
    - *Address in urban areas:* A street address is commonly used in urban areas. However, as for station points, street addresses do not exist everywhere and in every country.

REGISTRATION AND TRANSMISSION

The data should be registered in a common system and transferred from local police stations to a central data repository where all crash data are consolidated. All possible problems with this procedure should be identified. Ideally, crashes should be registered by the person who attended the scene; however, this is not always the case. If the crash is registered by someone else, this must be done without any significant loss of information. Data input should not be too time consuming and done preferably with a user friendly interface to ensure completeness and avoid errors. Optimizing the form used (such as electronic or paper) can bring major improvement. The variables recorded should at least include those listed in the "Variables reported" section earlier in the chapter. Further variables can be of additional value, but only if all fields have been reliably completed.

An investigation should be undertaken of the subsequent handling of registered cases and how cases are collected at national level. It is common that data are collected then kept at station level—in a filing cabinet or in a pile, which often results in a major barrier to improving data systems.

Special attention should be paid to the nature (paper mail, email, cloud) **and frequency** (daily to annually) **of the links between actors** involved in the data chain, and to the possible data nodes where data are gathered for verification, correction, or processing. The time period for the data to reach the crash database following a crash should be documented.

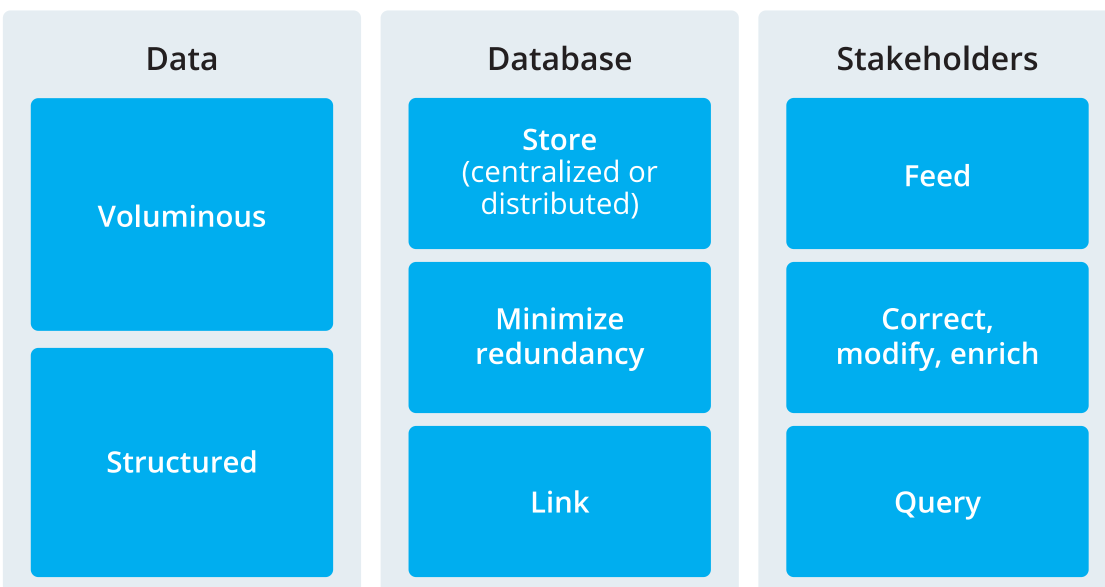
DATA STORAGE: THE CRASH DATABASE

Whatever the database system in use, the reviewer must always keep in mind the following paradigm: *Check that all the data stored are needed, and check that all the data needed are stored.* A database is a voluminous set of varied data, stored in centralized or distributed digital media to minimize redundancy and to link the different types of data. The database serves the needs of one or more organizations, so that (potentially different) stakeholders can feed the data, correct, modify, and enrich them; and query the database (see figure 2.3).

A database is built from a process comprising four main steps:

1. Analysis of the existing situation and needs
2. Creation of a series of conceptual models to represent all the important aspects of the problem
3. Translation of the conceptual models into a logical model and standardization of this logical model
4. Implementation of a database in a data management system, based on the logical model and optimization

Figure 2.3. Aspects of a Database



Source: Original figure produced for this publication.

A database management system is software aiming to manage the data with an adapted language, in which:

- Information is stored and organized as objects or tables;
- Tables are sets of fields describing the subject of the table; and
- Tables are linked by one or more relationships between fields, some of which are indexed.

The data review focuses on each of the different bullet points above, bearing in mind these requirements are not necessarily linked to a particular tool, although it is easier to achieve the objective with an online shared and dedicated tool than with individual Excel or other spreadsheets.

The structure of the database and the tools used to implement it are not unique. Several examples can be given worldwide of different choices (see appendix D). Nevertheless, some key points must be checked:

- A data dictionary must exist, and be known by the actors of the data chain
- Concepts like “not applicable,” “unknown,” and “missing” must be identified
- Every change in the database must be tracked and time-stamped.

At this stage, several roles can be identified:

- Contributors: Collect and provide required data for the database (such as hospitals or police); contributors may or may not be editors
- Editors: Enter the collected data into the database
- Database administrators: Manage the database consistency and assign access rights (reading, correcting, deleting, validating)
- Validators: Oversee declaring the data as valid for publication.

At this stage, the official and labelled database, once checked and published, must be clearly differentiated from the “living” database, which could evolve after the date of official validation with new information that enriches or modifies it.

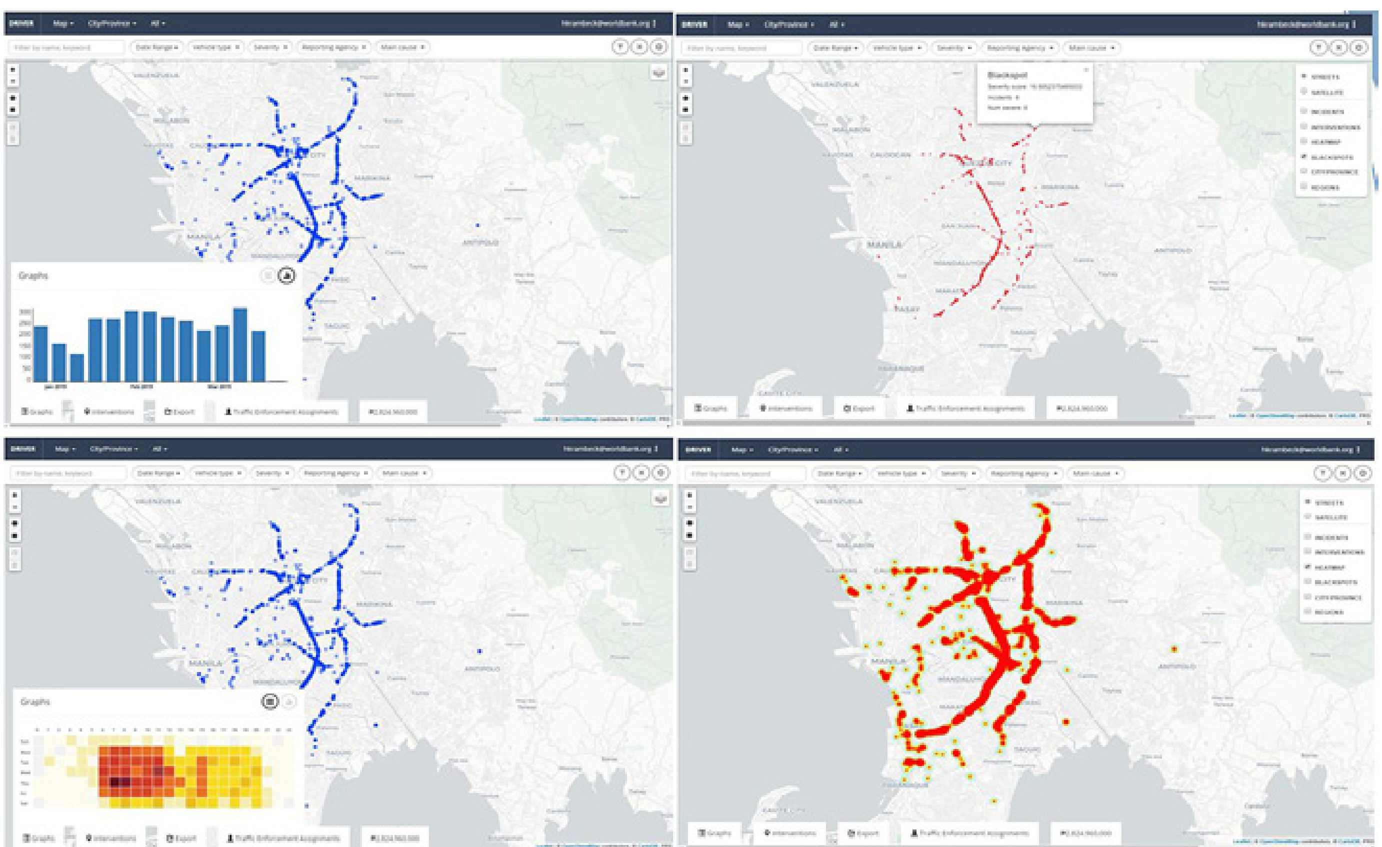
DATA QUERYING AND PRESENTATION

The database should feed into analysis tools. Sometimes, these tools are so integrated into the user interface they could appear to be embedded in the database itself. This is, however, not the case. The operating tools, even if linked to the structure of the database, are not part of it. The most efficient systems clearly distinguish storage and exploitation. Querying the database must allow the combination of different variables, such as selecting all crashes of child pedestrians on weekdays, just before school starts. Obviously, queries on the database must take account of and be consistent with the database structure. As an example, in a database the characteristics of the road users might be stored, along with the characteristics of the roads leading to an intersection at which a crash took place; however, the two might not be unequivocally linked. In that case, statistics combining the type of road user with certain characteristics of the roads cannot be produced (or worse, they might be produced but not make any sense).

The querying system should include functions that allow mapping of crash locations and display information on areas, routes, or locations in a useful way, such as in a factor matrix or as collision diagrams. Ideally, the system should also include a template for a standard report that can be generated by different administrative units, such as communities, provinces, and others. An example is the Data for Road Incident Visualization Evaluation and Reporting (DRIVER) system (figure 2.4), a web-based and open-source platform for geospatial recording and analysis of road crashes developed by the World Bank in cooperation with local governments and various data providers, including Mapillary, a street-level imagery platform. DRIVER allows filtering according to several variables, production of heatmaps and blackspot analyses, and zooming into single records (as shown in figure 2.5).

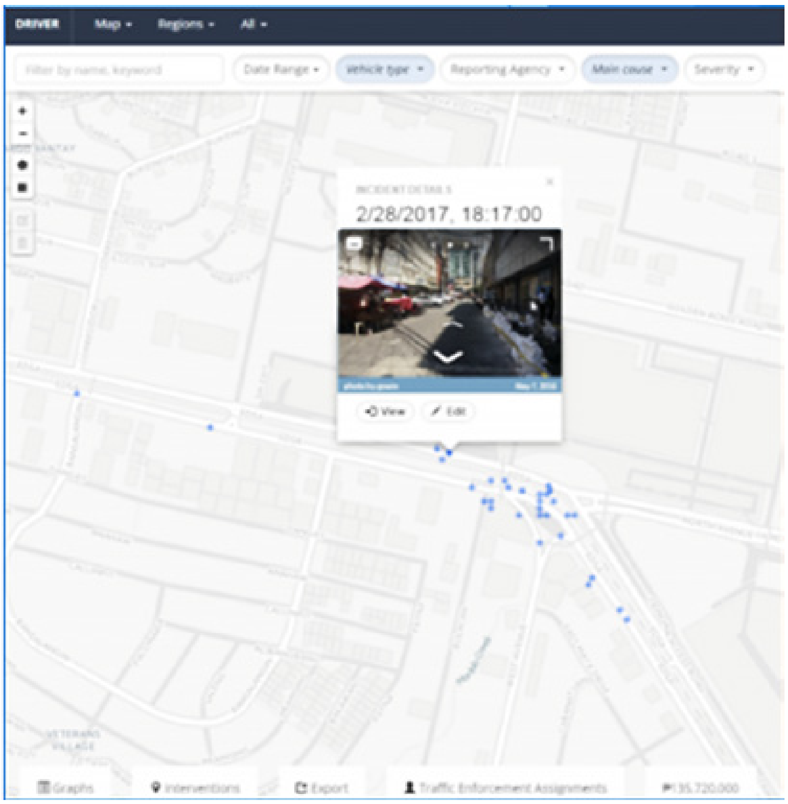
Crashes can be analyzed based on location, facilitating black-spot analyses and allowing users to relate crashes to road characteristics (see also the section discussing "Road user behavior" later in this chapter).

Figure 2.4. Screenshots of the DRIVER Map in Manila, Philippines



Source: Burlacu 2019.

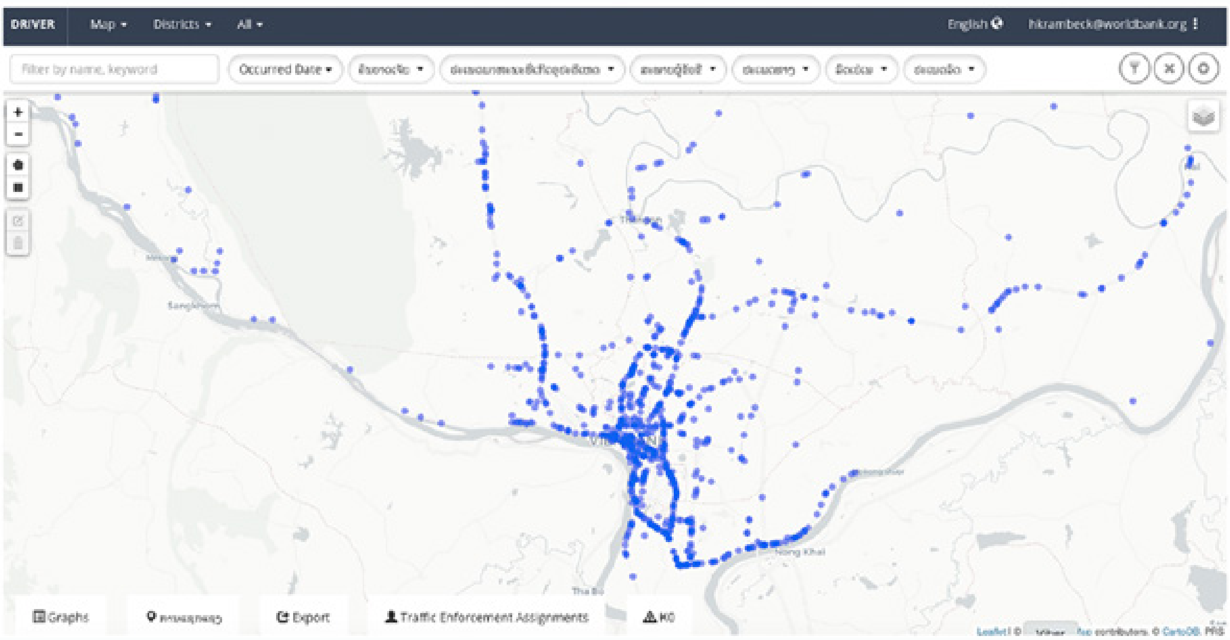
Figure 2.5. Screenshot of Single Record Identification in DRIVER



Source: Burlacu 2019.

Box 2.1 provides an example of how the DRIVER platform is used in Lao PDR.

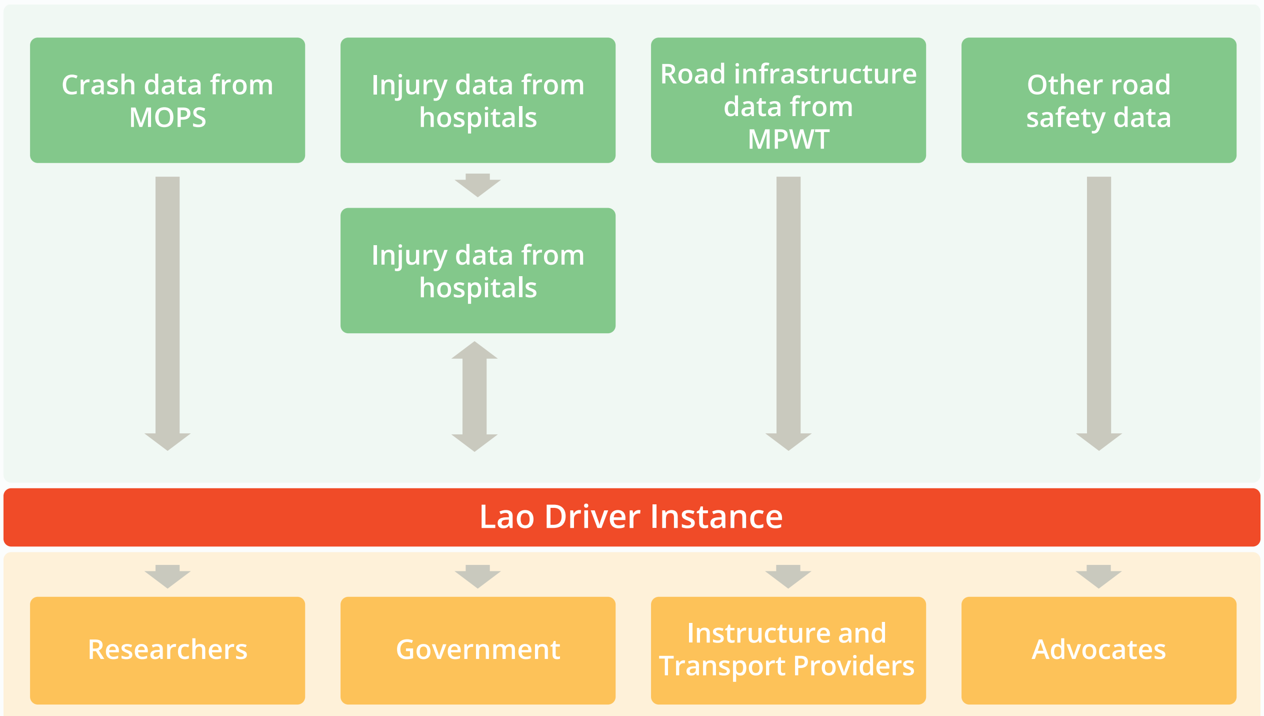
Figure B2.1.1 Screenshot of the DRIVER Platform in Lao PDR



Source: Lao PDR DRIVER platform (http://laos.roadsafety.io).

To date, a total of more than 2,000 crash records have been mapped and encoded into the DRIVER platform in Lao PDR. More than 100 people, including traffic police, have been trained in using DRIVER. These include police at the local level, the central Department of Traffic Police as well as staff from the Ministry of Public Works and Transport (MPWT) and the National University of Laos. The Lao DRIVER platform has been translated and updated into the Lao language and is currently accessible at http://laos.roadsafety.io (see figure B2.1.1) Currently, the MPWT and the Department of Traffic Police, with support from the World Bank, are in the process of scaling up DRIVER at the national level through the signing of legal instruments, standardizing data collection processes and forms, and securing technical resources, such as servers. A preliminary institutional arrangement for DRIVER implementation has been developed for Lao PDR, where the police, hospitals, and other ministries feed data into DRIVER, which can then be accessed by relevant stakeholders (figure B2.1.2)

Figure B2.1.2. Institutional Arrangement for the DRIVER Platform in Lao PDR



Source: Original figure produced for this publication.

SHARING DATA

The data should be accessible, both in terms of access rights and in terms of comprehensibility of information. Ideally, the actual data should be accessible to experts with a good understanding of the data structure and include an access tool that is easy for all to use. Rather than "sit on the data," the data "owners" should ensure the engagement of different stakeholders—including police, road administration, engineers, insurance organizations, lobby-groups, and local/regional/national policy makers. They have to make sure stakeholders can derive the information they need, for example, by producing dashboards and maps or by making standard reports available.

