Report on Crash Data Elements and Road Safety Indicators for Member Countries of the Asia Pacific Road Safety Observatory

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ACRONYMS

ADB	Asian Development Bank
APRSO	Asia Pacific Road Safety Observatory
CADAS	Common Accident Data Set
CARE	Common Accident Road Database
DCA	Definition for Coding Accidents
DOT	Department of Transportation
EU	European Union
FHWA	Federal Highway Administration
FIA	Federation Internationale de l'Automobile Foundation
FMCSA	Federal Motor Carrier Safety Administration
GHSA	Governors Highway Safety Association
GRSF	Global Road Safety Facility
GRSP	Global Road Safety Partnership
ICD-10	International Classification of Diseases-10
IRAP	International Road Assessment Program
IRTAD	International Road Traffic and Accident Database
ITF	International Transport Forum
MMUCC	Model Minimum Uniform Crash Criteria
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SUMP	Sustainable Urban Mobility Plan
USA	United States of America
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

The Asia Pacific Road Safety Observatory (APRSO) is the regional forum on road safety data, policies and practices to ensure the protection of human life on roads across Asia and the Pacific. Its mission is to generate robust fatal and serious injury road crash data and analysis to positively impact on policies and actions for road safety. APRSO provides a platform for decision-makers from countries in Asia and the Pacific to share experiences and learn about best practices to address the ongoing road safety epidemic. One of the major outputs of the Observatory is a report prepared by a Task Force on a minimum set of indicators for road safety. This report has utilized the work of the Task Force in its preparation[1].

The key objectives of this report are as follows:

- Review existing literature and manuals on road safety indicators (Chapter 2);
- Recommend a minimum set of crash data elements and indicators for the APRSO member countries (Chapters 3).

The purpose of this report is to provide a guide to those countries in the Asia Pacific region that are seeking to improve their road crash database systems to provide consistent and quality data regarding road crashes in their jurisdictions.

[1] This report was prepared by Charles Melhuish, Road Safety Specialist and Mirick Paala, Road Crash Database Specialist engaged by the Asian Development Bank to support the work of the APRSO Secretariat located in the Asian Development Bank (ADB).

CHAPTER 2: LITERATURE REVIEW

2.1 What are Indicators?

Indicators and combinations of indicators are used to reveal, measure and understand a particular issue or area of interest.[2] The types of indicators, how to collect and analyze them are heavily dependent on context and objective.[3] The Sustainable Urban Mobility Plan handbook defines the characteristics of indicators as "being well-defined, having existing knowledge available, being easily understandable, having clear definitions for each indicator, identifying a baseline value, setting target values, and taking into account data sources."[4] In addition, an indicator is a metric for progress (and the lack of it). It is crucial and instrumental to the development of necessary interventions and programs.[5]

The selection of indicators for a particular field is not a simple task. For one, there is no single variable that can account and cover complex issues such as road safety. On the other hand, too many and complicated indicators can cause information overload which can hamper efficiency and efficacy in decision-making.[6] Therefore, having a few indicators that can be reliably and accurately collected and can sufficiently account for a field of interest is ideal.

There is also an issue of data quality and availability. Indicators must be identified and customized based on the capacity and resources of data collectors and assessors. Every institution operates differently - at a different scale and level, different set of actors, different mandates – and these should be considered when developing indicators.[7] Involving intensive stakeholder consultations and workshops are helpful to address this issue.[8]

Finally, indicators must be relevant, appropriate, and provide compelling information that warrants the need for collecting them.[9]