CHECKING AND AUGMENTING THE DATA

The crash database could be checked and augmented using external data. Thus, the following questions need to be addressed:

- Are the data checked against other counts, such as hospital data, vital statistics, and coroners' reports? Is the completeness of the different databases known or estimated?
- Is double counting possible or checked? Are plausibility checks routinely conducted? Are the results fed back to those who originally record the crashes?
- Are the data linked to and enriched by other sources, such as hospital data and vehicle registration?

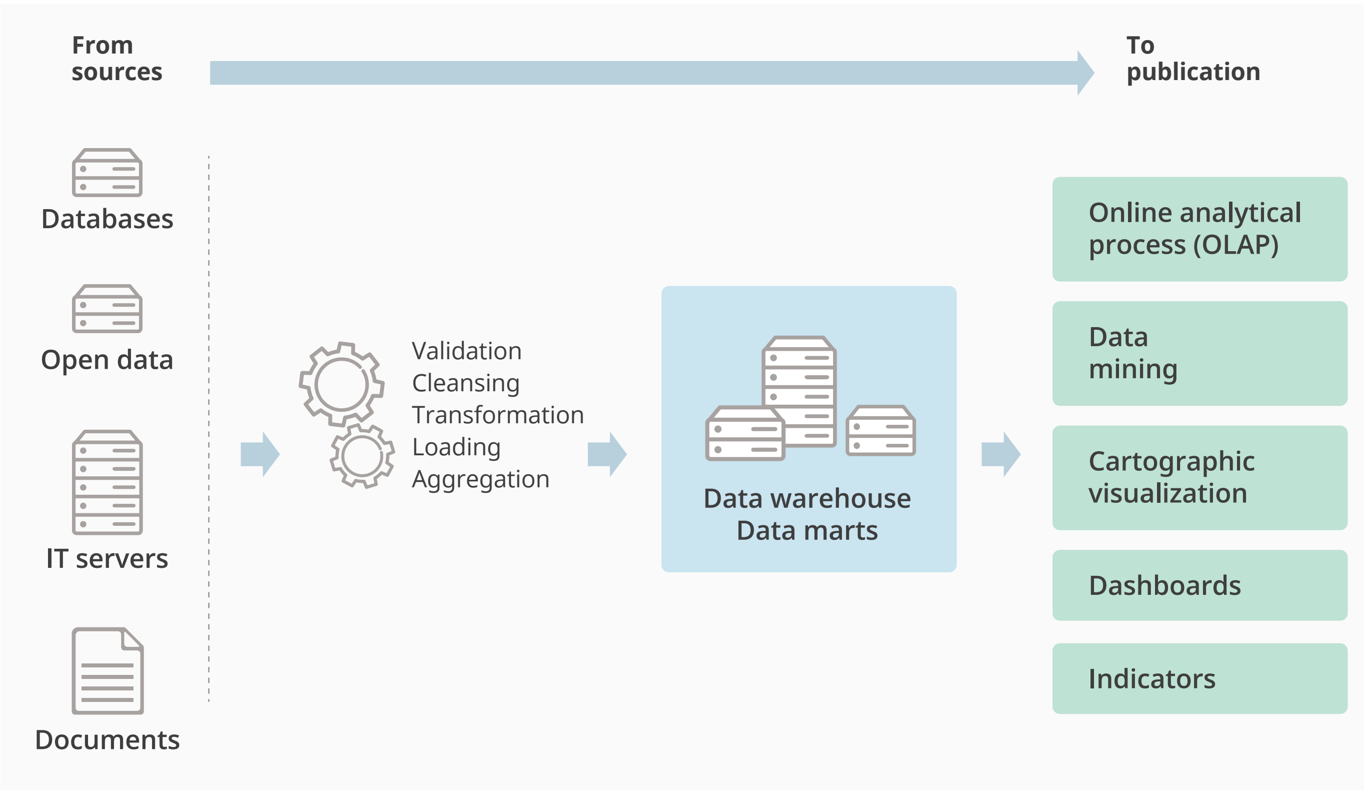
To achieve integration between crash data and a nonspatial dataset (health data, vehicle registration, driver licensing) will require matching of identifiers or data elements. These identifiers can be (a) unique identifiers, (b) secondary identifiers, or (c) customized identifiers. Unique identifiers include data elements specific to a single record, such as personal identification numbers and names. If using unique identifiers is not possible, secondary identifiers such as the gender, date of birth, age, and initials of any victims as well as the crash date and location can be used. If records meet a set number of matches with these secondary identifiers, the two will then be linked or merged. Finally, creating a customized crash identifier, such as a record number, will facilitate the linkage of the two database systems.

Notably, most current database systems are developed in open environments that allow easy interfacing with external data, which is stored in warehouses using an extract, transform, and load (ETL) process. The ETL process allows the validation, cleansing, transformation, loading, and aggregation of data for storage:

- In a ***data warehouse***, generally seen as a centralized storage space grouping together data from different sources, thus making them homogeneous or belonging to one uniform dataset; or
- Possibly in specialized partitions of a data warehouse ***(data mart)*** after validation, transformation, and cleaning, so as to be available in various forms to assist with decision making.

These are then made available to users for all purposes: Online Analytical Process (OAP), data mining, cartographic visualization, dashboards, and indicators. The complete dataflow is illustrated in figure 2.6.

Figure 2.6. Complete Dataflow for the Extract Transform and Load Process



Source: Duchamp 2017.

However, integrating datasets into a single database can produce duplicated records. To address this, a mechanism for duplicate record management must be in place. A dedicated office that checks the overall quality of data, including resolving potential duplicates, must be established.

Box 2.2 looks at the development of the National Road Safety Database in the Republic of Serbia.

Box 2.2 National Road Safety Database: Republic of Serbia

In 2016, the Serbian crash data collection system was revised, to harmonize with the European Common Accident Data Set (CADaS) and the system of causation factors used in the UK STATS19 accident data collection forms. The system was designed in a close cooperation between local police who collect the data and transport engineers who use the data. Training programs, automatic checking functions, and feedback to the officers who enter the data all help ensure a high level of quality.

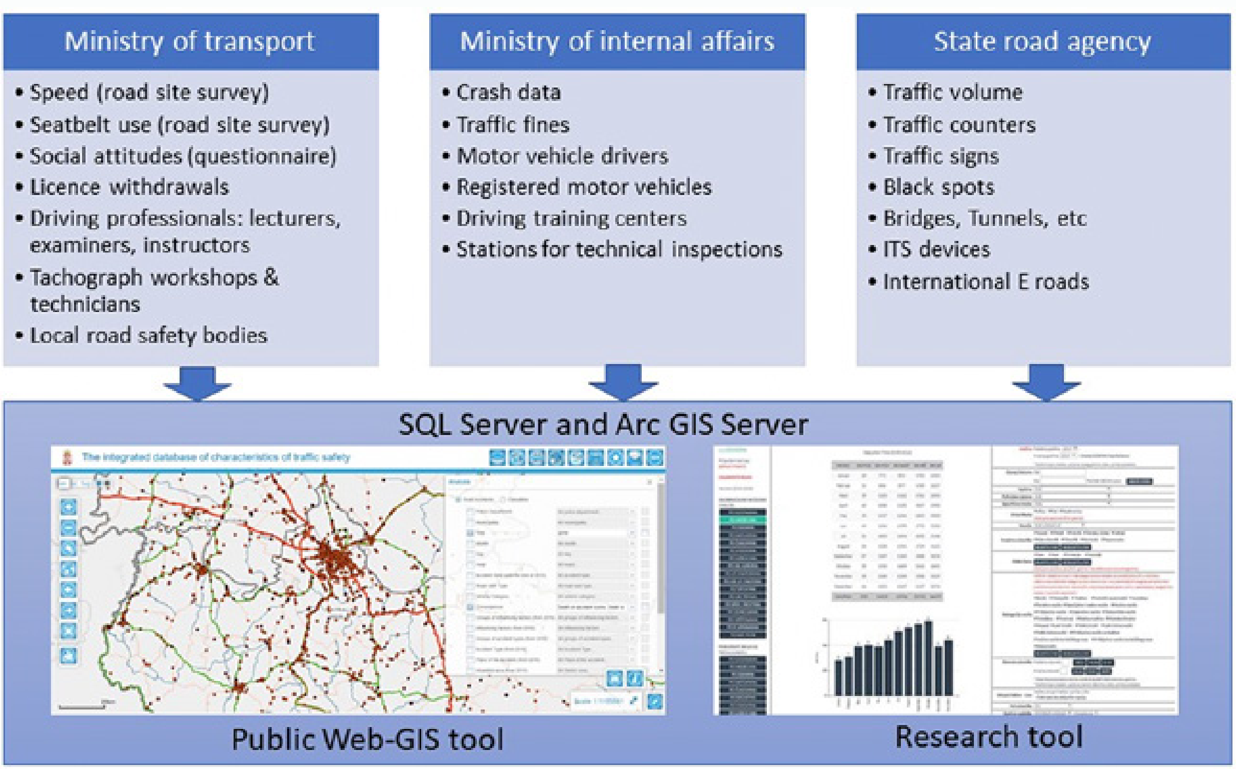
The crash data files are augmented with a large number of other data files gathered from the Ministry of Internal Affairs, the Road Traffic Safety Agency, and the State Road Agency Public Enterprise, "Roads of Serbia."

Together, the files form the national road safety database of Serbia (see figure B2.2.1). All information is GIS coded, allowing presentation of results as maps. Two tools, each tailored to different users, allow access to the information:

1. The public can access the information via a web tool (http://195.222.99.60/ibbsPublic/) that allows selection of accidents or victims according to many criteria, including the year, severity, vehicle type, road user type, age group, accident type, causation factor, road type, area type, among others. The results can be shown on the map or exported to spreadsheet files.

2. The researchers have a more advanced web-based tool that still allows them to quickly create queries in the database while combining criteria more freely. The advanced tool also includes all variables available in the database.

Figure B2.2.1 Flowchart for the National Road Safety Database of Serbia



Source: Martensen 2018.

2.2. Mobility Data: Exposure to Risk

To identify road risks, traffic data should be available and as detailed as possible. Ideally, these data should be available for each type of road user, including nonmotor vehicles and pedestrians. This section discusses various ways to collect these data, as well as surrogate data that can be used in the absence of data on travel distances.

Data on traffic volumes are important for the analysis and interpretation of crash data, because they quantify the numbers of at-risk units. Such units can be persons (population, license holders), vehicles (fleet attributes such as class or age), road sections (road lengths), or ideally instances of vehicles or persons moving in traffic (distance traveled, trips, minutes in traffic). They determine the total societal risk because some travel modes present more risk than others. For instance, a higher proportion of travel by motorcycle results in a higher number of casualties.

Risk is estimated by dividing the number of crashes or casualties by a measure of exposure, for example, the number of fatalities per 100,000 inhabitants or per billion kilometers traveled. Note that for this reason the risk must always be defined in terms of the numerator and the denominator. A good overview of exposure data for road safety analyses with practical examples for their collection can be found in the SafetyNet project (Yannis et al. 2005). Appendix C describes methodological considerations for the collection of exposure measures in more detail.

With a growing understanding for the need to shift traffic from motorized transport to more active modes such as walking and cycling, the modal share of different forms of transport are increasingly important. The modal share holds important implications for road safety and can represent a threat to road safety when motorized transport and vulnerable road users are mixed in traffic. However, as the share of active transport modes increases, more space in traffic is often dedicated to them, including pedestrianized road corridors and dedicated cycle lanes or paths, which offer safe ways to travel.

TRAVEL DISTANCES

The gold standard of crash and casualty analyses is to link them to distances traveled, because this allows the most direct link to countermeasures. By knowing how people travel (by car, bicycle, on foot, along with other modes) and how far, one can distinguish differences in road risk from differences in travel behavior.

Ideally, travel distances are estimated with *travel surveys.* Traditionally, a representative sample of the population is required to fill in a mobility diary (usually for one day) and report on each trip made as well as the modes of travel used. The estimation of distances and travel times by the travelers themselves is very unreliable. As a solution, rather than sampling persons willing to fill in a questionnaire, one can sample persons willing to install an application on their smartphone to measure travel modes, distances, routes, and travel speeds. Examples are available from Switzerland (https://ivtmobis.ethz.ch/mobis/covid19/en/) and the Czech Republic (https://www.czrso.cz/nub/post/map). The big advantage of survey data is that they include the distances covered by walking or by nonmotorized vehicles. Another alternative is to work with the data that big data collectors can provide, although often little is known about the representativeness of the underlying sample. In a first investigation conducted in 2021, researchers in Finland concluded relatively large differences exist between their own estimates of kilometers traveled and those estimated by Google (https://www.google.com/covid19/mobility/).[1]

Traffic counts offer an alternative. Traffic count systems allow for continuous measurements of traffic volumes over time. Traditionally, only motor vehicles have been counted. However, modern video observation techniques can also monitor walking and other nonmotorized modes of transport.

SURROGATE EXPOSURE MEASURES

If no travel distances are available, surrogate measures should be used for the interpretation of crash and casualty figures. These usually do not differentiate between modes and are therefore clearly less preferable to the more detailed data described above. However, as the number of participants is still most strongly determined by the amount of motor traffic (a pedestrian will rarely cause fatal injuries to another road user in a crash), these numbers can still be helpful in understanding the development of crash numbers in countries with growing motorization. Moreover, they are often readily available in economic statistics. Surrogate measures include the following:

- Fuel consumption
- Road length
- Vehicle fleet (from vehicle registration)
- Driver population (from license registration)
- Gross domestic product (GDP)

GDP, the final measure on the list, is the most indirect one, but also the one most readily available in most countries. Its relation to road safety is complicated, in the sense that richer countries usually have better road safety records (Kopits and Cropper 2005), while at the same time in these same countries, road safety improves when times are economically hard (ITF 2015). Nevertheless, all results are based on calculations of risks per travel distance. The GDP can be considered a good proxy of economic activity and in consequence mobility (Antoniou and Yannis 2013).

MODAL SHARE

If detailed distances per travel mode are unavailable, general estimates described in that chapter above can be supplemented by indicators for the share of different travel modes. While the detailed travel surveys described above remain the ideal way to investigate modal share, insights on modal share can also be based on other data. Very general questions on which modes are used most often can provide a rough overview, cost much less than a complete travel survey, and could also be added with other questionnaires. Moreover, many companies maintain data on how their employers travel to work. Mobility platforms such as Uber also have data on the number of drivers using motorized vehicles as opposed to bicycles. Pedestrian travel is the most difficult to estimate. However, the vehicle rate per household is a good proxy for that.

1 Google data compared to other traffic volume data sources in Finland. Taken from translated excerpts of an internal ITF/IRTAD memo written in December 2020 concerning telecommuting and COVID-19.

2.3. Safety Performance Indicators

The transport system consists of road users, their behavior, the roads they use (that is, the infrastructure), and their vehicles. All three components contribute to the safety performance of the system. For each component, this section discusses the different indicators of safety performance and the main issues when measuring them. Additionally, various examples for sets of internationally comparable SPIs are introduced.

While monitoring progress in road safety in terms of crashes and casualties is important, because these two indicators occur as the “worst case” of unsafe operational conditions in the road traffic system, they represent only a small portion of meaningful measurements. SPIs are indicators with strong causal links to road safety that better reflect road safety management and the state-of-the-art in a given country (Bliss and Breen 2009; 2013).

In principle, SPIs should be chosen in relation to the safety issues in the country under review. To determine the relevant intermediate outcomes, the crash data must be analyzed, and risks identified. As an example, if a high proportion of pedestrian fatalities is identified as a priority issue, the proportion of pedestrians walking on safe sidewalks is an important safety performance indicator. It is useful to formulate a target for this proportion. First, however, one must define how this can be measured and know the present level to formulate a target (WHO 2013).

The World Health Organization (WHO) has led a process of developing a set of voluntary global performance targets, involving member states and key stakeholders (WHO 2017). This process culminated in a set of 12 voluntary global road safety performance targets, listed in table 2.2. Each target represents a specific goal to be achieved at a global level, based on the combined efforts of individual countries wishing to contribute toward global objectives.

Table 2.2. WHO Global Road Safety Performance Targets

Global road safety targets		
1	National action plan	By 2020, all countries establish a comprehensive multisectoral national road safety action plan with time-bound targets.
2	Global alignment	By 2030, all countries accede to one or more of the core road safety-related United Nations legal instruments.
3	New roads	By 2030, all new roads achieve technical standards for all road users that take into account road safety or meet a three star rating or better.
4	Existing roads	By 2030, more than 75% of travel on existing roads is on roads that meet technical standards for all road users that take into account road safety.
5	Vehicle standards	By 2030, 100% of new (defined as produced, sold or imported) and used vehicles meet high quality safety standards, such as the recommended priority United Nations Regulations, Global Technical Regulations, or equivalent recognized national performance requirements.
6	Speeding	By 2030, halve the proportion of vehicles traveling over the posted speed limit and achieve a reduction in speed-related injuries and fatalities.

Global road safety targets		
7	Motorcycle helmets	By 2030, increase the proportion of motorcycle riders correctly using standard helmets to close to 100%.
8	Vehicle occupant protection	By 2030, increase the proportion of motor vehicle occupants using safety belts or standard child restraint systems to close to 100%.
9	Driving under the influence	By 2030, halve the number of road traffic injuries and fatalities related to drivers using alcohol, and/or achieve a reduction in those related to other psychoactive substances.
10	Distraction by mobile phone	By 2030, all countries have national laws to restrict or prohibit the use of mobile phones while driving.
11	Professional drivers	By 2030, all countries to enact regulation for driving time and rest periods for professional drivers, and/or accede to international/regional regulation in this area.
12	Emergency services	By 2030, all countries establish and achieve national targets in order to minimize the time interval between a road traffic crash and the provision of first professional emergency care.

Source: WHO 2017.

Each target has one to three relevant indicators, as detailed in Van den Berghe, Fleiter, and Cliff (2020). Most of the WHO targets concern SPIs 3, 4, 5, 6, 7, 8, and 12. However, other targets on crash and casualty outcomes (6, 9), and targets on interventions (1, 2, 10, and 11), show how important road safety data are at these different levels.

Performance indicators can relate to any part of the road traffic system and are usually classified as: directed infrastructure, vehicle/s used, road user behavior, and post-crash care.

INFRASTRUCTURE

The design and operational conditions of the road network play a significant role in the causation of crashes. Recent safety philosophies—such as the Safe System Approach—have thus extended the formerly user-centered approach to explaining crashes, known as “user blame” and advocate a shared responsibility in road safety; those who design, build, and maintain infrastructure shall share an (ethical) responsibility to avoid fatalities and serious injuries (see for example, ITF 2016).

A multitude of infrastructural factors contribute in several ways to causing, avoiding, or mitigating crashes. One of the many potential ways to structure safety principles for road infrastructure are those defined in the Dutch “Sustainable Safety” philosophy: functionality of roads (that is, to generate a hierarchically structured road network); assuring homogeneity of masses as well as speed and direction along a stretch of road; forgivingness of the road environment; and predictability of road course and road user behavior by recognizable road design (Wegman, Aarts, and Bax 2008).

As an illustration of useful infrastructure safety performance data, the star rating developed by the International Road Assessment Programme (iRAP) provides useful guidance to assess the safety of individual road sections (see figure 2.7).

Figure 2.7. The International Road Assessment Programme's Star Rating

iRAP **International Road Assessment Programme**
For a world free of high-risk roads

The International Road Assessment Programme (iRAP) provides a method to score the protection features of a road section, the "Road Protection Score" (RPS or "Star Rating"). The RPS includes treatment of roadsides, median separation of traffic flows, design and frequency of junctions (Lynam, 2012). Data are gathered using specially equipped vehicles, software, and trained coders.

In addition, combining iRAP star rating analysis with crash data offers a powerful tool for road administrators. Being able to map both the location of road crashes together with identified high-risk road user environments (e.g. 1 and 2-star) can help Governments to maximize intervention impacts relative to their limited budgets. Thus, road administrators can ensure safety improvements are urgently implemented for 1- and 2-star roads with a high number of fatalities and serious injuries; whereas special investigations would be needed from the Police for 4- and 5-star roads with a high numbers of crashes (where road infrastructure is already considered safe).

Source: International Road Assessment Programme website: https://www.irap.org.

Assessments of the highest risk parts of the network have proven to be very useful in low- and middle-income countries (LMICs). These assessments identify the level of risk for different road user groups to help identify and prioritize interventions that deliver cost-effective outcomes. The outcomes have led to better understanding and decision making regarding effective interventions. The data collected give some very powerful information for additional analysis beyond the road protection score (RPS) or star rating. More than 70 specific variables can be used individually or in combination to form measurable performance indicators. To return to the example of pedestrian safety, one can derive the percentage of the network above 30 kilometers per hour that have sidewalks where pedestrians are present.

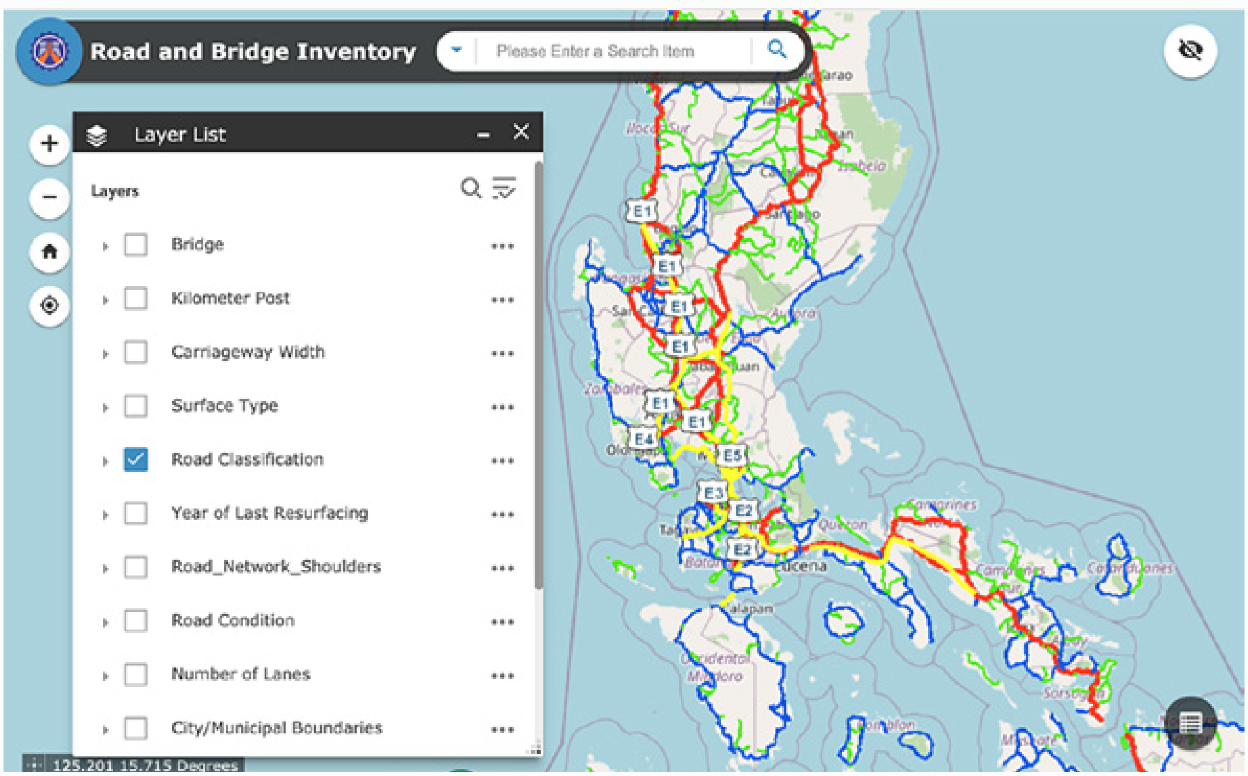
Asset databases can be an important source of information as well. The basic purpose of pavement management systems is to develop priority programs and schedules so that construction, rehabilitation, and maintenance work is conducted cost effectively. Local design data, such as traffic flows, material properties, and unit costs, allow technical as well as economic evaluations. Network properties or attributes, such as shoulder design, pavement texture, and roughness have been shown to affect road safety, and the combination of the road safety management system with the pavement management system can help optimize design, construction, and maintenance for road safety purposes (see, for example, Tighe, Cowe Falls, and Morrall 2001).

Box 2.3 provides an example of an asset database in the Philippines, maintained by the Department of Public Works and Highways (DPWH).

Box 2.3 Department of Public Works and Highways, Philippines

In the Philippines, the Department of Public Works and Highways (DPWH) maintains an extensive Roads and Bridges Inventory database (figure B2.3.1), which contains georeferenced data on various road infrastructure data elements. Examples of these data elements include road classifications, road conditions, surface type, carriageway width, and annual average daily traffic for the entire national road network in the country. In addition, the DPWH has extensive International Road Assessment Programme (iRAP) data throughout the country, used to guide road safety interventions.

Figure B2.3.1 Screenshot of the DPWH Road and Bridge Inventory Database



Source: DPWH Roads and Bridges Inventory:
https://www.dpwh.gov.ph/dpwh/2020%20DPWH%20Road%20and%20Bridge%20Inventory/index.htm.

VEHICLES

Vehicle technology can help both reduce the likelihood of crashes and mitigate their severity. Two dimensions of vehicle safety can be distinguished:

- Passive (also referred to as secondary) safety features such as seatbelts, airbags, and general crashworthiness of vehicles; and
- Active (primary) safety features, such as ABS (antilock braking systems) or ESC (electronic stability control).

A substantial part of reductions in fatalities over the past decades can be attributed to improvements in increased active and passive vehicle safety (European Commission 2018). For example, Méndez et al. (2010) show in the case of Spain that drivers of cars registered before 1985 have a significantly higher probability of being killed or seriously injured than drivers of cars registered between 2000 and 2005.

The Global New Car Assessment Program (NCAP) has evolved as the most widely used measure for the crashworthiness of passenger cars. Originally tailored to assess prevalence and function of passive safety features, credits in the rating (1 to 5 stars) since 2009 are also given for active safety features, that is, devices intended to reduce the probability of a crash. The NCAP safety rating today is composed of tests in four categories: adult occupant protection, child occupant protection, pedestrian protection, and safety assist. The latter is dedicated to advanced driver assistance systems (ADAS) and includes speed assistance, automatic emergency braking, and lane support, among others (European Commission 2018). Monitoring the NCAP distribution of a country's fleet helps evaluate efforts to improve the fleet's safety, such as new car incentive systems (see box 2.4 for details of the NCAP in action in Southeast Asia).

ROAD USER BEHAVIOR

In principle, performance indicators should be tailored to the problems of the country under review. Nevertheless, **some behaviors have proven problematic for road safety in many countries**. Some typical problems, along with the data collected to identify the extent of the problem and monitor progress, will be discussed in this section. As many of these SPIs require roadside surveys, appendix C indicates issues that require attention when conducting roadside surveys. In principle, data on *observed* behavior preferred over questionnaires measuring behavior as *reported* by the respondents. The latter are subject to awareness, memory, and social desirability issues. Nevertheless, questionnaires can be a cost-efficient alternative to collecting information on several types of behavior at once.

A set of comparable indicators is provided by the E-Survey of Road Users' Attitudes (ESRA) project. ESRA (https://www.esranet.eu/en/) is a joint international initiative of research centers and road safety institutes in 38 countries across five continents. The purpose of this network is to collect comparable data on the road safety situation and culture as indicated by road users' self-reported habits and behaviors, attitudes, beliefs, perceived norms and values. The data collected by means of online surveys yield a large set of road safety indicators. Although behavior observations are always preferred above self-reported behavior measurements, the ESRA questionnaire is a relatively cheap way to collect information across countries on all the behaviors mentioned above at the same time and in a comparable way.

Box 2.4 Malaysian Institute for Road Safety Research and the Association of Southeast Asian Nations New Car Assessment Program

The Malaysian Institute for Road Safety Research (MIROS), as the road safety center for the Association of Southeast Asian Nations (ASEAN), has been in the forefront of road safety research and policy in Southeast Asia since 2012. One of its main activities is partnering with the ASEAN New Car Assessment Program (NCAP), which implements vehicle safety standards in the region. Vehicles that undergo the collision tests and meet the standards set by the ASEAN NCAP also meet the United Nations vehicle safety standards. As hosts of the collision testing laboratory (figure B2.4.1), MIROS collects good quality vehicle safety data in the region, which are used for road safety policies and programs. Currently, MIROS is improving their testing capabilities to also include safety technologies for motorcycle safety.

Figure B2.4.1 ASEAN NCAP Collision Test Conducted in the MIROS Testing Laboratory

Source: MIROS (https://miros.gov.my). See the ASEAN NCAP website for information about the 2013 collision test for the Proton Prevé shown in the image: https://aseancap.org/v2/?p=3448.

SPEEDING

Excessive and inappropriate speed is the most critical factor contributing to road injuries in many countries. The higher the speed, the greater the stopping distance required, a more diminished field of vision, and hence the increased risk of a crash. As more kinetic energy must be absorbed during a high-speed impact, the risk of injury increases should a crash occur. Heterogeneity of driven speeds is also a risk factor as it increases the likelihood of conflicts. Traditionally, the identification of pre-crash speed requires a crash reconstruction often beyond the routine investigations conducted by the police. Therefore, coding of speed as a possible causation factor is often unreliable. Event data recorders that register the speed and acceleration in the seconds up to the impact are increasingly common. If the police have the materials and expertise to read these records (requiring a capacity only starting to develop in most countries), these data allow reliable conclusions about the role of speed in crash causation. SPIs, with respect to speeding, can be based on **mean speeds** available from various sources—such as big data providers including Uber, Google, and others—or in more detail as sold by providers of navigation services. These data are also called floating car data and from these, speed indicators can be meaningfully calculated for road sections—at least for rural roads—which allows *direct linking to crash counts*. However, stability over time is an issue, because the samples can vary strongly and usually no information is available on sample composition. Traditionally, speed measurements have been based on roadside measurements with radars, cameras, or tubes. These methods are *comparable over time*, if the devices stay at the same location, which is important for monitoring progress. However, the representativeness of the measurement location can be an issue and in general the density of the measurement points will not be sufficient to match local speeds to crashes. SPIs typically reported include the mean speed, V85 (the speed not exceeded by 85 percent of drivers) and the speed variance (GRSP 2008).

HELMET USE

The growing fleet of motorized two-wheelers in many LMICs makes the requirement of helmet use an urgent priority. Head injuries among users of two-wheelers is a primary concern. Motorcycle and bicycle helmets effectively prevent head injuries and reduce the severity of injuries sustained by riders and passengers of two-wheelers. However, data on head injuries resulting from motorcycle crashes might be difficult to interpret, for instance, because the distances traveled by motorcycle are unknown and rapidly changing. An observational study can, therefore, help estimate the **proportion of motorcyclists who wear helmets**, and can provide a better way of testing the success of a program to increase helmet use (WHO 2006). Collecting this information in roadside surveys is relatively straightforward (see appendix C). Alternatively, this can be covered by a survey.

SEATBELTS AND CHILD RESTRAINT SEATS

One of the most effective measures to protect occupants from injury in a crash is the proper fitting and use of seatbelts and child restraints. Both are proven to save lives and reduce injury severity, and all vehicle occupants should be appropriately restrained when traveling in a motor vehicle. Worldwide, however, not all vehicles are fitted with seatbelts, and not all occupants use them when they are available. In countries where car use is rising most rapidly, the use of seatbelts and child restraints is low. In addition, outcome data on seatbelt use is often unreliable because once the driver or passenger has left the car, investigating officers do not know whether the seatbelt was being used. For this reason, it is often more reliably coded for fatalities than for injured casualties. An indirect way to monitor the effect of seatbelts is the analysis of ejections from the vehicle or of injuries due to occupants striking the windscreen, both of which are less likely when a seatbelt was worn. Performance indicators for the use of seatbelts and child restraint seats include the **proportion of vehicles fitted with seatbelts** (in all seating positions), the **proportion of car occupants using a seatbelt,** and the proportion of children (correctly fastened) in child restraints (FIA Foundation 2009). Collecting this information in roadside surveys is relatively straightforward (see appendix C). Alternatively, this can be covered by a survey.

DRIVING UNDER THE INFLUENCE

The consumption of alcohol, even in relatively small amounts, increases the risk of being involved in a crash for all types of road users. In many countries, research indicates that considerable proportions of drivers, motorcyclists, and pedestrians have alcohol in their blood in sufficient concentrations to impair road user awareness. However, good data on drink driving is difficult to attain. Breath or blood tests of road users involved in a crash are not always conducted—especially if they have life-threatening injuries. This is particularly problematic because drink driving increases the risk of fatal crashes much more than the risk of lighter crashes. Therefore, indicators mainly based on drink driving in light crashes leave out an important part of the problem. In terms of SPIs, the **number of alcohol-related offenses** detected by police gives a reasonably complete picture over time—unless enforcement efforts change. The best practice, though difficult to carry out, is random testing of drivers in a road-side survey (GRSP 2007).

DISTRACTION

The rise in mobile communication devices and the information and entertainment they offer to drivers has made distraction a likely determinant for rises in road crash casualties in many countries (ITF 2020). An American naturalistic driving study estimates in more than half of all driving situations, the driver was distracted and on average the crash-risk of a distracted driver is doubled as compared to a driver who is fully attentive. For activities such as texting, this risk rises to 10 times as high as for a nondiverted driver (Dingus et al. 2016). With respect to distraction, crash and performance data are, however, difficult to obtain. Event data recorders will help identify drivers who never tried to prevent the crash by steering or braking, making either distraction or fatigue a likely causation factor; however, until the readout of these data has become common practice, a broad identification of crashes caused by distraction is impossible. Roadside observations can identify **drivers holding a cellphone**, and can even be automated with modern video analytical software. Note, however, that according to Dingus and colleagues (2016), 78 percent of distracting activities do not involve holding a cell phone. The evaluation of distracted driving in questionnaires is also problematic, as this behavior is strongly susceptible to awareness and memory effects. Questions about this behavior are most reliably answered when they relate to a trip that the respondent has just finished or interrupted, for instance, at a rest stop.

PROFESSIONAL DRIVERS

Driving requires continuous attention to the road, other road users, and your own vehicle. Long-term driving without a break can reduce attention and prolong reaction time, increasing the likelihood of crashes. As an example, as compared to a driver who has driven between 8 and 9 hours, the crash risk in the tenth hour of driving is increased by 70 percent and in the eleventh hour by 300 percent. One break reduces the crash risk by 18 percent and two breaks by 37 percent (Hoye 2016). Fatigue due to extended periods of driving can be a particular problem for professional drivers who often have to drive long hours without breaks to maximize their often meager earnings. This is the case in countries where public transport is privatized, with no laws to regulate the driving times. Questioning professional drivers about their driving times and any crashes they were involved in will help to shed light on this problem. If legislation on driving times and rest periods for professional drivers exist, equipping the vehicles used by professional with a tachograph is an important first step; the percentage of vehicles with a tachograph would serve as the resulting indicator. The percentage of drivers whose tachographs have been checked, and the percentage of drivers who comply with requirements for driving time and rest periods would become the indicators for the next steps.

In Europe, the Baseline Project (box 2.5) is helping to pinpoint road safety issues through a set of key performance indicators (KPIs).

Box 2.5 European Road Safety: The Baseline Project

The European Commission of the European Union (EU) has elaborated a list of key performance indicators (KPIs) for road safety to gain a clearer understanding of the different issues influencing overall safety performance. This minimal set of performance indicators has been selected in close cooperation with experts and authorities from the EU member states as a compromise between optimal information and practical feasibility (figure B2.5.1).

The Baseline Project (https://baseline.vias.be) aims to collect a set of harmonized indicators based on a common methodology. This methodology (preliminary versions were published in May 2021) will update older European manuals for the collection of SPIs (Hakkert, Gitelman, and Vis 2007).

Figure B2.5.1 The Baseline Project: List of KPIs for Road Safety, with Definitions

KPI area	KPI definition
Speed	Percentage of vehicles travelling within the speed limit
Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
Protective equipment	Percentage of riders of powered two wheelers and bicycles wearing a protective helmet
Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
Distraction	Percentage of drivers NOT using a handheld mobile device
Vehicle safety	Percentage of new passenger cars with a EuroNCAP safety rating equal or above a predefined threshold
Infrastructure	Percentage of distance driven over roads with a safety rating above an agreed threshold
Post-crash care	Time elapsed in minutes and seconds between the emergency call following a collision resulting in personal injury and the arrival at the scene of the collision of the emergency services

Source: The Baseline Project website: https://baseline.vias.be; European Commission 2019; Hakkert, Gitelman, and Vis 2007.

POST-CRASH CARE

The so-called "golden hour" in trauma management refers to the hypothesis that a patient has the best chances of survival when transported to a hospital within an hour after the crash. Consequently, paramedics are taught to work as fast as possible on-scene so the "golden hour" is not exceeded, despite the different philosophies in trauma care. One can roughly differentiate between two principles in management: "scoop and run," a strategy preferred in the United States, Poland, and the United Kingdom, and "stay and play," practiced in Germany and France, among other countries. The first strategy aims at the quickest possible transfer to the hospital, the second aims more at treating and especially stabilizing the patient before transport, accepting (when necessary) a longer time spent on-scene (Johannsen et al. 2017). The most basic indicator is the percentage of injured casualties that receive professional health care. If the scoop-and-run strategy is employed, the time elapsed between the crash and arrival in hospital becomes the most relevant indicator. For the second strategy, stay and play, the time to first contact with professional emergency care is the more relevant indicator.

2.4. Data on Road Safety Interventions

Road safety interventions range across road and vehicle engineering, enforcement, education, training and promotion, as well as medical services for crash casualties. Follow-up indicators for interventions are an important part of monitoring the implementation of countermeasures.

Road safety management should follow the steps of a plan-do-check-act (PDCA) process (ITF 2016). To follow up the measures taken to improve road safety, it is not only important to monitor progress in terms of outcomes (crash data) and safety performance (SPI data), but also to follow up the actual implementation of the agreed measures. Moreover, only detailed implementation data will permit the evaluation of the effectiveness of a measure in terms of reducing casualties or risky behavior. Nonetheless, sometimes when a measure has been adopted, no effect can be seen. In that case, it is important to know whether the measure was duly implemented and did not work, or whether barriers prevented implementation.

Bliss and Breen (2009), therefore, suggest monitoring safety interventions with regard to their output quantities. See figure 2.8 for areas of interventions and examples for indicators.

Figure 2.8. Intervention Indicators, Main Fields and Examples

Safety engineering	• Road sections with improved iRAP star rating • Number of intersections improved • Number of speed camera operational • Length of road with section control for speeding
Enforcement	• Number of tickets delivered • Number of drivers checked • Hours spent on check
Education	• Number of downloads for educational material • Number of children taught a course
Promotional activities	• Number of clicks on promotional video • Minutes of air time for a spot
Driver training	• Driving lessons taken by students • Exams attempted/exams passed
Vehicle testing	• Vehicles checked • Vehicles admitted after improvements
Emergency medical services	• Crash scenes attended • Average time to arrive at scene

Source: Adapted from Bliss and Breen 2013.