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[2] Gudmundsson, H, Hall, R, Marsden, G, and Zeitsman, J. 2016. *Sustainable Transportation: Indicators, Frameworks, and Performance Management*. Berlin Heidelberg: Springer-Verlag.
[3] Ibid.
[4] Gühnemann, A. 2016. *SUMP Manual on Monitoring and Evaluation: Assessing the impact of measures and evaluating mobility planning processes*. [Online]. [25 June 2020). Available from www.eltis.org and www.sump-challenges.eu/kits.
[5] Ibid.
[6] Congelton, R. and Sweetser, W. 1992. Political Deadlocks and Distributional Information: The Value of the Veil. *Public Choice*, 73, 1-19.
[7] Gudmundsson, H, Hall, R, Marsden, G, and Zeitsman, J. 2016. *Sustainable Transportation: Indicators, Frameworks, and Performance Management*. Berlin Heidelberg: Springer-Verlag.
[8] Hills, D. and Junge, K. 2010. *Guidance for transport impact evaluations: Choosing an evaluation approach to achieve better attribution*. UK: Tavistock Institute.
[9] Gühnemann, A. 2016. *SUMP Manual on Monitoring and Evaluation: Assessing the impact of measures and evaluating mobility planning processes*. [Online]. [25 June 2020). Available from www.eltis.org and www.sump-challenges.eu/kits.

There are many ways to categorize indicators.[10] They can be:

- Based on dimension in which the indicator moves (i.e. time, space)
- Based on complexity of the messages conveyed by the indicator
  - Descriptive – clear illustration of a condition using a particular variable
  - Efficiency – divide at least two variables with one another to derive a ratio
  - Normative – help assess a problem, using a standard, threshold, criterion or target
  - Index or Total Welfare – Combining multiple indicators
- Based on positions of the indicator before or after the events it indicates
  - Leading – predict the peaks and troughs
  - Lagging – occur after the fact
- Based on stages in a process that the indicator can support – combination of previous indicators including overall level, scale, and timeframe of their applicability in the process of producing or maintaining a certain service or product.
  - Input
  - Output
  - Outcome
  - Efficiency (Input/ Output)
  - Effectiveness (Targets/ Outcomes)

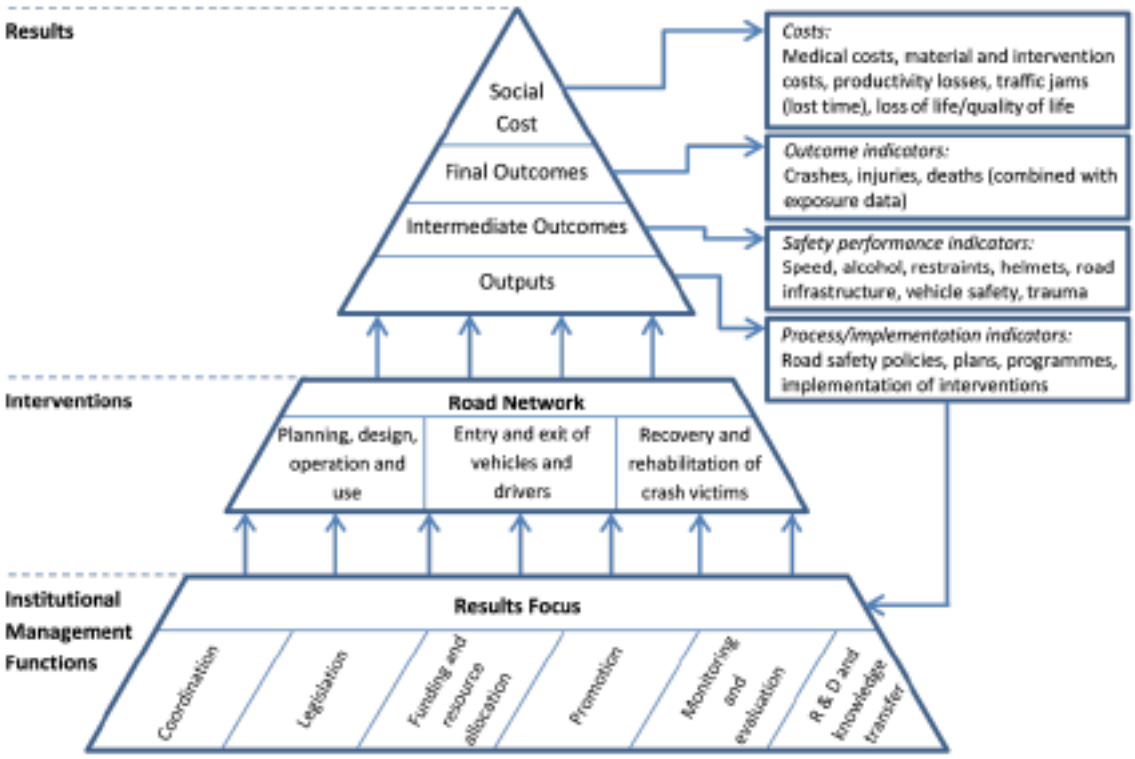
The choice of type of indicator however is mainly based on the framework from which it exists.