2.5. Reports and Data from Regional Road Safety Observatories

Regional road safety observatories in Latin America, Asia-Pacific, and Africa, and other regions can also provide regional road safety data that will offer further context in a national data review. Through the reports and outputs of the observatories, the performance of a particular country in terms of data collection can be compared with other similar countries in the region. Observatories can also provide the reviewer guidance on road safety priorities in the region and, in turn, identify which types of data are most crucial and needed to improve road safety in a country. For example, motorcycle crashes are one of the most pressing problems in the Asia-Pacific region and will require more robust data in terms of motorcycle safety.

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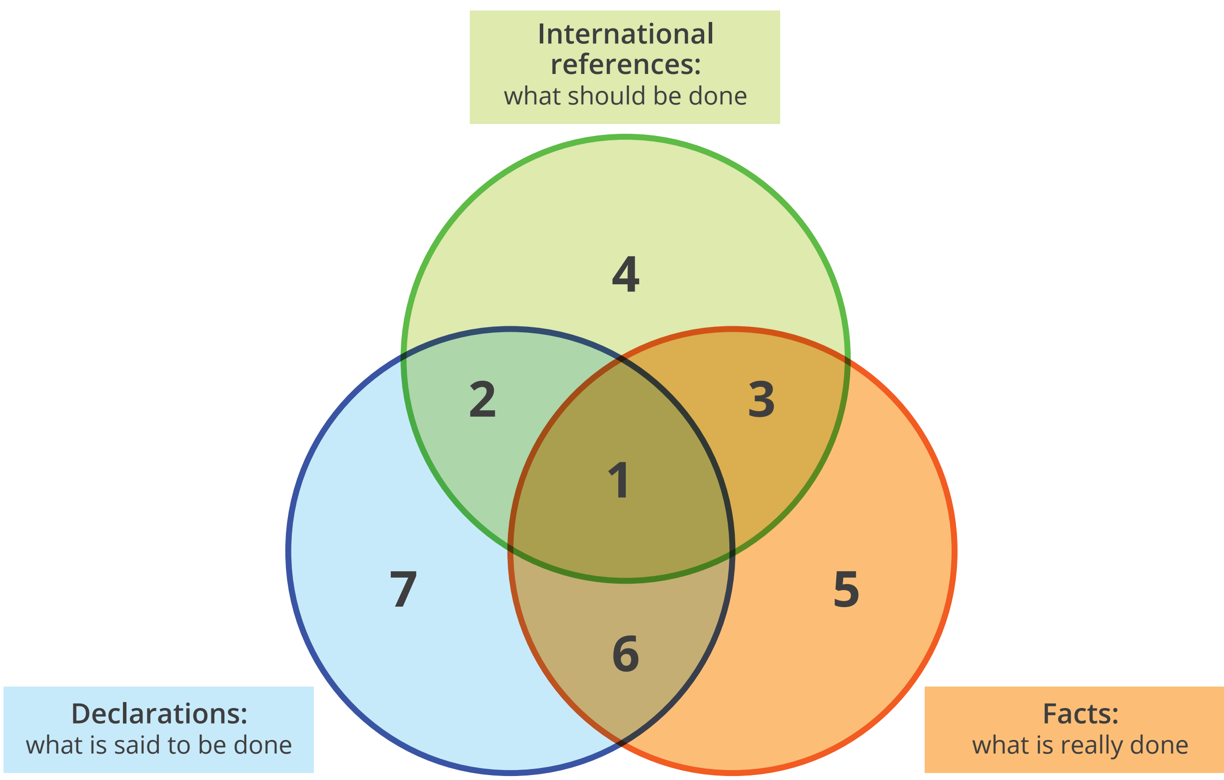
3. Preparing for the Road Safety Data Review

During a road safety data review, the practice of different actors should be assessed within the country and the adopted approaches relative to international standards. To prepare for a road safety data review, a realistic scope for the topics to be addressed should be agreed upon. The host team should collect information and arrange meetings ahead of the visit. The review team should analyze all information made available and look for additional information, such as earlier reviews or international publications.

When assessing the situation in the target country, the reviewer should identify gaps between the best international practices, as summarized in the previous chapter, and which steps have been completed, as reported by the country's institutions. More importantly, the reviewer should confirm whether the official procedure is also implemented in practice. The situation assessment process is represented in figure 3.1 as a Venn diagram.

Figure 3.1. Situation Assessment: Comparison between the Official Procedure (Declarations), the Actual Practice (Facts), and the Internationally Recommended Practices (International References)



Source: Original figure produced for this publication.

The reviewer should situate each aspect of the road safety data system in one of the six areas symbolized in this Venn diagram and adapt their recommendations accordingly.

- **Area 1:** This is the ideal situation; the reviewer needs to simply provide a certificate of conformity.
- **Area 2:** In this area, the stakeholders understand what must be done, and state it has been completed; however, the reviewer sees that actual practice differs from the official declaration. Nonconformities in the procedure do not result from lack of knowledge, but from implementation issues, including those related to materials, organization, training, and budget. The recommendations will therefore focus on practical implementation.
- **Area 3:** Those in charge do not fully understand whether their procedural practice is sound. The reviewer should investigate why this discrepancy exists, present what is done as good practice, and decide whether the practice should be kept, revised, or increased.
- **Area 4:** This is the area for real progress: While not yet completed (neither declared nor in practice), the procedure has been deemed essential. The reviewer will first have to insist on the need to implement the intended practice. Focus on the necessary training to make those involved aware of the importance of this action.
- **Area 5:** In practice, certain actions have been undertaken; however, these actions are not part of the official procedure and their purpose is not clear. Stakeholders should consider committing resources to the procedure that could be invested more usefully.
- **Area 6:** The procedure contains certain actions, and these have been put into practice. Before commenting on these, the reviewer should check carefully whether each action has a purpose specific to the target country.
- **Area 7:** The official procedure contains actions for which the purpose is unclear, but these have not been put into practice. The procedure could be adjusted to increase its credibility.

Finally, the reviewer should strive for full implementation of the necessary procedure that leads to data conforming to international standards, or the green circle. The review therefore focuses on the implementation of the necessary actions to achieve that goal, notably areas 1 through 4 in the diagram.

A data review can serve several purposes and should reflect the level of development in road safety data within a country. Objectives for the review can include: (a) working together on road safety data to build initial trust, (b) building capacity, (c) empowering a team in the host country, and (d) facilitating progress with data as well as other road safety initiatives. Depending on the context, the road safety data review can serve as the starting point of this process or take place at a more advanced stage. In the first case, the visit mainly serves for consultation and getting to know the actors and helps to establish a mentoring system where a team in the country is set up and mentored by one or more experts over a longer period. Further work can continue with online meetings and could be linked with the capacity-building programs planned in the observatories.

If data collection is already more advanced, the visit can serve as a review of existing practice. The review report will describe the strengths and weaknesses of the data-collection system and indicate where improvements can be made.

Challenges triggered by COVID-19 made online meetings much more common and demonstrated many discussions can be successfully led online. Online meetings can therefore form an integral part of the preparation and the follow-up. However, the key objectives mentioned above—trust building and investigating the actual practice in data-collection—can require in-person meetings. Sensitive issues should preferably not be discussed online, especially if several persons are involved. Technical discussions play an important part of building personal relations, but not the only one. Spending time together also helps review participants get to know each other on a more personal level, which facilitates future cooperation.

3.1. Scope of the Review

If time is limited, defining which data should be reviewed becomes especially important. For an initial visit of approximately one week, the focus would be on crash data; however, the review should also assess the availability of other data. A follow-up visit could be required. Depending on several factors, a large part of the week should be reserved for the full coverage of crash and casualty data across the whole chain, from observation continuing through to the making information available to all stakeholders. The general availability and use of other data types can be addressed in a much shorter time.

Because a broad range of different data types are all relevant for road safety management, it is important to define the scope of the review beforehand. Detailed discussions could be required to address all the issues mentioned here and collect all relevant information. Language barriers, for example, can make discussions quite lengthy and a federal structure might require assessing the practice in different states. Revising the line of questioning according to the first discussions might prove necessary, which could reduce or extend the scope of the review based on progress with the interviews. However, in principle, a clear scope should be defined beforehand. Depending on the scope of the review, different stakeholders will need to be contacted. For example, if indicators for road quality have to be investigated, the reviewer must meet engineers in the transport departments responsible for construction and maintenance of the road network, while also evaluating the collection of police enforcement data, which would require meetings with police and justice departments.

It takes about a week to investigate the collection, storage, and use of crash and casualty data. Safety performance indicators (SPIs) and mobility data comprise a complex field because they typically include many different data types and each could require similar efforts to investigate them as do the crash and casualty data. Consequently, a thorough investigation of the whole data collection process—as foreseen for crash and casualty data—might take another week. Thus, the review should focus on crash and casualty data first. For SPI and mobility data, the emphasis could be on discussing which indicators and mobility data are available and how each is linked to crash data and used in the analyses. Based on the problems identified in the crash data and on the discussions with various stakeholders, the review team will gain some insights into which type of indicators would be useful and feasible.

3.2. Preparations by the Host Team

The hosting team should prepare information on different aspects of road safety data collection: (a) an overview of the indicators available, (b) the actors involved, (c) a description of the data collection procedure for the indicators defined in the scope, and (d) examples of the use of the data. Before the visit takes place, the hosting team should help the review team arrange meetings with all important stakeholders.

The host country should be represented by the lead agency for road safety, often the national steering committee, a transport-related ministry department, the national road agency, or other appropriate agencies. Ideally, this agency should also be responsible for road safety analyses and more importantly, for coordinating road safety activities across all sectors and stakeholders.

The following documentation should be provided to the review team, if available:

- Overview of all available road safety data
- List of key partners in road safety data collection, analysis, and use
- Crash registration form (police)
- Registration form (hospital)
- Definitions and legal basis
- Relevant outputs: reports, maps, analyses
- Data tables

For the review team to adequately prepare, the delivery date should be agreed upon in advance of the mission. Documents should preferably be provided in the language of the review, but should also be sent in the country's language, if possible.

The following section explains in greater detail the documentation required, along with some practical considerations on how to organize the visit.

OVERVIEW

The host country should produce a table of all relevant road safety data available (see table 3.1). This table should include crash and casualty data (from police and hospital records) and, if applicable, also list road safety performance indicators and mobility data. The list should indicate for how long (and at what frequency) the data are available and give some important splits that can be made, for example, by road user type, by age group, and by road type. The institution in charge of collecting and maintaining the data should also be indicated.

If available, documentation about the data collection process should be sent ahead. As an example, the collection of crash data should ideally start with the officer who records the crash at the scene and end with the crash database. Some questions to be answered include the following: What are the intermediate steps? How are the data collected, aggregated, cleaned, augmented, and checked? How are data stored and organized? How are data shared and analyzed for road safety interventions?

Table 3.1. List of Available Road Safety Data

	History: First year (and frequency) for regular reporting or dates for ad-hoc measurement	Important variables available (including age, road user type, road type)	Institution responsible for data collection
Police/insurance data:			
Fatalities			
MAIS 3+[a]			
Severely injured			
Slightly injured			
Property damage only			
Hospital data:			
Emergency room patients			
Admissions			
MAIS 3+			
Ambulances			
Exposure data:			
Travel distances			
Vehicle fleet			
Number of valid driver's licenses			
Road length			
Safety Performance Indicators:			
Helmet usage			
Seat belt usage			
Driving under the influence			
Speeding			
Distraction			
Road protection scores:			
Vehicles' NCAP[b] scores:			
Other:			

Source: Original table produced for this publication.
Note: a. MAIS 3+ = Maximum Abbreviated Injury Scale, where an injury is rated greater than 3 on a scale of 1 (minimal injury) through 6 (maximal injury). Injuries rated 3 and higher are considered critically serious; b. NCAP = New Car Assessment Program.

KEY PARTNERS IN ROAD SAFETY DATA COLLECTION, ANALYSIS, AND USE

Usually, the relevant organizations that should be listed include:

- Ministries involved with road safety
- Police
- Hospitals
- Statistics office
- Agencies and coroners in charge of vital registration
- Transport/road/public works department engineers
- Vehicle registration and driver licensing departments
- Nongovernmental organizations (NGOs)
- Road safety advocacy organizations
- Academia and research institutes
- First responders, such as fire and rescue services and disaster management teams
- Insurance companies

If subnational authorities play an important role in road safety management, they could also be included on the list.

The main stakeholders and their roles and responsibilities in the process of data collection should be described. The reviewers should follow the path of data collection and talk to everyone involved in the whole chain, for example, medical staff who document their patients' injuries and the causes, coders who enter the information into the database, staff responsible for building and maintaining the database, staff involved in information technology (IT) system architecture and government servers, and possibly staff who check the injury data and link them to other data sources.

Data collection can concern police, hospitals, and also the vital registration and mortality statistics. For each of these, the review team should trace who collected the data in the first place, who maintains the system for their storage, and who has access to it. If the data are linked, the responsible party should be indicated.

Moreover, information should be provided on how data are being used by the key stakeholders. In this description, the following questions should be considered:

- Who analyzes road safety data, and for whom?
- How are police using data to direct their activity?
- How do engineers use the data?
- Are road safety data linked to the design, construction, and maintenance of the road network?
- Are the crash data linked to asset data?
- Do any other groups use the crash data, such as insurance companies, NGOs, researchers?

RELEVANT OUTPUTS: REPORTS, MAPS, ANALYSES

Ahead of the visit, the review team should try to gain an insight into how available road safety data are used. Some outputs should be requested as examples of the types of analysis conducted in the country under review and which stakeholders are targeted. The host country's team should indicate whether these outputs are published regularly (for example, annually) or as ad hoc studies. These outputs should help to answer the following questions:

- Which analyses are carried out to inform road safety policy-making?
- Which stakeholders are making use of the data?
- Which types of data are used?
- Are there analyses where different types of road safety data are combined?

CRASH AND CASUALTY REGISTRATION FORM

A crash data form used by police as well as health data forms used by hospitals, along with a glossary for the variables and possible values, should be made available as PDFs (portable document format), if possible.

DEFINITIONS FOR CRASH DATA

International transport statistics are based on the glossary for transport statistics (Eurostat, ITF, and UNECE 2019). Aligning crash data reporting with this set of definitions is advised. The reviewer should check the following:

- What counts as a road crash?
    - o To collect data on road traffic crashes, the review must define which crashes are included and excluded. For example, the host country could indicate for the following cases whether they would be considered as road crash casualties: drivers committing suicide or having heart attacks; single vehicle crashes, crashes without motorized vehicles; and crashes on nonpublic roads. If any national definitions are used by the police, these should be made available.
- Who qualifies as a casualty?
    - o How are fatalities, severely injured, and slightly injured defined in the country under review?

The legal framework for data registration activities should be described. If in place, legislation should be presented on (a) the investigation of road crashes, (b) cataloguing different types of vehicles, or (c) national statistics, such as regulating principles of reliability, independence, transparency, and data protection. Moreover, information should be provided on whether the obligation to share data is regulated by law or—on the contrary—impaired by privacy regulations.

DESCRIPTION OF DATABASE(S)

The host country should provide a description of how road safety data are stored. This should contain the type of data, the variables, and the architecture of the database. Materials describing the following aspects of the database should be sent, if available:

- Variables/glossary
- Software, such as Excel or other dedicated software
- Architecture
- Checks and controls
- Links to other data
- Access
- Output options, such as visualizations, dashboards, and standard report, among other options

ACTUAL CRASH DATA

For the crash data, the review team should check the data for temporal and spatial consistency. Annual data for the period for which data are considered valid should be investigated. Possible breaks due to changes in methodology should be indicated. The following tables of annual figures should be provided, if available:

- Fatalities by age group and gender
- Fatalities by road type
- Fatalities by road user type and region
- Number of severely injured, hospitalized, or Maximum Abbreviated Injury Scale (MAIS) 3+ casualties
- Percentage of fatalities who died on the spot, as opposed to those who died in hospital
- Population by region

The review team should also request the number of road crash fatalities from vital statistics, recording the occurrence and characteristics of vital events such as births, deaths, and marriages for the most recent years available.

VISIT PREPARATION CHECKLIST

The hosting team should go through the following checklist:

- Appoint a host team associated with the lead agency for road safety. The host(s) should help identify the stakeholders, accompany the reviewers, and, if necessary, translate and interpret.
- Organize an interministerial or interagency meeting.
- Organize and schedule appointments with relevant officers, at different levels, from different agencies, including the following:
    - o Directorate of the ministries involved with road safety; possibly the same as for police:
        - – Road safety entity (bureau of this administration, or mandated institute) that usually provides national road safety data analysis
        - – Local entities of the above ministry in charge of local implementation of road safety policy

  - o Police department: (deputy) police commander and police officers from operational teams in at least two regions and from two different levels. In some countries, the police comprise several entities responsible for urban areas, for the countryside, for motorways, and other transport infrastructure. In that case, it is necessary to meet each of them, or at least the most important ones
  - o Transport/road/public works department
  - o Hospitals or other health centers: staff in charge of registry systems in hospitals or other health centers where road crash patients are brought and registered. If this is an important component of data collection, two different hospitals should be visited
  - o Ministry of Health and staff in charge of managing data from hospitals and health centers
  - o Bureau of statistics: staff in charge of fleet and population data, death statistics, vital statistics, mobility statistics, infrastructure statistics
  - o Other important stakeholders, such as research centers, universities, road safety advocacy, and insurance

- Acquire necessary permissions to attend a crash site, together with the investigating officer

In practice, it might not be possible to accommodate all visits within the tight schedule of one mission. The host team will have to do their best to arrange as many of these essential meetings as possible. One-to-one interviews are ideal, but group meetings could be a valuable alternative—especially if people feel free to report possible problems. Ideally, the visit should start with the entity in charge of public road safety policy. Meeting this person is the best way to gather a broad overview of the situation from the outset and to pin down the issues at stake.

3.3. Preparations by the Review Team

The review team should prepare the visit by reviewing the information provided by the host team, checking the crash data for completeness and consistency (if possible), comparing the national figures to those from international sources, and investigating earlier reviews on the host country and any previously issued recommendations. In order to gain maximum information from discussions during the country visit, the team should carefully review the material in close cooperation between visiting and hosting teams. The team can also consider conducting a pre-visit video conference to elaborate on data needs and challenges.

The preparations should include the following steps:

- Establish an overview of the organization structure in the host country
- Identify key stakeholders, indicating whom the team should meet during the visit
- Search for previous reviews or related research on the host country
- Review existing documentation and reports
- Inspect crash data:
  - o Compare crash definitions used to United Nations Economic Commission for Europe (UNECE) definitions
  - o Inspect crash data for anomalies
  - o Compare reported crash numbers to World Health Organization (WHO) statistics
  - o Compare reported crash data to vital statistics
- Assess the use of SPI and mobility data

The following sections describe the preparation activities in more detail.

ESTABLISH AN OVERVIEW OF THE ORGANIZATIONAL STRUCTURE

The hosting and visiting teams should work together to establish an overview of the organization, detailing how different stakeholders work together, the roles and responsibilities at the institutional and staff level, what the crash data collection chain looks like, and any agreements in place for data collaboration.

The hosting team should help the visiting team understand relevant processes and procedures. It can also be helpful for the visiting team to consider cultural aspects relevant to the review. Since team members will not necessarily be aware of cultural specificities, it could also be useful for the visiting team to meet with people who have visited the host country before or have an online meeting with a local consultant not originally from the host country.

IDENTIFY STAKEHOLDERS

The host team should identify the main actors and describe their roles in data collection and data usage. During the visit it will be important to look for gaps in engagement with these partners, and a check of the stakeholders listed by the host team against the list of typical stakeholders (see chapter 4) could be useful. Possibly, the team might have to check with the host team to identify who else could assist in the collection, analysis, and eventual use of data. As an example, an existing asset database might prove quite useful, even if not directly linked to performance management activity.

The review team should also check with the host team whether they have made the necessary arrangements to meet people at different levels. To understand whether general procedures are actually applied in practice, it is important to speak with the agency leaders as well as those who attend crash scenes, fill in forms, and perform other tasks related to data collection.

IDENTIFY EARLIER REVIEWS AND OTHER LITERATURE

Consultants planning the review should investigate any previous reviews. Often, quite a few reviews have been carried out. Some of them might have been data specific and others might have touched on data issues. It is often informative to investigate what has been previously reviewed and what early recommendations have been issued or actioned. Before issuing new recommendations, the team should reflect on whether the earlier recommendations have been implemented and, if not, determine the barriers that impeded their implementation.

Also, reviewers should check for other publications of interest about the host country. Interesting sources include the *Global Status Report on Road Safety 2018* (WHO 2018); the country profiles (World Bank 2019), Lancet publications on the global burden of disease and injury (for example, Chen et al. 2019), or the E-Survey of Road Users' Attitudes (ESRA) project country factsheets, available online at https://www.esranet.eu/en/publications/.

REVIEW THE EXISTING DOCUMENTATION AND REPORTS

The host team should provide the review team with prior access to a range of materials, documentation, and relevant studies on the data collection systems, such as crash or hospital registration forms, glossaries, lists of indicators available, and other materials, along with the outputs based on road safety data, including reports and dashboards. With translation software continually improving, language should no longer be a barrier.

The documentation on data procedures can help the reviewers prepare for the visit. Moreover, the availability of such documentation indicates how well these procedures are structured. A glossary for the registration of crashes should be included, but, if not, the registration forms for the police and hospitals, if available, offer an overview of the collected variables.

Depending on the level of detail, reviewers should check beforehand whether the choice of variables is adequate, and confirm during the visit whether all variables have been filled in reliably.

The studies and reports provided should indicate whether, and how, different types of data are actually used. Progress should be monitored using different types of data. The review team should check whether all available indicators are indeed evaluated. Not all analyses are equally meaningful. As an example, crash data can be presented simply as numbers, though it is easier to make sense of the data when rates per population, vehicles, kilometers, and other indicators are shown as the development over time or comparison of percentages in different situations. If the crash location is available, crashes can (and should) be related to road characteristics. Normally, in-depth reports addressing particular problems or pertinent questions would also be available. During the review, the team should evaluate whether publication formats suit the purposes of different stakeholders. For instance, the police should be able to use the data to understand when and where enforcement activities are needed, or the data could contain the necessary network information to inform infrastructure programs.

CHECK THE DATA PROVIDED

COMPARE DEFINITIONS USED FOR INTERNATIONAL REFERENCE

To compare data in the regional road safety observatories and for benchmarking purposes, it is useful if the definitions applied by the host country agree with the definitions applied in international crash statistics (Eurostat, ITF, and UNECE 2019). For example, the criterion for fatalities should be death within 30 days, for severely injured it should be 24 hours in hospital, or a Maximum Abbreviated Injury Scale rating of 3 or higher, or MAIS 3+ (Weijermars et al. 2018), and for slightly injured needing medical help. All crashes involving a moving vehicle—even if it is only one vehicle and even if this is a nonmotorized vehicle—should be included.

CHECK DATA FOR ANOMALIES

The review team should have a thorough look at the crash data before the visit. Individual crash records, if available, can be checked for completeness and consistency; for example, crashes occurring during daylight hours cannot be coded as night-time crashes; pedestrians should not have been counted as passengers, and other potential issues. If no individual records are available, perhaps for privacy or other reasons, a closer look at the summary statistics can also indicate possible problems. For example, the **annual data can be plotted over time**. Any sudden breaks could either be related to major events in the country, such as a pandemic, an economic crisis, or a new law making seatbelts mandatory, or it could point to changes in crash registration. Anomalies, such as sudden changes in the development, can be interesting to discuss during the visit. The **regional data can then be compared to check for full spatial coverage.** Typically, one should aim for 5 to 10 regions in the analysis and compare, for example, the number of fatalities per population for each region or the distribution of road user types for fatalities in each region, such as the percentage of pedestrians, motorcyclists, and car occupants among the fatalities. Large differences between regions. For instance, a much smaller proportion of pedestrians among fatalities, can be related to real differences with respect to traffic in general, such as urban versus rural areas, or with respect to road safety such as better infrastructure. However, these differences can also point to weaknesses in the data registration methodology, for example, not recording pedestrian crashes.

The local experts should be aware of large regional differences, which will either provide an explanation in terms of traffic safety, or deduce a possible a data-collection issue—along with, ideally, a possible solution.

Comparison of fatalities who died on the scene and who have died in hospital can reveal possible problems with updating crash records when the victim has died in hospital. In European countries, between 17 percent and 43 percent of road safety fatalities are reported to have died in hospital (Adminaite et al. 2018). Although differences can also be due to differences in trauma response, lower percentages are likely to point to issues with updating crash records when casualties die in hospital. In Organisation for Economic Co-operation and Development (OECD) countries, the ratio between reported fatalities and reported hospitalized casualties ranges between 2 and 31 (with an average of 9) hospitalized casualties per fatality. However, the true estimated ratio is about 15 hospitalized casualties per fatality (World Bank 2019).

COMPARE REPORTED NUMBERS TO OTHER STATISTICS

The World Bank *Country Profiles* (World Bank 2019) share the country-reported data for low- and middle-income countries (LMICs) and contrast them with the estimated numbers in the *Global Status Report on Road Safety 2018* (WHO 2018), along with estimates based on the global burden of disease (GBD) data gathered from the Institute for Health Metrics and Evaluation's GBD Results Tool, available on the Global Health Data Exchange: http://ghdx.healthdata.org/gbd-results-tool. The WHO estimates are at least 3 to 4 percent higher due to differences in definition—for instance, WHO statistics also include deaths after more than 30 days—and because cases with "unclear intentionality" are added pro-rata to the road traffic crash counts. However, the WHO estimates can exceed a country's record by much more. On average, middle-income countries (MICs) report only 50 percent of fatal crashes, while low-income countries (LICs) report only 10 percent (World Bank 2019). Reviewers should check "Explanatory Note 3" of the *Global Status Report* (WHO 2018, 288–95) for the methods applied to different groups of countries and to which group the host country belongs. For large differences between the WHO estimate and the number reported, reviewers should ask the local experts for an explanation. Note, however, that often countries' experts do not understand how the WHO arrived at the relevant estimates.

Another useful check is to compare the number of fatalities to the country's **vital statistics**. If the cause of death is included, road crash fatalities can be derived from these.

REVIEW REPORTS AND OUTPUTS OF REGIONAL OBSERVATORIES

The regional road safety observatories should have reports on road safety priorities and data of countries within a certain region. Comparing the national data with other data from similar countries in the region would provide insight on a country's performance—in data collection in particular, and road safety in general. Outputs from the observatories can also provide context as to the most pressing issues in a certain region, which can then inform on the types of data to prioritize.

PREPARING FOR THE INTERVIEWS

To prepare for the interviews during the visit, questions should be derived from the general introductions in these guidelines and from the issues identified during the preparations. The materials provided in advance and the details of the investigation of data completeness and consistency should be reported in the appendix of the review report. It can be useful to discuss possible data issues identified in these investigations completed during the visit. However, the value of triggering interesting discussions should be balanced with the importance of building trust and getting to know the country. If the visit is mostly about establishing a working relationship, this sort of discussion might better be postponed. If the visit serves to screen the data collection and use, it is useful to have some possible issues at hand. One should, however, proceed from the assumption that a reasonable explanation exists. The reviewers should be prepared to learn about the local road safety situation and data system rather than arriving convinced something is wrong. Chapter 4 discusses the actors that should be consulted and the topics to examine. A list of questions for each actor should be prepared and used to conduct semi-structured interviews. Generic lists of questions that can be adapted to the host country can be found in appendix B.

Preparing a brief presentation for each meeting can be useful, which should include the objectives to be pursued, the role played by the host institution, and the main issues to be dealt with in the meeting to help participants understand the importance of the meeting and why their collaboration is required.

A brief summary of the preparatory activities is outlined in figure 3.2.

Figure 3.2. Preparatory Activities for Road Safety Data Reviews

Source: Original figure produced for this publication.

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4. Country Visit: Stakeholders to Meet

All entities involved in the collection or use of road safety data should be consulted. This concerns governmental actors, the institutions that deal with crashes directly, as well as other stakeholders. During the visit, the most important stakeholders should be consulted on all issues relevant to their role in the collection and use of the different types of road safety data.

This chapter discusses the entities typically involved in a road safety data review. Topics that should be discussed during a review often overlap between different stakeholders, because one of the important objectives of the data review is to address inconsistencies between the approaches of different institutions. The essential topics are listed in the chapter 5, with indications of which stakeholders should typically be consulted on each topic.

The review team should attempt to meet with all stakeholders, including ministries involved in road safety, police, statistics offices, road safety advocacy, and road safety scientists. For those bodies who report the data, the review team should meet staff at various levels, such as local, regional, national, management, and those executing the work. Consequently, the country visit will likely be densely packed with interviews.

The procedures might not be uniform throughout the entire country, and could differ for states, provinces, or even municipalities. For instance, each police district and type of hospital might have different protocols. In some countries, various police entities oversee different parts of the road network. In all these cases, speaking with representatives from each active institution should be prioritized.

4.1. Ministries and Government Departments

The ministry responsible for road safety is often the ***transport department***. Even when this is not the case, the transport ministry should be using road crash data to define blackspot locations and determine road design. These departments also commonly collect data related to driver licensing and vehicle registration.

In addition, road safety should also be the responsibility of the ***health departments***, and where possible, the review team should identify the specific department(s) tasked with collecting crash data. This might be the public health or the epidemiology department or could be the rehabilitation, emergency, or post-crash department. Different departments often collect specific types of crash data.

In some countries, the ministry of the ***interior*** is responsible for road safety or can provide data on police interventions.

The ***lead road safety agency*** is usually situated in one of these ministries. It should include a group of data analysts charged with aggregating all data, including the questions stakeholders have, the available data, and corrections for possible problems with the data. This group serves as the natural hosting team for the data review. These analysts should benefit most from the review in terms of capacity building, but should already have the capacity to carry out meaningful analyses. The group's output should reflect the needs and expectations of policy makers and road safety

advocacy groups. The analysts are also responsible for making the data available to others. For their analyses, they should be aware of how the data collection process functions. They should check the data and—if they become aware of problems—would be responsible for initiating work to correct them.

Ideally, the topic of road safety should be addressed cross-sectionally across relevant organizations. An interministerial or ***interagency meeting*** should be organized to ensure statements from one agency are validated or cross-checked with statements from another agency. The review team should also meet with the departments not yet involved in road safety work to check for additional data sources and gauge whether policy makers might support and request additional data collection, and if so, whether they could provide the necessary resources. The departments should also be asked about their use of road safety data.

Subnational authorities can play an important role in road safety data collection especially if the relevant competencies, such as infrastructure, policing, or laws, are not situated at the federal level. In that case, speaking with subnational representatives separately, or bringing them together for a group discussion, can be very helpful. While these guidelines address a data review at the national level, this type of review could also inform local or subnational authorities looking to assess their data management practices. The applicability is, however, limited to the type of data for which the authority in question is responsible.

4.2. Police

The review team should assess the police's commitment to collecting crash and other road safety data, to the practical implementation of data collection, and also their use of the data. Reviewers should inquire how well the police understand the reason these data are collected, and the importance of this task in managing road safety outcomes. If the police actually use the data they themselves collect, this tends to increase their commitment. If different police bodies are involved in data collection, they should ideally all feed into the same national database and use the same (or sufficiently similar) data collection protocol. With separate databases, all issues concerning data transfer must be investigated. Moreover, it is essential to speak with personnel in each of the police bodies and examine whether the procedures are sufficiently similar. At least two separate police departments should be visited. Ideally, one of them should be located in the capital city, or wherever the review is situated, and serve as police headquarters or other office high up in the hierarchy. The team should also visit a police department in a contrasting region, possibly a rural or more distant office, and of a lower hierarchical level, perhaps a regional office. The interviews should not be restricted to the management, but also include field officers who attend crash scenes. If any other personnel enter data into crash forms, they should be interviewed as well.

4.3. Hospitals

Mortality statistics can be used to check crash data, or might even serve as their base. The data reported to the World Health Organization (WHO) contain a code for cause of death, which identifies casualties of transport accidents. However, those statistics are also not necessarily complete. Where hospitals play a vital role in the registration of road crashes, the reviewers should investigate how registration works in practice. This could concern the registration of details about the crash in the hospital's database, such as the travel mode of the victim and the opponent. Cooperation with the police to improve crash records is also important, including notifying the police of the crash, determining the severity of resulting injuries, and updating the crash report when needed, for example, when a patient dies. A third topic of interest concerns collecting data on trauma response, such as how long an injured casualty receives medical treatment after a crash.

4.4. Statistics Office

In many countries the national statistics office collects data from the police and hospitals. This office might be the entity responsible for checking, correcting, and augmenting the data, such as by linking them to other data sources. The statistics office might also maintain other relevant databases, including vehicles, drivers' or riders' licenses, fines, and verdicts for offenders, and also maintain the vital statistics used to check the number of fatalities.

4.5. Coroners

Vital registrations of deaths are collected from data provided by doctors, hospitals, and coroners. In most countries, violent deaths, such as road crashes, require forensic action, and all three groups would, understandably, appreciate knowing about working procedures relating to road crashes. This interest applies especially to coroners, who carry out analyses of psychoactive substances on corpses. Results of the coroners' procedures can be used to check and augment the road crash database. The reviewers should investigate how coroners collect data, how they classify road traffic fatalities, and whether they report to the road traffic accidents database or to the traffic police.

4.6. Insurance Companies

Although they do not function in an official capacity, insurance companies may play a significant role when constructing traffic-related indicators. For instance, the Dominican Republic produces road fatality numbers by aggregating the databases from law enforcement officers, forensics, hospitals, and vehicle insurance companies. A similar approach is being planned in Thailand, where the insurance companies hold the most comprehensive crash datasets in the country.

4.7. Road Safety Advocacy Groups and Journalists

Advocacy groups are important users of road safety data. Reviewers could benefit from interviewing these groups. Suggested questions include the following: Do they have access to data?; and Do they use road safety data? Moreover, advocacy groups often collect data as well. Are the data shared with other actors? In addition to actual lobby groups, journalists can also be important users of road safety data. They can play a role in increasing awareness of the need to improve road safety, but they can also contribute to a hostile climate towards road safety interventions and data collection activities.

4.8. Research and Academia

Research and academia play an important role in road safety policy-making efforts. The lead agency should be supported by analytical work conducted by academic researchers, making sure they have access to all road safety data. In additional, researchers can often help with technical issues, such as matching hospital data with police data, the weighting of road-side survey results, or location mapping and spatial modeling of crashes.

5. Interviews: Topics to Address

In the interviews, reviewers should focus on practical information and collecting evidence of how procedures are actually carried out, as compared with the official protocol. It is important to talk to those persons who implement the procedures, such as officers at the scene, those who enter the data, and others. Process demonstrations and answers to practical questions can help reveal structural problems. This chapter suggests questions for the various relevant topics.

The reviewers should be prepared for differing cultural contexts influencing behavior, such as interviewees being hesitant to answer any question with "no" or other negative response, or admit to a mistake or being involved in corruption. Such aspects can not only affect data collection practices, but also what interviewees say and how they say it. Obtaining concrete, accurate information requires the review team to focus on practical implementation, which helps in evidencing the procedures as properly carried out, as compared with the official protocol.

Practical demonstrations and observing the execution of different tasks offer a more accurate picture than verbal explanations. For a more vivid, complete picture of the country's road safety data situation, the review team should ask to visit a crash site with the police, or visit a hospital or health center. They should always ask to see concrete examples and materials. Focusing on practical restrictions in terms of time, transport, and equipment can help the review team assess whether the outlined procedures are truly being implemented.

Reviewers should gauge whether all stakeholders understand and support the need for quality data. Moreover, commitment to identifying and correcting possible problems is a necessary, but not always given, condition for progress. The interaction between members of different organizations is also important. They should be aware of each other's actual procedures in data collection and coordinate their efforts, for example, police and health bodies. Consequently, the same questions should be put to many actors and the consistency of their responses checked.

Meetings with stakeholders should be conducted as semi-structured interviews. A generic set of interview questions for the different stakeholders can be found in appendix B. To help prepare for the interviews, this set of questions should be adapted to the situation in the country under review. During the interviews, the reviewers should use the questions as a starting point and as a checklist to validate whether all relevant topics have been discussed. Following the results of the first interviews, the questions for later ones might need to be updated. Group discussions can be a time-efficient way to get input from several people, although some people may be uncomfortable discussing problems in this setting. Sometimes one-on-one discussions will encourage more open responses.

The topics included in the interviews should cover the whole chain of investigation, registration, transmission, storage, processing, and use of data. The topics covered here concern the police crash data, the hospital injury data, and other road safety data, such as safety performance indicators (SPIs) and travel data. Each of the topics in the remainder of this chapter should be discussed with different actors to find out not only how things are supposed to occur, but also how they are implemented in practice. An important objective for reviewers is to make sure the practices of different actors converge. The following sections provide for each topic **concrete instructions on which aspects the reviewers should consider and which questions should be asked.**

5.1. Organization of Crash Data Collection by the Police

Everybody who interacts with police data should be aware of how they are collected. Accordingly, the questions below should be put to both the police as well as analysts in the lead road safety agency and the statistics office, if they handle these data.

NOTIFICATION

How are the police notified? Is there a central emergency number? Who notifies the police about crashes when victims are taken to hospital in private cars? Could there be crashes of which the police are not notified, for example, crashes involving only one vehicle or only nonmotorized vehicles? What happens if participants are not insured—do they still call the police? What are the possible reasons why people would not report a crash to the police, such as driving without a license, driving while intoxicated, or having a general distrust of police?

REGISTRATION OF CRASHES

Do the police have the budget and personnel resources to attend every crash scene, at least those resulting in serious or fatal injuries? What about remote areas, geographic or climate conditions, or too many crashes? Could these circumstances result in not attending a crash scene? Are enough patrol vehicles available to attend every crash scene? Reviewers should ask very specific questions about all practical aspects of how police process crash data, such as the number and length of work shifts, how many officers attend a crash scene, the number of reported crashes, the types of vehicles involved, the time required for registration, and a quick assessment of whether it all adds up can help indicate circumstances in which crash scenes cannot be attended. In cases where the police cannot attend the crash scene, are crash data collected in other ways?

INFORMATION INCLUDED IN CRASH DATA

What is reported about crashes and how? Which variables are coded? If the registration form has not been provided in advance of the visit, the review team should inquire and attain a copy. Is the form online or on paper? Is the form uniform throughout the country? Which tools are used during the crash investigation, such as a measuring wheel or laser device, alcometer, global positioning system (GPS) device, video camera, and other tools? Can these be shown or demonstrated to the review team?

For several variables, reviewers should discuss how each is coded and, accordingly, how the officer at the scene would correctly determine the coding. Chronically difficult issues include, for example: use of protective equipment, intoxication, speeding, and injury severity. Is the hospital contacted about whether a casualty's condition has declined or, particularly, if a casualty has died in hospital? If so, is the information on injury severity updated in the database?