2.2 Framework in Identifying Frameworks

Frameworks are tools to identify and organize indicators.[11] In road safety, the Global Road Safety Facility (GRSF) developed guidelines in road safety management.[12] These guidelines provide a framework which identifies the different aspects of road safety and how they relate with each other. Three elements are identified: *institutional management functions, interventions, and results*.

[10] Gudmundsson, H, Hall, R, Marsden, G, and Zeitsman, J. 2016. *Sustainable Transportation: Indicators, Frameworks, and Performance Management*. Berlin Heidelberg: Springer-Verlag.
[11] Ibid.
[12] Bliss, Tony and Breen, Jeanne. 2013. *Implementing the Recommendations of the World Report: Road safety management capacity reviews and safe system projects guidelines (English)*. Washington DC: World Bank Group.

Figure 1: Road Safety Management Framework



Institutional management functions comprise of coordination, legislation, funding and resource allocation, promotion, monitoring and evaluation, and R&D and knowledge transfer. These institutional functions act as the base of an effective road safety management strategy and when fulfilled, will translate to interventions.

Interventions refer to the safety measures to the road, vehicle, road user, recovery and rehabilitation of crash victims. Interventions are focused on the road network where crashes occur. Effective interventions will then produce appropriate safety outcomes.

It has to be emphasized that results do not only refer to number of fatalities and injuries which are identified as the final outcomes. There are also immediate outcomes such as traffic speeds and outputs such as the number of safe infrastructure.

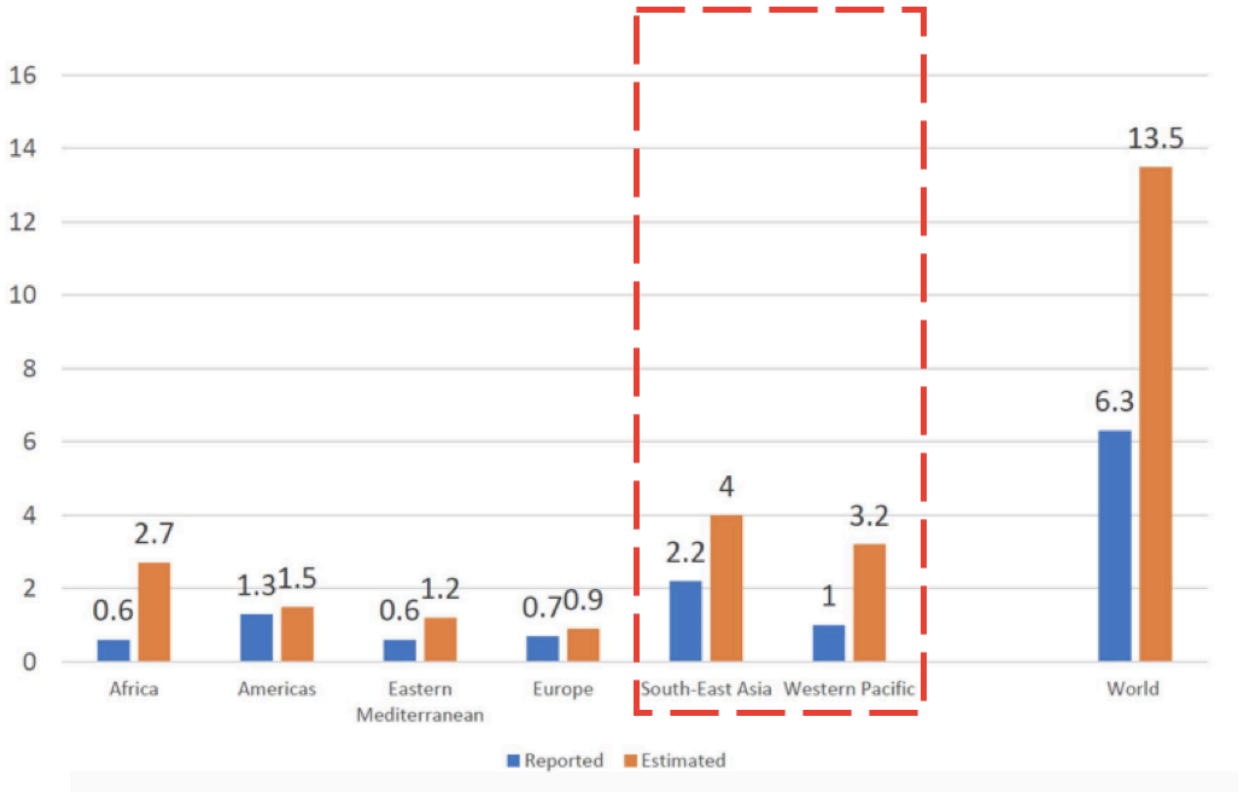
This framework has informed the development of various road safety strategies around the world. It is in this regard a sound road safety strategy will utilize this framework to inform the