If causation factors are coded, reviewers should check on which information these factors are based. Such factors are generally recorded without the officers being able to obtain reliable information. Moreover, the factors available for selection often focus mostly on driver errors, rather than addressing all aspects of the road traffic system, including road user behavior, infrastructure, and vehicles.

DATA TRANSMISSION

When and where is the crash entered into the database? Directly at the scene? Afterwards? How long after attending the crash scene? Is the person who fills out the crash registration form the same as the person attending the scene? If not, which information is the entry based on and is the completed registration form checked at the local police station?

If the initial registration is on paper, who is responsible for entering data into the database? Is the registration form sent to a central location? Is someone at the local police station checking whether all registration forms are completed and sent to and then imported into the central database? What process ensures each form is counted? Is double counting possible? And if so, what is done to avoid it? What about data updates—for example, a crash that turns out to be fatal three weeks later? How long does it take for data to reach the crash database following a crash?

HUMAN RESOURCES

What kind of training do officers who investigate crashes receive? How many days? By whom? Are all officers trained? Are they all trained in the same way? Are any follow-up or refresher courses offered? Does the training succeed in highlighting why recording crashes is so important? If data analysis is an officer's duty, is this addressed in training? Is there sufficient budget allocated for training? Are there training standards that cover how to process and analyze crash data?

LEGAL FRAMEWORK

Which crashes are the local police legally obliged to report: all, all injury crashes, all fatal crashes? Are the police obliged by law to share the data? Or do any legal constraints, for example, privacy restrictions, prohibit this? Does the legal framework identify other stakeholders in crash data collection?

CHECKING DATA AND FEEDBACK TO LOCAL POLICE

Are there checks or controls on whether the police fully report on all the crashes they are obliged to record? How? Are there consequences for the local police if not all crashes are reported? Are quality checks conducted on crash reporting? Is the completeness of the variables filled in checked? Are consistency and plausibility checks routinely, or automatically, conducted? Are the results fed back to the local police? To the officer who coded the case?

What is, or could be, done to motivate the police regarding data registration? Is the registration of any value to the local police? Do they get reimbursed? Are database entries also used to produce reports for the court? Do the local police use the summary information on crashes themselves, or are they aware of any local policy makers using the data?

5.2. Surveillance of Road Traffic Injuries by Hospitals

Hospital data are an important complement to data collected by the police. If hospital data are used for statistics on road traffic casualties, the local staff involved in registration should be interviewed as well as the management of the hospitals and institutions that further collect and process the data. Questions that should be considered are described in the following paragraphs.

MEDICAL TREATMENT OF ROAD TRAFFIC CASUALTIES

Which hospitals or health facilities treat road traffic casualties? Are all road traffic casualties treated in hospitals? What if the casualty is not insured? How do road traffic casualties arrive at the hospital? Mainly or all by ambulance? Are there also private ambulance services? What happens after the casualties arrive—first the emergency department, then admission to the hospital if needed? Which other data sources could be used—emergency calls, ambulance dispatching, insurance? Could these be used to check the completeness of the casualty registration? Or to address post-trauma care? Or to investigate the medical costs related to road crashes?

INFORMATION INCLUDED IN ROAD INJURY SURVEILLANCE SYSTEM

Is there a system for registering road traffic injuries? How do hospitals collect and report the data? How is each field in the hospital record form filled in? Which information about the crash is included? Road user type of patient? Road user type of the other involved party, if any? Information about the location (urban, rural, type of road)? What about data for patients transferred to another hospital? Would the established cause of the injuries be included in the records of the second hospital?

Is the system set up exclusively for the collection of data on road traffic casualties? If not, how can road traffic casualties be selected or disaggregated from other forms of trauma? How is whether a patient is a road traffic casualty or not determined? What is the definition of a road traffic casualty? Which variables or characteristics are included in the injury surveillance system? How does the system work in practice? When is a case reported—directly, or based on information from another system or registry? Who enters the information in the injury surveillance system? Are these people trained to do this? How long and how thorough is the training? Is follow-up or refresher training offered? Do they have adequate time to enter the data?

ASSESSMENT OF INJURY SEVERITY

How is a serious injury defined? Are they familiar with the MAIS scale? The Abbreviated Injury Scale (AIS) measures the severity of each injury on a scale from 1 (slight injury) to 6 (non-treatable, usually fatal injury) for each of the 9 regions of the body (head, face, neck, thorax, abdomen, spine, upper extremity, lower extremity, external, other). The Maximum AIS (MAIS) determines the highest AIS-score out of all injuries sustained (AAAM 2016). In many countries. MAIS 3 or higher is considered a serious injury (Weijermars et al. 2014). Do they include the AIS information in their reports or intend to do so? If not, what method is used to determine whether an injury is considered serious?

DATA TRANSMISSION

Are procedures and forms uniform throughout the country? How is data from different hospitals combined? What happens to data for patients who are transferred to another hospital; could they be double counted? Which casualties are recorded in the system—only people admitted to hospital, or outpatients as well?

HUMAN RESOURCES

Who enters the information in the injury surveillance system? Does the staff have adequate time to do this? Are they trained to do it? How long is the training? Is follow-up or refresher training offered? Is there sufficient budget allocated for training? Are there training standards? Does the training include information about road crashes and the importance of injury surveillance to improve road safety?

LEGAL FRAMEWORK

Are all hospitals and health centers obliged to register casualties in the injury surveillance system? What happens if they fail to do this? Are there incentives for the hospital to register road traffic casualties? Do private hospitals report as well? Do any privacy restrictions prohibit reporting of road traffic injuries? Is hospital staff obliged to inform the police about incoming road crash casualties?

CHECKING DATA AND FEEDBACK TO LOCAL HOSPITALS

Are the data checked for missing records, completeness of records, or inconsistencies? If so, how? Is feedback on data quality provided to the hospitals and local staff?

Are there any indications about the degree of completeness or about under-registration? Are there other databases from emergency rooms, ambulance dispatchers, and other sources? Could this information be useful in checking the registration of road traffic casualties?

5.3. Storage, Integration, and Quality Control

The use of road safety data depends crucially on how it is integrated, stored, and made accessible to all stakeholders. Different data sources must be linked to ensure completeness and applicability and the data quality should be controlled and fed back to those who collect and enter the initial data. The following questions help to assess these important steps.

DATABASE AND ACCESSIBILITY

The existing databases, for crash or hospital data, for example, should be assessed by means of practical demonstration to understand the features included and see whether the appropriate people know how it is used. Additionally, the following questions could be asked:

Who is maintaining the central crash and casualty database? Does it combine different sources, such as police, hospital, coroner data, or civil registry? What is the architecture of the crash database? Is the crash information linked to other databases, such as the vehicle or license registry or asset databases for road management? Does the coding of data allow for cross-referencing between datasets?

Who feeds the database? Who is authorized to make changes? Who has access? Is there a data warehouse that enables the combining of crash and casualty data with mobility data or SPIs? Is the information aggregated or linked? Are there any standard outputs (maps, dashboards, visualizations, or standard reports) produced automatically?

INTEGRATING INFORMATION FROM DIFFERENT BODIES

Hospitals, police, and other actors, such as the civil registry or coroners, should cooperate to ensure the identification and correct classification of all road traffic casualties. It is important to identify gaps in the chain of registration so these can be corrected later by aggregating different databases.

Do medical staff check whether police are informed when they treat crash casualties? Do the police consult medical staff in reporting the injury severity? How are changes in injury status handled? Most importantly, what happens if a crash victim dies in hospital? Who takes the initiative to update the crash record? Do police contact the hospital after 30 days to check for any update to the recorded severity? Or does the hospital notify the police if a crash victim dies in hospital? What if a casualty dies somewhere else? For example, in some cultures, families bring the patient back home before he or she passes away. Would these cases be identified in the civil registry or by a coroner?

COMPLETENESS AND QUALITY OF DATA

The road safety agency, the statistics department, or central police management, civil registry, and road authority could (and should) all contribute to the various integrated data sources at central level and help enhance data quality. The following questions should be considered:

Are the data checked at central level? Are the numbers comparable across datasets? Vital statistics? Coroner data? Are police data and hospital data matched, or at least the numbers compared?

Are quality checks conducted to ensure consistency and completeness? What happens in the case of problems? Missing cases? Inconsistent coding? Many incomplete fields? Are the data corrected, and if so, how? Are the results fed back to the collecting bodies, that is, the police and hospitals?

Are estimates of under-registration included? How is under-registration estimated? If discrepancies appear with other figures, such as those in the *Global Status Report* (WHO 2018), are the local actors aware of that? Do they have an explanation?

The reviewers should ask to see individual crash records. These should be checked for completeness and consistency. If the preparatory analysis, including differences across regions, has indicated any abrupt changes over time or large differences between regions, the review team should discuss any possible explanations in terms of “real” differences with respect to factors such as traffic participation or road structure, or whether the *reported* differences point to inconsistencies in registration practice.

5.4. Other Road Safety Data

Road safety data includes crash data as well as data about the safety performance of the road traffic system and interventions to improve road safety. These data are best used when combined with other data such as traffic data, such as distances traveled and the split between different transport modalities. While the focus of a limited review should be on crash data, the availability and use of other road safety data should be discussed, along with the possibility and methods of collecting other road safety data, with the department of transport, police, hospitals, statistics office, and road safety researchers.

MOBILITY DATA

Travel data are important in interpreting crash and casualty data in relation to the distances traveled or with surrogate measures of them. The review team should explore what kinds of data are available, such as distance traveled, population, vehicle registration, road length, and gross domestic product (GDP).

For dedicated data collections on mobility, the team should check the following issues:

- Which travel modes can be differentiated?
- At what frequency is the data collected (permanently, annually, ad hoc, or other)
- Are the data representative (see appendix C)?
    - o What is the spatial resolution for which you can make meaningful statements (country, region, municipality, road)?
    - o What is the temporary resolution for which you can make meaningful statements (year, month, day, hour, or other)?
- How are these data used?

If no dedicated data collection on mobility is yet in place, discuss what could be done. Explore the use of "smart" measurements, such as smartphone apps or data from telephone companies. However, it might very well be the case that mobility questionnaires are still the cheapest way of establishing the share of different transport modes in traffic. To relate the development of casualty numbers to the development in motorization, fleet size by vehicle class, fuel sales, and even GDP can be interesting surrogates.

SAFETY PERFORMANCE INDICATORS

As intermediate outcomes, SPIs are essential in linking countermeasures to final outcomes (crash and casualty data). The review team should discuss the concept of performance indicators with different actors in the lead agency as well as in other ministries or road safety advocacy groups. If appropriate, their value in monitoring and evaluating the effect of road safety measures should be explained. The following questions could be considered:

- Which SPIs are available? Are evaluations of road user behavior (speeding, use of protective equipment, intoxicated driving, distractions) available? Could big data sources, such as mean speed data, help? Are roadside surveys conducted? Are data on underlying attitudes available? Are data on the safety scores of roads or vehicles available? Is an asset database for the maintenance of the road network available? For the available SPIs, ask for details on data collection—including representativeness, observed versus self-reported, and sample size—and be sure to inquire about the use of the resulting figures.
- Which SPIs would be considered the most useful for the review country? Which would be the most achievable to measure? For example, the use of protective systems is relatively easy to observe systematically, while even countries with long road safety research traditions struggle to measure distraction or to produce safety scores for their road networks.

Many SPIs require roadside surveys (see appendix C). However, while observed behavior is more reliable, self-reported behavior can be a much cheaper alternative, because several behaviors can be addressed at once (see the section on Road user behavior in chapter 2). To measure speeding, floating car data provide an alternative to classic measurements with radars or tubes. Also, big data companies share average speed data per road segment, which can be matched with crash data (see the Infrastructure section in chapter 2).

Reviewers should discuss with the department of transport which indicator could be collected to monitor physical infrastructure improvements (see the Infrastructure section). Consideration could be given to road-related SPIs, such as monitoring the International Road Assessment Programme (iRAP) star rating of road sections or implementation indicators, such as the number of improved intersections.

IMPLEMENTATION INDICATORS

To keep track of the implementation of countermeasures and to evaluate their effect, it is important to collect data on all types of intervention.

For example, **police** data could include the number of checks conducted, the number of camera readouts, the number of tickets and fines imposed, the degree to which controls and distribution of fines are automatized, or the time passing between offense and sanction. Data collection for these indicators is often impaired by practical or institutional barriers. Consider the following questions:

- Do the police register their working hours according to particular activities, for example, alcohol checks, speeding controls, and other activities? Is this done by all police entities? Can these data be aggregated? Is the same software used by the various entities? Are there institutional barriers to releasing these data, such as in some countries where publishing internal procedures is a sensitive issue? Could these barriers be overcome? Which agreements could be made to deal with data protection issues? **Could intersectoral commitment be increased?** Which level would, in that case, be the most important to address?

- For the **road administration**, indicators could include stretches of road with reduced speed limits, length of road sections, number of intersections, or the resources spent on road maintenance and redesign. An important question here is whether these data are systematically registered. Is this the case for all parts of the country? Who would take the initiative to combine data from different (for instance, regional) offices? Are all actors willing to make public how they spend their time and money?

- Is **vehicle testing** mandatory? Which institution is responsible for summoning owners to test their vehicles? Are data available from testing centers, concerning the number of vehicles checked, the number of vehicles that complied or failed the safety tests, and the percentage of vehicles admitted after repairs? What is the frequency of testing, is it tied to annual or biannual registrations? Which specific safety elements are tested?

- The emergency services are important sources for data on **post-trauma care**. How are ambulances dispatched? Do these services maintain data on the number of deployments and their timings? Would these data allow estimated percentages of crash scenes attended by an ambulance and the time needed for the ambulance to get there?

For more information on this subject, see Bliss and Breen (2013).

5.5. Capacity

The review team should evaluate the capacity for all functions in the data collection and analysis process. Capacity can concern knowledge, time, or materials. The following questions could be useful:

- **How is a sufficient level of knowledge ensured?** What are the backgrounds of the employees? How much time do they typically spend on the job? Is there a problem with turnover? How long do employees, on average, stay in that position? If on-the-job training is offered, how does that work in practice? Are seniors systematically paired with juniors? How are the rules and methods passed on? If formal training is provided, is everyone trained? If not, are the contents actually passed on to other colleagues, and if so, how? If training programs are offered, the review team should talk to those responsible for organizing the training as well as those who should, presumably, have received it.

Moreover, the availability of the necessary resources in terms of materials and time foreseen for the task should be checked. Specifically, the following questions could be considered regarding specific tasks:

Data collection:

- **What capacity is there to investigate crashes at the scene?** How are the officers who attend the crash scenes trained? Do they enter the crash data into the system themselves or does someone else do this? If other people do it, how are they trained? Is adequate time provided to attend the crash scene? Is the necessary material available? Is the software sufficient to enter the records into the database? Is work time allotted specifically for data entry?
- **In hospitals, who registers road crash victims on a database?** Do they have a medical background? How are they trained for this task? Do they know anything about road safety? How much time is needed to enter each case into the system? Do the staff have adequate time to complete this task? Are means (such as software or tools) available to ease the burden of data collection or registration?

Storage and analysis:

- **Maintaining a crash database requires technical resources and know-how.** What is the architecture of the system? Is it a relational database? Is the database linked to other databases? Is the hardware sufficient to support this structure, and any possible improvements? Are the persons who maintain the database the same as those who built it? Are they data scientists? If not, what is their level of expertise?
- **Does the system allow all necessary analysis?** Does it serve the needs of all stakeholders? Can the data be cross-tabulated, for example, can an analysis be conducted to determine number and location of child pedestrians walking at or around school start times? Are spatial analysis tools or tools available to determine crash risk for different areas or parts of the network?
- **Who are the people making use of the data?** What is their background? Is training provided for them? For how long have they been on the job? Which software and analysis techniques do they typically use? Do they have the capacity to run analyses meaningful to stakeholders? As a minimum, these data users would need to know how to query the database, how to cross different variables to identify relevant subgroups of cases, and they should also be able to master pivot tables. If these users exist, the review team should check if they have identified any projects or tasks where the methodology or software is lacking.

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6. The Review Report

The review report should describe the context of the review and identify the key stakeholders and their role in data collection and use. The report should then describe the data systems reviewed in terms of content, data collection procedures, storage, and use. The integration of the various data systems should be discussed. Recommendations should consider organization, methods, training, and communication.

Although the structure of the report depends on the scope defined and on the data structure in the country, a general framework for the review report, such as the following recommended structure, can be helpful:

- **Context**
  - o General description of (road safety) situation
  - o Earlier reviews, past research
  - o Context of the present review
- **Key stakeholders in the road safety data collection system (collectors and users)**
  - o Levels of understanding of importance of road safety data by key stakeholders
  - o Capacity in collecting, processing, analyzing, and reporting road safety data
- **Safety data currently collected**
  - o Crash and casualty data (by police and/or hospital)
    - » Crash and casualty data available
      - – Definitions
      - – Variables
      - – Time series
    - » Data collection process
      - – Notification
      - – Recording at the crash scene
      - – The path of the data
      - – Checking and corrections
    - » Database: storage, availability, and provision of data
      - – Architecture
      - – Linking to other types of data
      - – Accessibility and functionality
    - » Staff, budget, equipment, and training of the actors involved
    - » Evaluation of crash and casualty data
      - – Completeness
      - – Quality
      - – Uniformity
  - o Other road safety data
    - » Mobility data available
    - » Road safety performance indicators available
    - » Quality of each data type
      - – Representativeness and availability
      - – Compatibility with crash data
    - » Links between road crash database and other data: frequency, automation, and scale (at the crash, local, regional, national, or global level)
- **Evaluation of road safety data completeness (compare with the Checklist on Monitoring and Evaluation in appendix A)**

- **Use of road safety data**
  - o Accessibility
  - o Analyses (statistical and thematic relevance, consistency, and consideration of time series)
  - o Relation to policy, policing, and engineering
  - o Combination of different data sources
  - o Integration in pre- and post-evaluation of infrastructure or development projects
- **Summary of observations**
  - o Completeness, quality, and uniformity of data collected
  - o Use (and combination) of all data presently collected
  - o What do the actors themselves want to change?
  - o Observed strengths and possible improvements
- **Reference to earlier reviews, if applicable**
  - o Implementation of previous recommendations
  - o Barriers to implementation
- **Conclusion with (new) recommendations and a road map for implementation**
  - o Organization
  - o Method
  - o Training
  - o Communication
  - o Suggestions for data to be collected
- **Appendices**
  - o Data analyses
    - » Comparison with internationally reported casualty figures
    - » Consistency across regions
  - o Short report on each visit

In most cases, crash and casualty data collection can be based on police data, on hospital data, or on both. The structure when describing the data collection system(s) depends on the relative importance of these systems and on the stage at which these data are aggregated, if at all. In most cases, the topics listed under the bullet, *"Crash and casualty data (by police and/or hospital),"* will be covered first in relation to police data, then the same list of topics will be discussed in relation to hospital data, and finally, there should be discussion of whether and how hospital data are used to check and extend the police-based crash data. However, if the reporting system is strongly based on hospital data, or if the two sources are aggregated early on, the structure might look somewhat different. The evaluation section for crash and casualty data should address all data sources used. If police and hospital data are combined, the review team should evaluate this combination.

In the evaluation and recommendation sections, organizations, methods, training, communication, and additional data needs should be addressed. For organizations, their structure and cooperation with different institutions involved should be evaluated, including the number of "stations" that data have to pass before they are aggregated in a database, or different practices for crash investigations in different police bodies. An important point is whether the actors have the necessary resources available, such as budget, personnel, hardware, software, vehicles, and others. For the various stakeholders the review team should assess whether they are committed to the need for road safety data, and if not, how they could be convinced, for instance, by which kind of output.

The evaluation of methods should, for example, look at possible improvements in crash investigations, including variables recorded, how causal factors are identified, the way data are checked and linked to other data, the structure and maintenance of the database; or the data analysis options provided by the database. Moreover, suggestions could be made for meaningful comparisons not yet made or for types of output that would be meaningful for those who feed the database and other stakeholders.

In terms of training, a description should be given of which training needs have been identified and how these could be addressed in the short term. Changes that would ensure capacity in the long term could be suggested. Important topics would include training continuity and the training of new people.

With respect to communication, recommendations could be made on how data can be used and presented in an accessible format. Suggestions could include products tailored to stakeholders' specific needs—such as for road engineers to improve road design and maintenance, for police to target enforcement activities, and address budget concerns—or using data to raise awareness about the consequences of road crashes and priority risk factors.

Before suggesting additional data needs, the recommendations should first focus on the use and combination of all existing data sources. Data are collected, but not yet used for road safety (for example, vital statistics and coroners' data, vehicle registration data, and road management data) should receive special attention, including recommendations for and benefits of using these data in road safety analyses. If opportunities and needs for collecting additional data are identified during the meetings, this should also be included.

Generally, the evaluation should focus on the strong points first and also report what the actors themselves want to change. Suggestions for improvement should indicate the priority for each recommendation and take into account the efforts and resources needed to implement them. A good way of presenting proposals is to position the actions on a diagram according to their degree of difficulty on the one hand, and their degree of effectiveness on the other. In addition, a budget estimate should also be developed as well as a work plan for data improvement programs. Finally, it is particularly important to provide sound reasoning why these efforts are necessary and what advantages will be gained by their implementation.

7. Conclusions

Road safety data are important to support evidence-based decision making in a country. They help in understanding the social and economic costs on the issues at hand, selecting effective countermeasures, setting targets, and monitoring progress. Many countries are building up their capacity for data collection and use, and the World Bank intends to support this process.

A data review can help countries in understanding the importance of road safety data, pinpointing possible sources of under-reporting of casualties, help make maximal use of all available data, and possibly, identify additional data and indicators. The data review should help to build up capacity in the host country and will often be conducted by a joint team of local as well as international experts. It can serve to screen the data collection process and identify problems with using the data. Ideally, it would also set up a partnership arrangement or mentoring relationship that could be continued online after the visit to follow up on issues identified during the visit.

Very importantly, **road safety data are much more than just casualty data.** They also comprise safety performance indicators (SPIs), contextual data, such as traffic data, and implementation indicators. While each country is different and data collection and use should therefore be tailored to its needs, referring to international standards for the sake of comparability of the data can be useful—allowing the review team to benchmark and identify countries with similar problems and good practices that could help solve specific issues. With this in mind, these guidelines give an overview of the international standards for casualty data, but also of SPIs and mobility data.

The guidelines are further meant to provide support to road safety experts who will review a country's road safety data—be they local or international experts. The various steps in the review process examine the whole data collection chain, data accessibility, its use, and the engagement of different stakeholders in supporting these activities. In this way, **the guidelines will support the work of regional road safety observatories**.

The data review described here will be the first step in a process to improve road safety data management. A sample terms of reference for procuring consultancy services to lead the data review is attached as appendix E. Following the data review, recommendations should be developed that include prioritizing actions, identifying resources, suggesting a workplan to move forward, and convincing policy makers to further support road safety.

Annex A. Sample Monitoring and Evaluation Checklist

CHECKLIST: MONITORING AND EVALUATION

Questions	Yes	Partial	Pending	No
For each category of roads (national, regional, provincial, city) are sustainable systems in place to collect and manage data on road crashes, fatality and injury outcomes, and all related road environment/vehicle/road user factors to achieve the desired focus on results?				
For each category of roads (national, regional, provincial, city) are sustainable systems in place to collect and manage data on road network traffic, vehicle speeds, safety belt and helmet wearing rates to achieve the desired focus on results?				
For each category of roads (national, regional, provincial, city) are regular safety rating surveys undertaken to quality assure adherence to specified safety standards and rules, to achieve the desired focus on results? Risk ratings? Road protection scores?				
For each category of roads (national, regional, provincial, city) are systems in place to collect and manage data on the output quantities and qualities of safety interventions implemented to achieve the desired focus on results? Safety engineering treatments? Police operations? Educational activities? Promotional activities? Driver training? Vehicle testing? Emergency medical services?				
For each category of vehicles and safety equipment (private, commercial, public, helmets) are systematic and regular safety rating surveys undertaken to quality assure adherence to the specified safety standards and rules to achieve the desired focus on results? Vehicle safety rating? Helmet testing?				
For each category of post-crash service (pre-hospital, hospital, long-term care) are systematic and regular surveys undertaken to quality assure adherence to the specified standards and rules to achieve the desired focus on result?				
Are systems in place to monitor and evaluate safety performance against targets regularly to achieve the desired focus on results?				
Do all participating agencies and external partners and stakeholders have open access to all data collected?				

Source: Bliss, Tony and Jeanne M. Breen. 2009. Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/712181469672173381/GRSF-Country-Implementation-Guidelines.

Annex B. Interview Question Sets

QUESTIONS ON ORGANIZATION AND CAPACITY

TO ROAD SAFETY ANALYSIS GROUP/LEAD ROAD SAFETY AGENCY

1. **Organization of research/policy-making units:**
    a. To which ministry/governmental department does the unit belong?
    b. How many staff work at unit and what is their background?
    c. Are people working full time for the unit?
    d. For how long do people in general stay in the unit?
    e. How are staff members trained for their job?
    f. How do you see the cooperation with different stakeholders?

TO THE POLICE

1. **Organization of the police:**
    a. Are there dedicated police units for road safety?
    b. Ratio of police staff dedicated to traffic safety relative to population?
    c. What is the geographical scope of your competence? All roads? Only urban?

QUESTIONS REGARDING REGISTRATION OF CRASH DATA

TO POLICE, ROAD SAFETY ANALYSIS GROUP, PLUS OTHER ACTORS (SUCH AS STATISTICS OFFICE)

1. **Which definitions do you apply (and why are certain choices made)?**
    a. For road traffic crashes (including single-vehicle crashes, including crashes without motorized vehicles, and including crashes on nonpublic roads)
    b. For fatalities
    c. For serious road injuries

2. **Notification:**
    a. How are the police notified that a road traffic crash has occurred? (Central emergency number? Who notifies the police?)
    b. Could there be crashes you are not informed of (crashes with only one vehicle involved, or without motor-vehicle involved? What if someone has no insurance or if the casualty is family and they do not want to be prosecuted, etc.)?

3. **Crash investigation:**
    a. Do the police have the resources to attend every crash scene? (Remoteness, geographic or climate conditions, too many crashes, etc.)
    b. Which characteristics are reported (form available)?
        i. About the casualties (severity, person characteristics, seatbelt use, helmet use, alcohol use)
        ii. About the crash (conflict type, maneuver, location, circumstances, speed, alcohol, etc.)
        iii. About the vehicles involved (types of vehicles involved, characteristics)
        iv. Are all participants in a road crash tested for alcohol?
        v. How are other characteristics determined (in particular severity, causation factors, protective equipment)?
4. **Transmission of data:**
    a. How do the police report a crash? (Standard form? Online/on paper? Uniform throughout the country?)
    b. Is the person who fills out crash registration form the same as the one attending the scene? (If not, which information is the entry based on?)
    c. Who is responsible for finalizing the crash registration form? Is the completed registration form checked by someone at the local police station?
    d. If on paper: Who is responsible for entering data in the database (Is registration form sent to central location or is this done at local police station, and by whom?)
    e. Is someone at the local police station checking whether all registration forms are completed and sent to/imported into the central database?
    f. Is double counting possible? And if so, what is done to avoid it?
    g. Do you check with the hospital whether a casualty has died in the hospital and if so, how is information on injury severity updated in database?
5. **Are police officers trained in reporting road traffic crashes? If yes:**
    a. What kind of training, how many days?
    b. By whom?
    c. All police officers?
    d. Is there any follow-up?
    e. Are there refresher courses?

TO LOCAL POLICE

1. **Consequences of not reporting/registering, and own use of data:**
   a. Are you obliged to report all road traffic crashes/all serious/fatal road traffic crashes? By law? By a higher-order institution?
   b. Does someone outside the police station perform checks on crashes reported by your police station?
   c. Do you get any feedback on registration of crashes/reported crashes?
   d. What happens if you do not report (any) crashes?
   e. What are the reasons for not reporting crashes or for not completing the report in the central database? (in case relevant)
   f. Do you use data on reported crashes yourself? Or are you aware of data being used by local decision makers?

TO CENTRAL INSTITUTION

1. **Checking, linking, augmenting:**
   a. Are data linked to other databases (vehicle, hospital, judicial, etc.) to enrich the information?
   b. Are data linked or compared to other databases (hospital, vital statistics, coroner reports, mortality statistics) to check the numbers?
   c. Are plausibility checks executed? Which?
   d. Are data inconsistencies, etc., reported back to those who collected them in the first place?

2. **Registration level of fatalities and serious road injuries:**
   a. Are you aware of under-reporting? If there is a difference between reported numbers of fatalities and other estimated numbers (WHO, vital statistics, etc.) discuss this here.
   b. Are all road users reported? Vulnerable road users? Single vehicle crashes? Even those that might not benefit from insurance? Why are choices made?
   c. Are all regions covered? All days of the week? Daytime as well as nighttime? If there are regions and/or periods for which the results of data analysis look suspicious, discuss this here.
   d. Are victims who die later on in hospital included in fatalities? How is this organized?

3. **Do the police have data on preventive interventions?**
    a. Number of checks conducted/hours spent
    b. Number of fixed/mobile radars
    c. Number of tickets and fines

QUESTIONS ABOUT SURVEILLANCE OF ROAD TRAFFIC INJURIES

HOSPITAL STAFF, MINISTRY OF HEALTH, ROAD SAFETY ANALYSIS GROUP, STATISTICS OFFICE, ETC.

1. **Practice concerning medical treatment of road traffic casualties:**
    a. Which hospitals or health facilities treat road traffic casualties?
    b. Are all road traffic casualties treated in hospitals? What if someone is not insured?
    c. How is it decided to which hospital a road traffic casualty is brought?
    d. How do road traffic casualties arrive at the hospital? Mainly/all by ambulance? Public or private ambulance services?
    e. What happens then? First emergency department, then admission to the hospital if needed?

2. **Injury surveillance system:**
    a. How do hospitals collect data in the injury surveillance system?
    b. Are procedures uniform throughout the country?
    c. How are data from different hospitals combined?
    d. Is the system exclusively used for the collection of data on road traffic casualties? If not, how can road traffic casualties be identified?
    e. How is it determined whether a patient is a road traffic casualty? What is the definition of a road traffic casualty?
    f. Which variables or characteristics are included in the injury surveillance system?
    g. Do you perform checks? If so, which? (missing records, completeness of records, inconsistencies)
    h. Do you provide feedback to hospitals concerning the data they provide? (completeness, inconsistencies, use of data?)

3. **Registration level:**
    a. Are all hospitals and health centers obliged to report casualties in the injury surveillance system? What happens if they fail to report?
    b. Which casualties are recorded in the system? People who are admitted in hospital? Or also outpatients?

c. Are there any benefits for the hospital from reporting road traffic casualties in the injury surveillance system?
d. Is the system used for purposes other than the registration of road traffic casualties?
e. Do you have an indication of the level of completeness or under-registration?
f. Is there a register for all ambulance trips? Would this information be useful for checking the registration of road traffic casualties?

TO THE LOCAL HOSPITAL

1. **Practical implementation:**
   a. Do you report road traffic casualties that you treat in the injury surveillance system? If not, why not?
   b. Which casualties? Only casualties that are admitted, or also emergency department?
   c. Does the surveillance system also include other patients? If so, how do you mark road traffic casualties/how can road traffic casualties be selected?
   d. What is your definition of a road traffic casualty?
   e. How does it work in practice? When do you report? Directly, or on the basis of information from another system or registry?
   f. Who enters the information in the injury surveillance system? Are these people trained in how to do this? How, any follow-up, refresher training?
   g. Which variables or characteristics are included in the injury surveillance system?
   h. How is injury severity assessed?

2. **Consequences of not or incorrectly reporting:**
   a. Are you obliged to report casualties in the injury surveillance system? What happens if you do not report?
   b. Does someone check (inside or outside the hospital) if casualties are reported and if reporting is correct?
   c. Are there any benefits for the hospital from reporting road traffic casualties in the injury surveillance system?
   d. Is the system used for purposes other than the registration of road traffic casualties?

3. **Other information:**
   a. Do you report back to the police when a road traffic casualty has died so it can be included as a fatality in the police record?

QUESTIONS ON OTHER ROAD SAFETY DATA

MINISTRIES AND DEPARTMENTS FOR TRANSPORT AND INTERIOR, STATISTICS OFFICE, ROAD SAFETY ANALYSIS GROUPS, AND ADVOCACY GROUPS

1. **Information on travel/mobility/vehicle registration:**
    a. What kinds of data are available? (demographics, vehicle registration, vehicle miles traveled, mobility survey)
    b. Check issues listed for each variable that is collected
2. **Information on Safety Performance Indicators (SPIs):**
    a. Are you familiar with the concept of SPIs?
    b. Which SPIs could be relevant for your country?
    c. Which information on SPIs is already available and how reliable is this information?
    d. For which SPIs could information be collected and how?

QUESTIONS ABOUT ROAD SAFETY DATA STORAGE AND ACCESSIBILITY

1. **Crash database:**
    a. What is the architecture of the crash database?
    b. Who has access?
    c. Is there a data warehouse that enables combining crash data with exposure data or SPIs? Is the information joined or linked?
    d. Are there any standard outputs (dashboards, visualizations) produced automatically?

QUESTIONS ON ROAD SAFETY DATA USE

TO DECISION MAKERS, ROAD SAFETY ADVOCACY GROUPS, ROAD SAFETY ANALYSIS GROUPS, ENGINEERS, AND TRANSPORT PLANNERS

1. **Analysis of data:**
    a. Which analyses do you perform?
        i. Do you cross two or more crash variables to receive specific numbers (for example, children dying as pedestrians in the period before school starts)?
        ii. Do you monitor the development of casualties within particular groups (for example, motorcyclists, young adults, etc.)?
        iii. Do you produce maps with crashes?
        iv. Do you relate crashes to particular road characteristics?
        v. Do you evaluate countermeasures (such as in pre- and post-studies)?

   b. How do you determine which questions to investigate?
   c. Do you have standard outputs that inform other stakeholders?

2. **Road safety policy making:**
   a. How is road safety policy making organized? Who is responsible for:
      i. Infrastructural measures
      ii. Regulation (in relation to road user behavior and in relation to vehicles)
      iii. Enforcement
   b. Do these authorities base their measures on road safety data?
      i. Which information?
      ii. Who provides it?
      iii. How do they use it?
   c. What measures are taken to assess under-reporting of fatalities and serious injuries? If applicable, what is done about it?
   d. Which kinds of data or analysis would they like to see?

EVALUATION

TO ALL STAKEHOLDERS

1. **Do you have any suggestions for improving registration of fatalities and serious injuries?**

2. **Which other road safety data would you consider most important to collect?**

3. **How could the use of road safety data be improved?**

Annex C. Methodological Issues for Collecting Travel and SPI Data

MOBILITY DATA

A good overview of exposure data for road safety analyses with practical examples for their collection can be found in the SafetyNet project as discussed in Yannis et al. (2005).

TRAVEL DISTANCES

The gold standard for relating crashes and casualties to the calculation of risks is the distance traveled (either per vehicle or per person).

- Desirable variables for travel distances: road user group and vehicle type, and road type.

A number of methods can be used to estimate travel distances:

Surveys

A representative sample of the population is required to fill in a mobility diary—usually for one day. Participants indicate departure and arrival time for each trip made, along with the origin and destination. Mobility surveys are, for the moment, the only way to estimate the distances traveled by vulnerable road users. Usually, the surveys offer all types of disaggregation in terms of person characteristics, including age, gender, vehicle type, trip purpose, and more.

When conducted online, surveys have become relatively cheap, though representativeness can become an issue. Possible issues include the following:

- Representativeness of the sample:
  - o Rural areas (for all kinds of surveys)
  - o Elderly people (for online surveys)
  - o Working people (for phone surveys or door-to-door interviews)
- Response rate or selective responses (in particular for postal surveys)
- Representativeness of time: seasons, week versus weekend, vacation, among other time-related factors
- Data quality: possible inaccuracies in the estimation of distances

Typically, participants fill in a travel diary for one day, for which they give detailed reports (time, purpose, travel mode, distance, and often also start and end points). The collection should be spread so that the four seasons are all represented, every day of the week, all hours of the day. The estimation of distances and travel times by the travelers themselves is very unreliable. As a solution, rather than sampling persons willing to fill in a questionnaire, one could sample persons willing to install an application on their smartphone to measure distances, routes, and travel speeds. As this is a rather new technique, not much experience exists in countries with a long tradition of recording travel behavior. Likely issues include representativeness (how to record trips undertaken by persons who do not use smart phones), reliable identification of the travel mode, and privacy concerns.

For more information see, "Innovation of the Dutch National Travel Survey: Implementation of the New Design" (Smit, Mol, and van der Waard 2017) presented at the European Transport Conference in Barcelona, Spain.

Travel counts

Traffic count systems operating in most countries allow for continuous measurement of traffic volumes over time. The measurement sites could be more or less representative of the entire road network examined. Two main approaches are used to derive vehicle kilometers from counts: one based on weighted counts, in which a site is assumed to be representative of a number of other sites, and the other approach, which uses statistical models to estimate the counts for the nonmeasured sites. In both cases, the estimated counts are multiplied by the length of the sections to obtain aggregate vehicle kilometers.

- Counting devices: pneumatic tubes, cameras, RADAR, LIDAR
- Desirable variables: road type, area type, region, vehicle type (if counting device can differentiate)
- Issues: representativeness of measurement location; estimating counts for nonmeasured locations

Odometer readings

The information on vehicle distances traveled can be based upon the vehicles' technical inspections, if mandatory at a particular interval (for example, annually). When a vehicle is inspected, the distance traveled is registered and compared with the reading from the previous inspection. Knowing the type of vehicle and the total numbers of that type, it is possible to give an estimate of distance traveled by type of vehicle.

- Desirable disaggregation: vehicle type, vehicle age
- Issues: Foreign vehicles are not included; no information when or where kilometers are driven

Fuel consumption

Driven kilometers can be estimated on the basis of fuel consumption (see SafetyNet D2.1 in Yannis et al. 2005). However, the fuel efficiency of different types of vehicles and their share in the fleet must be known. Raw fuel consumption can also be used to express risk (such as casualties per ton of fuel). While this can show real progress in countries with rapidly growing motorization, it is inadequate in countries with minor changes in the distances driven as the trend is also influenced by changes in fuel efficiency. Many countries use this method, but mostly in combination with other methods, including Germany and France. Data on fuel efficiency in France can be found in Ricrorch and Sarron (2018, 168–75).

- Possible variables: fuel type (diesel versus gasoline)
- Issues: changes to the energetic efficiency of vehicles

OTHER TRAFFIC INDICATORS

Road length

- Desirable variables: road type, area type, region
- Issues: often unavailable for local roads. Moreover, it is difficult to establish a uniform international classification of the types of roads outside urban areas that goes beyond indicating if it is a motorway or not.