identification and prioritization of appropriate indicators. At every level of the road safety management framework, a set of indicators should be developed.

2.3 Underreporting of Road Crashes

While the framework has been used to guide institutions to identify gaps in road safety management as well as the collection of data, underreporting of road crash data and indicators are still a huge challenge in the Asia Pacific region. According to the World Health Organization (WHO), there is still no robust data on road traffic fatalities and injuries.[13] This is a result of the lack of robust vital registration systems in countries as well as the lack of quality police data. Official fatality data from countries often have large discrepancies from fatality estimates of the WHO (see Figure 2).[14]

Figure 2: Comparison of Reported Crashes and WHO Estimates across Regions, 2018



Another issue is the lack of coordination and integration between the police and health data in most countries. In a study made by the WHO, health and police data have significantly different figures for numbers of fatalities and injuries.[15]

[13] WHO. 2018. *Global Status Report on Road Safety 2018*. Geneva: World Health Organization.
[14] Ibid.
[15] Ibid.

This is also supported by individual country-level research and studies. Health and police data have been shown to vary widely especially in terms of defining fatalities. Hospitals usually follow the international guidance on defining fatalities as happening within 30 days of a crash while police often define fatalities as occurring between 24 hours to seven days.[16] This is a common issue in crash data reporting in several of the countries in the Asia Pacific region and is a significant issue in preparing comparisons between countries.

Several experts also pointed out that police data are often unreliable especially concerning contributory factors in crashes and one of the reasons is the lack of well-defined crash data elements specifically designed for certain road user groups such as cyclists[17]. In a recent study in the Philippines,[18] some crash data elements are often left blank when recording crashes. Table 1 shows an example of crash data elements and the percentage of utilization in data forms.

Table 1: Utilization of Crash Data Elements in Crash Reporting in the Philippines, 2020[19]

Data field	Number of responses	Response rate
Driver error	246	18.85%
License number	589	45.13%
Last name	1,283	98.31%
First name	1,289	98.77%
Middle name	1,127	86.36%
Gender	1,271	97.31%
Age	1,137	87.13%
Address	1,238	94.87%
Involvement	1,295	99.23%
Injury	755	57.85%
Hospital	459	35.17%
Alcohol/drugs suspected	90	6.90%
Seatbelt/helmet worn	145	11.11%

Other outstanding observations in data collection across the Asia Pacific include:

- *Police and hospitals often use manual forms which are open to interpretation and errors.* Some of the fields have no assigned values therefore data is not standardized. Handwriting can also be illegible, and the form can be vulnerable to loss or damage. When the data is uploaded into the system, it may contain incorrect data.

[16] Duc, N., Hoa, D., Huong, N. and Bao, N. (2011). Study on Quality of Existing Traffic Accident Data in Vietnam. *Proceedings of the Eastern Asia Society for Transportation Studies*, [online] 8. Available at: https://www.academia.edu/4140898/Study_on_Quality_of_Existing_Traffic_Accident_Data_in_Vietnam [Accessed 10 Jan. 2020].
[17] Rolison, J. 2020. Identifying the causes of road traffic collisions: Using police officers' expertise to improve the reporting of contributory factors data. *Accident Analysis and Prevention*, [Online]. Available at: h https://www.sciencedirect.com/science/article/pii/S0001457519311650. [Accessed 4 July 2020].
[18] Valdez, A. 2020. *Evaluation of Electronic Road Incident Record Application and Trial in the Philippines*. Manila: Intelligent Transport System Laboratory, University of the Philippines Diliman.
[19] Ibid.

- *Locations are not exactly identified*. Often there is a lack of devices to accurately record location data. Location data are often recorded as road or street names which will not help the identification of high-risk locations.
- *The whole data collection process is tedious and complicated for the police.* Forms often include 80+ indicators and can be as long as four pages which police often have trouble completing.
- *Over-all lack of data quality assurance measures.* Once the police records a crash, this is often not updated anymore and will not be cross-checked with other datasets such as hospital records.
- *Main cause of crashes is mostly recorded as human error*. Because crash data reporting is done primarily for prosecution purposes and not really for assessing road safety, then there is a requirement to identify 'victims' and 'suspects' and ascribe fault to one of the parties involved in a crash.
- *Other datasets are not leveraged*. Crash data is not integrated with road infrastructure data, health data, and licensing and vehicle registration data.

2.4 Crash Data Elements in Literature

The World Health Organization (WHO) published a Road Safety Data Systems Guide[20] in September 2010. This publication was prepared by the Federation Internationale de l'Automobile (FIA) Foundation, the Global Road Safety Partnership (GRSP), WHO, and the World Bank. It consists of four chapters all focusing on road safety data: (1) Why are road safety data needed, (2) How to construct a situational assessment, (3) How to design, improve, and implement data systems, and (4) Using data to improve road safety. The manual provides detailed advice on how to design, improve, and implement data systems involving key stakeholders in a country. A common dataset and minimum data elements are enumerated in the manual. An overview of minimum crash data elements is shown in Figure 3.

[20] World Health Organization. 2020. *Data systems: a road safety manual for decision-makers and practitioners*. [online] Available at: https://www.who.int/roadsafety/projects/manuals/data/en/ [Accessed 1 July 2020].

Figure 3: Minimum Crash Data Elements[21]

Crash related	Road related	Vehicle related	Person related
• Crash identifier (unique reference number assigned to the crash, usually by police) • Crash data • Crash time • Crash municipality/ place • Crash location • Crash type • Impact type • Weather conditions • Light conditions • Crash severity°	• Type of roadway* • Road functional class* • Speed limit* • Road obstacles • Road surface conditions* • Junction • Traffic control at junction* • Road curve* • Road segment grade*	• Vehicle number • Vehicle type† • Vehicle make† • Vehicle model† • Vehicle model year† • Engine size† • Vehicle special function† • Vehicle manoeuvre (what the vehicle was doing at the time of the crash)	• Person ID • Occupant's vehicle number • Pedestrian's linked vehicle number • Date of birth • Sex • Type of road user • Seating position • Injury severity • Safety equipment • Pedestrian manoeuvre • Alcohol use suspected • Alcohol test • Drug use • Driving licence issue date • Age°

° Derived or calculated from other data elements.

* Depending on the quality and detail of road inventory and hardware data available, it may be possible to obtain this data element through linkage to other databases.

† Depending on the existence, quality and detail of a motor vehicle registration database, it may be possible to obtain this data element through linkage to motor vehicle registration files.

Comprising of a total of 42 data elements, the WHO recommends to generate 15 of the data elements from existing sources such as the vehicle registration database and a road infrastructure database. This results in at least 27 data fields to be collected at the crash scene.

An additional set of elements is also recommended by the WHO outlined in Figure 4.

[21] World Health Organization. 2020. *Data systems: a road safety manual for decision-makers and practitioners*. [online] Available at: https://www.who.int/roadsafety/projects/manuals/data/en/ [Accessed 1 July 2020].