Vehicle fleet (from vehicle register)

- Desirable disaggregation: vehicle type; vehicle age (engine size)
- Possible issues:
  - No inclusion of foreign vehicles
  - The inclusion of new vehicles (this is typically good if the purpose of the database—for example, taxation, insurance, technical inspection—is mandatory for all vehicles

- o Are all types of vehicles included? What about motorcycles and mopeds?
- o Are identification codes unique? Can there be duplicates? (What about lost license plates?)
- o Are scrapped vehicles removed?

Driver population (from license registration)

- Desirable disaggregation: age, gender, vehicle type (nationality, experience)
- Possible issues:
  - o Foreigners are not included
  - o Deceased drivers (or withdrawals): Are they removed from the register?
  - o Could there be duplicate entries (such as for upgraded licenses)?
  - o Hierarchies—for example, car licenses can also permit the riding of mopeds or motorcycles, making it impossible to estimate the number of drivers for each category.

SAFETY PERFORMANCE INDICATORS

Although relatively old, the methodology presented by the EC project SafetyNet (Hakkert, Gitelman, and Vis 2007) can still be considered the international state-of-the-art for many of the safety performance indicators (SPIs), including those for speed, occupant protection, and protective gear.

For speed data, this is however rather outdated, because nowadays speed data are available from providers of navigation services. They are even provided for free by big data providers such as Google or Uber. These companies provide the mean speed per road segment, which can be matched to crash data. The best reference for conducting road-site surveys for alcohol use is probably the Driving under the Influence of Drugs, Alcohol and Medicines (DRUID) project (see Houwing et al. 2011).

ROADSIDE SURVEYS

Because many SPIs require roadside observation, some basic rules should be checked when evaluating the data collection for an indicator. Ideally, a sampling plan to address time and place of measurement will be repeated regularly, say, annually, in the same way.

Time: Check for a reason to believe that rates differ between night and day and week versus weekend (such as for alcohol) or seasons (such as pedestrian or bicycle counts). If so, significant periods must be represented according to their actual share of traffic. If no reason exists to believe the rates differ (distraction and seatbelt use, for example), daytime measurements with one observation period per year are acceptable.

Place: Distinguish different types of cities (such as capital, large city, or town) as well as between rural roads and motorways. These five main categories of public road network should be included more or less proportionally to their share of traffic. However, at least 1,000 vehicles should be observed per category. Weighting: Often the sampling plan includes the same number of vehicles per relevant level, such as road types, period types, or regions, rather than different sample sizes according to their share in traffic. In this case each level has to be weighted according to its actual size when calculating the national average. Sometimes, certain types of road sites, periods, or vehicle types are oversampled on purpose. For example, for driving under the influence of alcohol and drugs, weekend nights are considered particularly relevant. So, although only a small proportion of traffic takes place in these periods, the sample for this period should be large enough to allow for analysis of driver characteristics. Again, in the overall analyses, such as for different periods throughout the week, weighting has to be applied to correct for oversampling. A good description of necessary sample sizes, measurement errors and weighting can be found in chapter 2 of Hakkert, Gitelman, and Vis (2007).

Observations: Vehicles should be selected *randomly* for observation. This point is particularly important to stress if the measurement is conducted in cooperation with the police, because it runs counter to their usual practice. Police would usually focus on suspicious-looking drivers, either on the basis of their behavior or because of a dominant offender profile, which does not result in a representative measurement. Rather, vehicles should be checked strictly in the order they arrive at the measurement location. For each vehicle selected, reporting of all variables measured should be completed before switching to the next vehicle. Skipping vehicles is acceptable, but incomplete records should be avoided.

Regular measurement of the key performance indicators is essential for monitoring road safety. To make this comparable over time, the same methodology should be maintained. For this reason, the first measurement should be carefully planned because later improvements to the methodology will always affect the comparability of successive measurements.

Next to regular monitoring, countermeasures should be evaluated by conducting measurements of the related SPIs before and after implementation. If regular measurements are in place, at least one of these pre- and post-measurements can be conducted within the regular monitoring measurement.

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Annex D. Examples of Database Structure

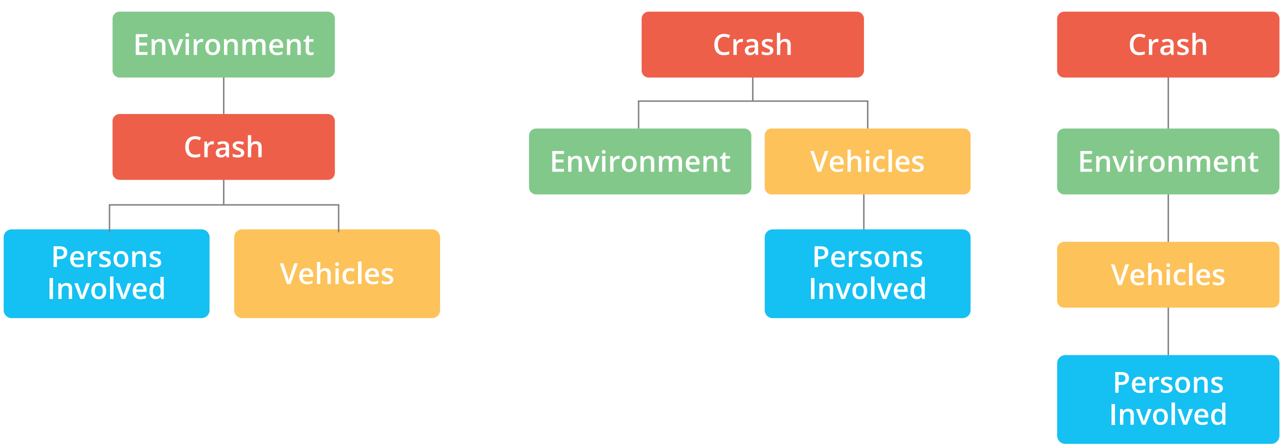
The structures of crash databases can vary and often result from their history and from the different players and organizations led to build and then develop them over time. In addition, databases often retain in their structure the memory of old technical constraints, such as the capacity to store, transmit, or address data.

Most crash databases are structured according to the principles of diagram A shown in figure D.1. However, according to the Common Accident Data Set (CADaS), diagram B illustrates the European Union Care Database structure. The French database TRAxy is integrated in a powerful information technology (IT) system; diagram C describes its dataflow.

The Data for Road Incident Visualization Evaluation and Reporting (DRIVER) is largely based on data elements normally collected by the police, but can be customized to reflect a particular country's context and needs. DRIVER allows for integration of crash data with other types of data, such as health data from injury surveillance systems, vehicle registration data, driver licensing data, and road infrastructure data. Because of this flexibility, the vehicle, person, and environment details can be linked to the crash.

Figure D.1. Crash Database Structures

Diagram A



Source: Original graph produced for this publication.

Diagram B

Accident (1)

VARIABLE_NAME	REF_LINK
ACCIDENT_ID	A-1
COUNTRY_CODE	
YEAR	
ACCIDENT_DATE	A-2
ACCIDENT_TIME	A-3
NUTS	A-4
LAU	A-5
WEATHER_CONDITION	A-6
LIGHT_CONDITIONS	A-7
ACCIDENT_WITH_PEDESTRIANS	A-8
ACCIDENT_WITH_PARKED_VEHICLES	A-9
SINGLE_VEHICLE_ACCIDENTS	A-10
AT_LEAST_2_VEH_NO_TURNING	A-11
AT_LEAST_2_VEH_TURN_CROSS	A-12
LATITUDE '	R-1
LONGITUDE '	R-2
E_ROAD_KILOMETRE '	R-4
URBAN_AREA '	R-12
JUNCTION '	R-13
REL_TO_THE_AT_GRADE_JUNC '	R-14
JUNCTION_CONTROL '	R-15

1 — 1

Traffic Unit "

VARIABLE_NAME	REF_LINK
ACCIDENT_ID	A-1
E_ROAD	R-3
FUNC_CLASS_1ST_ROAD	R-5
FUNC_CLASS_2ND_ROAD	R-6
ANNUAL_DAILY_TRAFFIC_1ST_ROAD	R-7
ANNUAL_DAILY_TRAFFIC_2ND_ROAD	R-8
SPEED_LIMIT_1ST_ROAD	R-9
SPEED_LIMIT_2ND_ROAD	R-10
MOTORWAY	R-11
ROAD_SURFACE_CONDITIONS	R-16
ROAD_OBSTACLES	R-17
CARRIAGEWAY_TYPE	R-18
NUMBER_OF_LANES	R-19
EMERGENCY_LANE	R-20
ROAD_MARKINGS	R-21
BRIDGE	R-22
WORK_ZONE_RELATED	R-23
REGISTRATION_COUNTRY	R-24
ROAD_CURVE	R-25
ROAD_SEGMENT_GRADE	R-26

Traffic Unit " (N)

VARIABLE_NAME	REF_LINK
ACCIDENT_ID	A-1
TRAFFIC_UNIT_ID	U-1
TRAFFIC_UNIT_TYPE	U-2
VEHICLE_SPECIAL_FUNCTION	U-3
TRAILER	U-4
ENGINE_POWER	U-5
ACTIVE_SAFETY_EQUIPMENT	U-6
VEHICLE_DRIVE	U-7
MAKE	U-8
MODEL	U-9
REGISTRATION_YEAR	U-10
TRAFFIC_UNIT_MANOEUVRE	U-11
FIRST_POINT_OF_IMPACT	U-12
FIRST_OBJECT_HIT_IN	U-13
FIRST_OBJECT_HIT_OFF	U-14
INSURANCE	U-15
HIT_AND_RUN	U-16
REGISTRATION_COUNTRY	U-17

1 — N

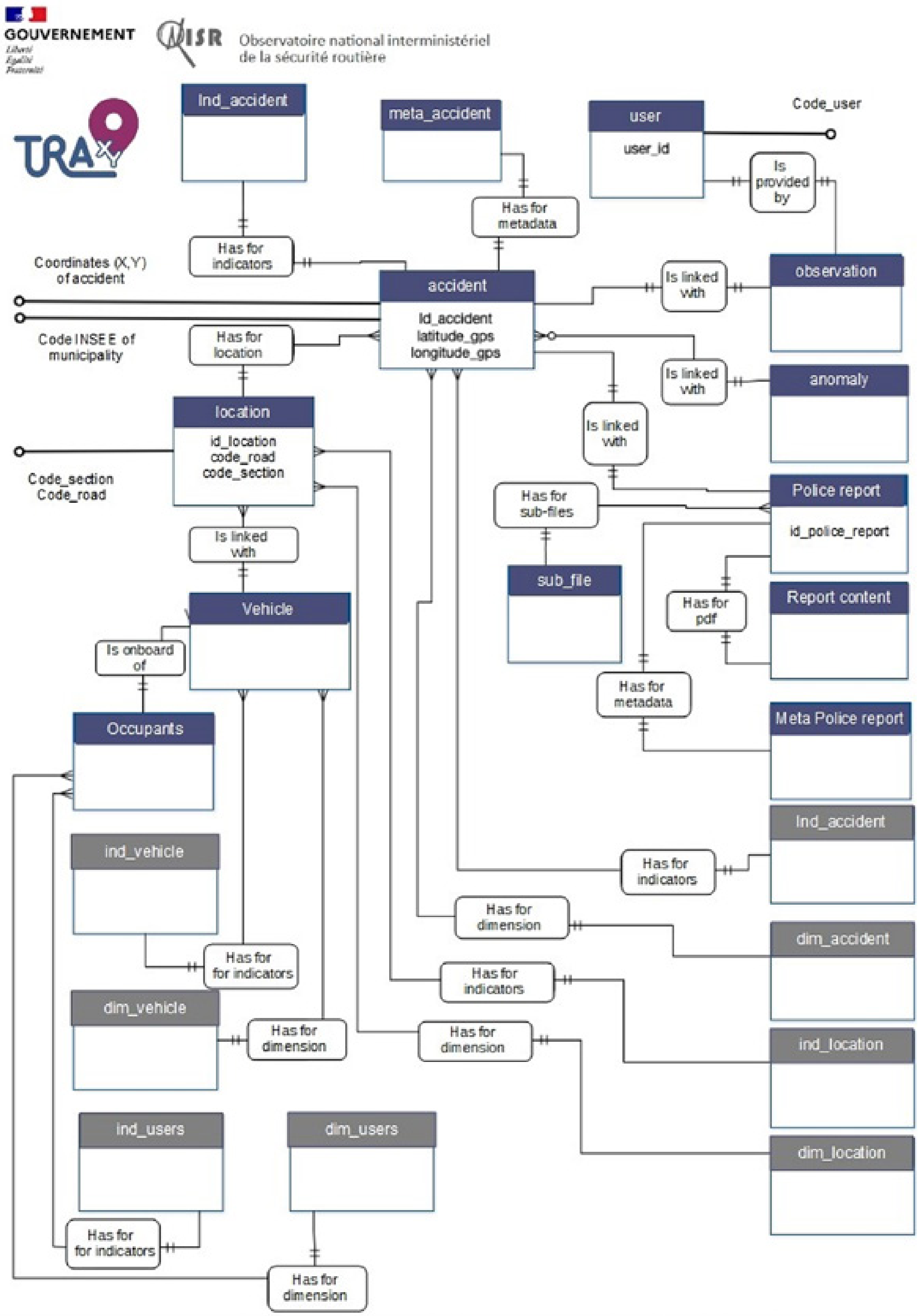
Accident

VARIABLE_NAME	REF_LINK
ACCIDENT_ID	A-1
TRAFFIC_UNIT_ID	U-1
PERSON_ID	P-1
YEAR_OF_BIRTH	P-2
GENDER	P-3
NATIONALITY	P-4
INJURY_TYPE	P-5
ROAD_USER_TYPE	P-6
ALCOTEST	P-7
ALCOTEST_SAMPLE_TYPE	P-8
ALCOTEST_RESULT	P-9
ALCOTEST_LEVEL	P-10
DRUG_TEST	P-11
DRIVING_LICENCE_ISSUE_DATE	P-12
DRIVING_LICENCE_VALIDITY	P-13
SAFETY_EQUIPMENT	P-14
POSITION_IN_ON_VEHICLE	P-15
PARTIC_DISTR_BY_DEVICE	P-16
PSYCHO_PHYS_IMPERMENT	P-17
TRIP_JOURNEY_PURPOSE	P-18

' : Fields moved from Road teble to Accident table
" : Traffic Unit can also be a Vehicle or a Pedestrian

Source: European Commission

Diagram C



Source: French National Interministerial Road Safety Observatory.

Annex E. Sample Terms of Reference

1. OBJECTIVE

The primary objective of the proposed consulting services is to review and assess crash data and road safety data collection and analysis and develop a road map for improving data in the country.

2. SCOPE OF SERVICES

The Consultant shall review the prevailing system of road crash data and road safety data collection and analysis, including conducting research and undertaking a literature review of published studies and reports, reviewing existing documentation, forms, and reports, assessing legal and policy instruments, inspecting crash data, assessing safety performance indicators (SPIs) and mobility data, conducting consultations and interviews with relevant stakeholders, and drafting a report enumerating and discussing findings and analysis as well as recommending the way forward in improving data.

3. MAIN TASKS

The Consultant shall conduct a detailed review of crash data and road safety data in the country. This includes systems used by the different ministries such as the police, the health sector, civil registry, road transport, among other relevant offices.

3.1. Conduct a preparatory research and review, which includes identifying stakeholders and government structure, reviewing policy and legal instruments, assessing existing documentation, forms, and reports, inspecting data, and assessing SPIs, and mobility data.

3.2. Consult each ministry related to crash data, SPIs, and mobility data reporting and analysis, and collect feedback regarding current procedures and systems.

3.3. Evaluate the institutional arrangement for reporting, recording, analyzing, and sharing data and the extent to which the current arrangement meets agency requirements for analysis and understanding of road safety problems.

3.4. Identify and review relevant institutional and legal policy instruments related to road crash data collection, analysis, and sharing.

3.5. Assess current technical resources and staff capacities of each ministry in relation to crash data collection.

3.6. Review the crash data forms used by the different ministries and identify and compare data elements and definitions used and methods of collection.

3.7. Review earlier and ongoing initiatives and reviews on data, assess their findings, and identify lessons learned and challenges.

3.8. Examine actual on-the-ground reporting practice and identify strengths, gaps, and challenges.

3.9. Identify gaps in current arrangement, especially with respect to underreporting of crashes, fatalities and serious injuries, compliance with reporting formats and procedures and recommend improvements to institutional and reporting arrangements and procedures.

3.10. Recommend necessary modifications to current and planned procedures and systems for recording (including reporting process and report form), analyzing, and reporting road crashes, and recommend methodologies for the efficient and accurate entry of data.

3.11. Based on the assessment, prepare a report summarizing findings and analysis as well as identifying recommendations for improving crash data, SPIs, and mobility data collection and analysis.

4. REPORTING REQUIREMENTS

4.1. The Consultant is expected to carry out the assignment tasks as stipulated in the terms of reference (ToR), in very close coordination with concerned government agencies.

4.2. The Consultant shall complete the outputs and deliverables based on the schedule displayed in the table below.

4.3. The duration of the services will be two-and-a-half (2.5) months from the time of the contract signature.

No.	Required deliverable and/or output	Due timing (from mobilization)
1	Inception report (IR), inclusive of all tasks with detailed work program	15 days
2	Data review draft report	2 months
3	Data review final report	2.5 months

5. TEAM COMPOSITION AND QUALIFICATIONS

The professional qualifications, skills, and experience required are as follows:

No.	Position	Minimum qualifications	Specific required expertise
1	Team leader	Graduate qualifications in engineering, law, economics, administration, management, or equivalent/relevant field. Specialist high-level qualifications relevant to Road Safety management and coordination functions is preferable.	Sound in-depth knowledge of national or international findings and directions in modern road safety management principles and the “safe system” approach to road safety. Should have about 10 years of experience conducting scientific analyses of road environment, vehicle and human factors contributing to road crashes and injuries. Experience of being a team leader on similar assignment is desirable.

No.	Position	Minimum qualifications	Specific required expertise
2	Deputy team leader cum IT specialist	Graduate qualifications in civil, mechanical, or transport engineering, or computer science or equivalent.	About eight years of experience in data information and management systems including user friendly interfaces; extensive experience in managing complex information technology (IT) projects, across a range of public sector agencies and levels of administration, at least two of which should be in developing and transitional countries. Experience with crash analysis systems or road safety information management systems is desirable.
3	Road safety specialist	Graduate qualifications in engineering, science, economics, administration, management, or equivalent/relevant field.	Experience in highway/general policing/enforcement with minimum overall professional experience of eight years. Shall be highly experienced in leading implementation of large road safety programs.

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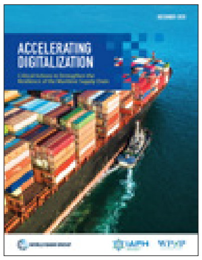

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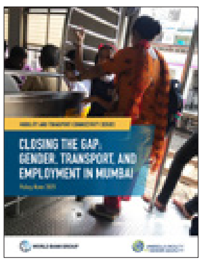

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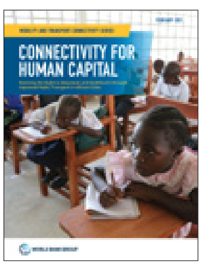

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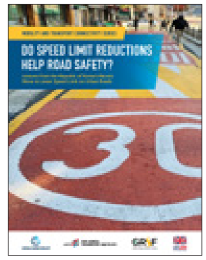

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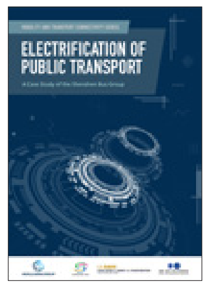

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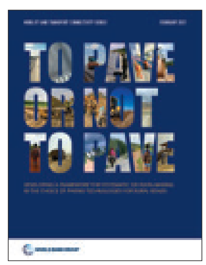

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