Figure 4: Additional Crash Data Elements[22]

Crash related	Road related	Vehicle related	Person related
• Location relative to roadway	• Urban area • Tunnel • Bridge • Number of lanes • Markings • Work-zone related	• Vehicle identification number (VIN, issued by manufacturer) • Registration place and year • Registration number • First point of impact • Insurance • Hazardous materials	• Distracted by device • Driver licence class and jurisdiction • Driver manoeuvre • Trip/journey purpose (see Box 3.1)

This additional set while optional can also be helpful in understanding crashes. In addition to a list of data elements, the WHO also provides more detail on each of the data fields.

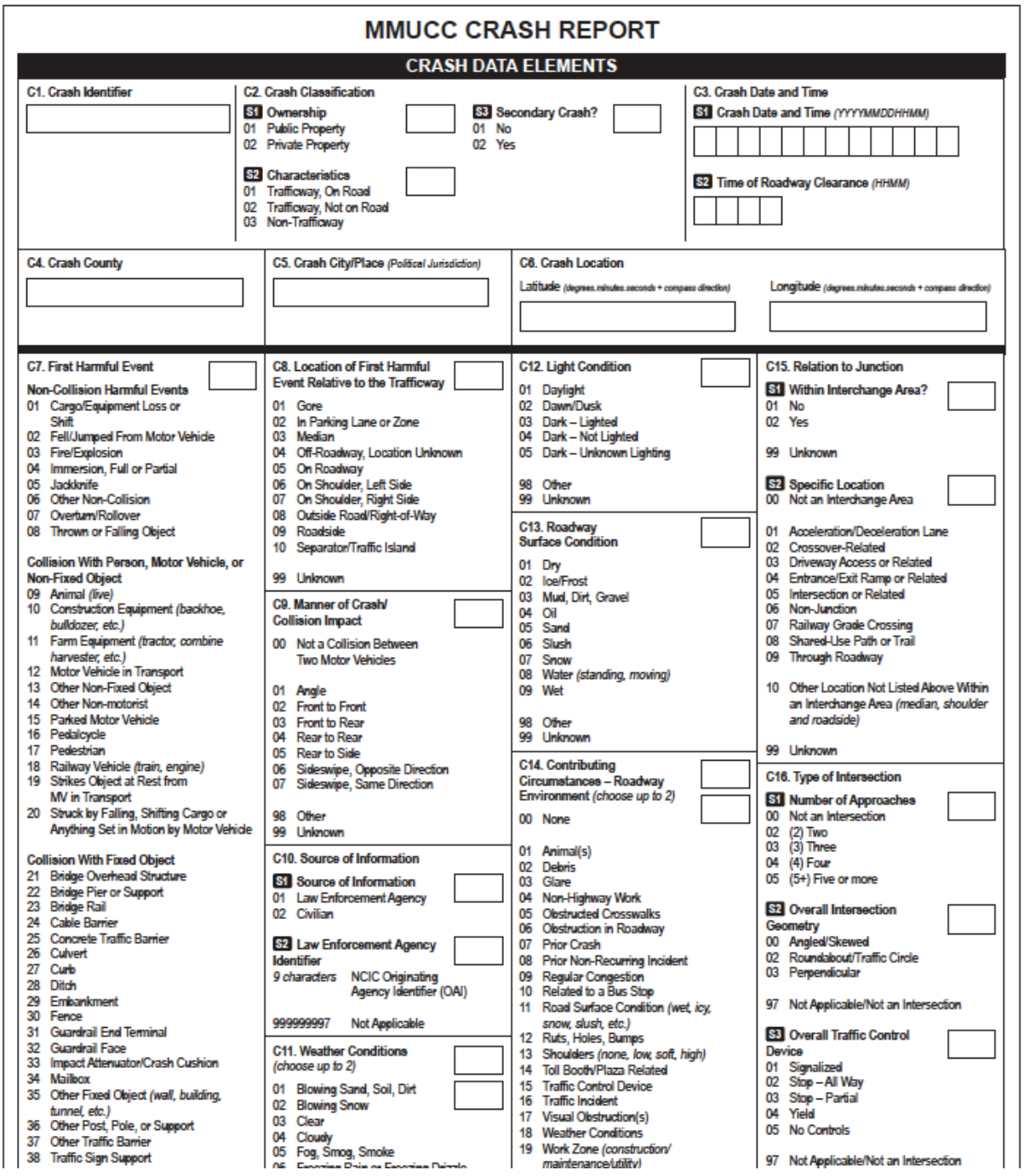
National Highway Traffic Safety Administration (NHTSA), United States – Model Minimum Uniform Crash Criteria (MMUCC)

In 2017, an updated version of the MMUCC[23] was published. The MMUCC is a guideline set by the United States Department of Transportation to standardize crash reporting of the different states in USA. This list is a result of collaboration between the NHTSA, Federal Highway Administration (FHWA), Federal Motor Carrier Safety Administration (FMCSA), National Transportation Safety Board (NTSB), Governors Highway Safety Association (GHSA), and experts from State Departments of Transportation (DOTs), local law enforcement, emergency medical services, safety organizations, industry partners, and academia. There were also online public consultations that were organized to finalize the list.

The MMUCC list of data elements comprise a total of 115 data fields with the following categories: Crash details, Vehicle details, Person details, Road details. Particular types of crashes also have additional data reporting fields such as for Fatal Crashes, Large Vehicles and Hazardous Materials, Non-Motorists, and Dynamic Data.[24] Page 1 of the 12-page sample crash data form is provided in Figure 5.

[22] World Health Organization. 2020. *Data systems: a road safety manual for decision-makers and practitioners*. [online] Available at: https://www.who.int/roadsafety/projects/manuals/data/en/ [Accessed 1 July 2020].
[23] United States Department of Transportation and National Highway Traffic Safety Administration. 2017. *Model Minimum Uniform Crash Criteria Fifth Edition (2017)*. [Online]. Available at: https://www.nhtsa.gov/mmucc-1 [Accessed 1 July 2020].
[24] Ibid.

Figure 5: Page 1 of MMUCC's Crash Report)[25]



MMUCC CRASH REPORT

CRASH DATA ELEMENTS

C1. Crash Identifier

C2. Crash Classification

S1 Ownership
01 Public Property
02 Private Property

S3 Secondary Crash?
01 No
02 Yes

S2 Characteristics
01 Trafficway, On Road
02 Trafficway, Not on Road
03 Non-Trafficway

C3. Crash Date and Time

S1 Crash Date and Time (YYYYMMDDHHMM)

S2 Time of Roadway Clearance (HHMM)

C4. Crash County

C5. Crash City/Place (Political Jurisdiction)

C6. Crash Location

Latitude (degrees.minutes.seconds + compass direction)

Longitude (degrees.minutes.seconds + compass direction)

C7. First Harmful Event

Non-Collision Harmful Events
01 Cargo/Equipment Loss or Shift
02 Fell/Jumped From Motor Vehicle
03 Fire/Explosion
04 Immersion, Full or Partial
05 Jackknife
06 Other Non-Collision
07 Overturn/Rollover
08 Thrown or Falling Object

Collision With Person, Motor Vehicle, or Non-Fixed Object
09 Animal (live)
10 Construction Equipment (backhoe, bulldozer, etc.)
11 Farm Equipment (tractor, combine harvester, etc.)
12 Motor Vehicle in Transport
13 Other Non-Fixed Object
14 Other Non-motorist
15 Parked Motor Vehicle
16 Pedalcycle
17 Pedestrian
18 Railway Vehicle (train, engine)
19 Strikes Object at Rest from MV in Transport
20 Struck by Falling, Shifting Cargo or Anything Set in Motion by Motor Vehicle

Collision With Fixed Object
21 Bridge Overhead Structure
22 Bridge Pier or Support
23 Bridge Rail
24 Cable Barrier
25 Concrete Traffic Barrier
26 Culvert
27 Curb
28 Ditch
29 Embankment
30 Fence
31 Guardrail End Terminal
32 Guardrail Face
33 Impact Attenuator/Crash Cushion
34 Mailbox
35 Other Fixed Object (wall, building, tunnel, etc.)
36 Other Post, Pole, or Support
37 Other Traffic Barrier
38 Traffic Sign Support

C8. Location of First Harmful Event Relative to the Trafficway
01 Gore
02 In Parking Lane or Zone
03 Median
04 Off-Roadway, Location Unknown
05 On Roadway
06 On Shoulder, Left Side
07 On Shoulder, Right Side
08 Outside Road/Right-of-Way
09 Roadside
10 Separator/Traffic Island
99 Unknown

C9. Manner of Crash/ Collision Impact
00 Not a Collision Between Two Motor Vehicles
01 Angle
02 Front to Front
03 Front to Rear
04 Rear to Rear
05 Rear to Side
06 Sideswipe, Opposite Direction
07 Sideswipe, Same Direction
98 Other
99 Unknown

C10. Source of Information

S1 Source of Information
01 Law Enforcement Agency
02 Civilian

S2 Law Enforcement Agency Identifier
9 characters NCIC Originating Agency Identifier (OAI)
999999997 Not Applicable

C11. Weather Conditions (choose up to 2)
01 Blowing Sand, Soil, Dirt
02 Blowing Snow
03 Clear
04 Cloudy
05 Fog, Smog, Smoke

C12. Light Condition
01 Daylight
02 Dawn/Dusk
03 Dark – Lighted
04 Dark – Not Lighted
05 Dark – Unknown Lighting
98 Other
99 Unknown

C13. Roadway Surface Condition
01 Dry
02 Ice/Frost
03 Mud, Dirt, Gravel
04 Oil
05 Sand
06 Slush
07 Snow
08 Water (standing, moving)
09 Wet
98 Other
99 Unknown

C14. Contributing Circumstances – Roadway Environment (choose up to 2)
00 None
01 Animal(s)
02 Debris
03 Glare
04 Non-Highway Work
05 Obstructed Crosswalks
06 Obstruction in Roadway
07 Prior Crash
08 Prior Non-Recurring Incident
09 Regular Congestion
10 Related to a Bus Stop
11 Road Surface Condition (wet, icy, snow, slush, etc.)
12 Ruts, Holes, Bumps
13 Shoulders (none, low, soft, high)
14 Toll Booth/Plaza Related
15 Traffic Control Device
16 Traffic Incident
17 Visual Obstruction(s)
18 Weather Conditions
19 Work Zone (construction/ maintenance/utility)

C15. Relation to Junction

S1 Within Interchange Area?
01 No
02 Yes
99 Unknown

S2 Specific Location
00 Not an Interchange Area
01 Acceleration/Deceleration Lane
02 Crossover-Related
03 Driveway Access or Related
04 Entrance/Exit Ramp or Related
05 Intersection or Related
06 Non-Junction
07 Railway Grade Crossing
08 Shared-Use Path or Trail
09 Through Roadway
10 Other Location Not Listed Above Within an Interchange Area (median, shoulder and roadside)
99 Unknown

C16. Type of Intersection

S1 Number of Approaches
00 Not an Intersection
02 (2) Two
03 (3) Three
04 (4) Four
05 (5+) Five or more

S2 Overall Intersection Geometry
00 Angled/Skewed
02 Roundabout/Traffic Circle
03 Perpendicular
97 Not Applicable/Not an Intersection

S3 Overall Traffic Control Device
01 Signalized
02 Stop – All Way
03 Stop – Partial
04 Yield
05 No Controls
97 Not Applicable/Not an Intersection

It has to be noted that the data elements in the MMUCC is customized for the United States context and policies and might not be relevant for other countries.

[25] United States Department of Transportation and National Highway Traffic Safety Administration. 2017. *Model Minimum Uniform Crash Criteria Fifth Edition (2017)*. [Online]. Available at: https://www.nhtsa.gov/mmucc-1 [Accessed 1 July 2020].

European Union (EU)- Common Accident Data Set (CADAS)

CADAS which stands for Common Accident Data Set is aimed to standardize the definitions and collection of crash data elements throughout Europe.[26] It builds on the indicators found in the European road crash database system called Common Accident Road Database (CARE) as well as indicators enumerated by the WHO and the MMUCC. European countries can voluntarily adopt CADAS for their own individual database systems.

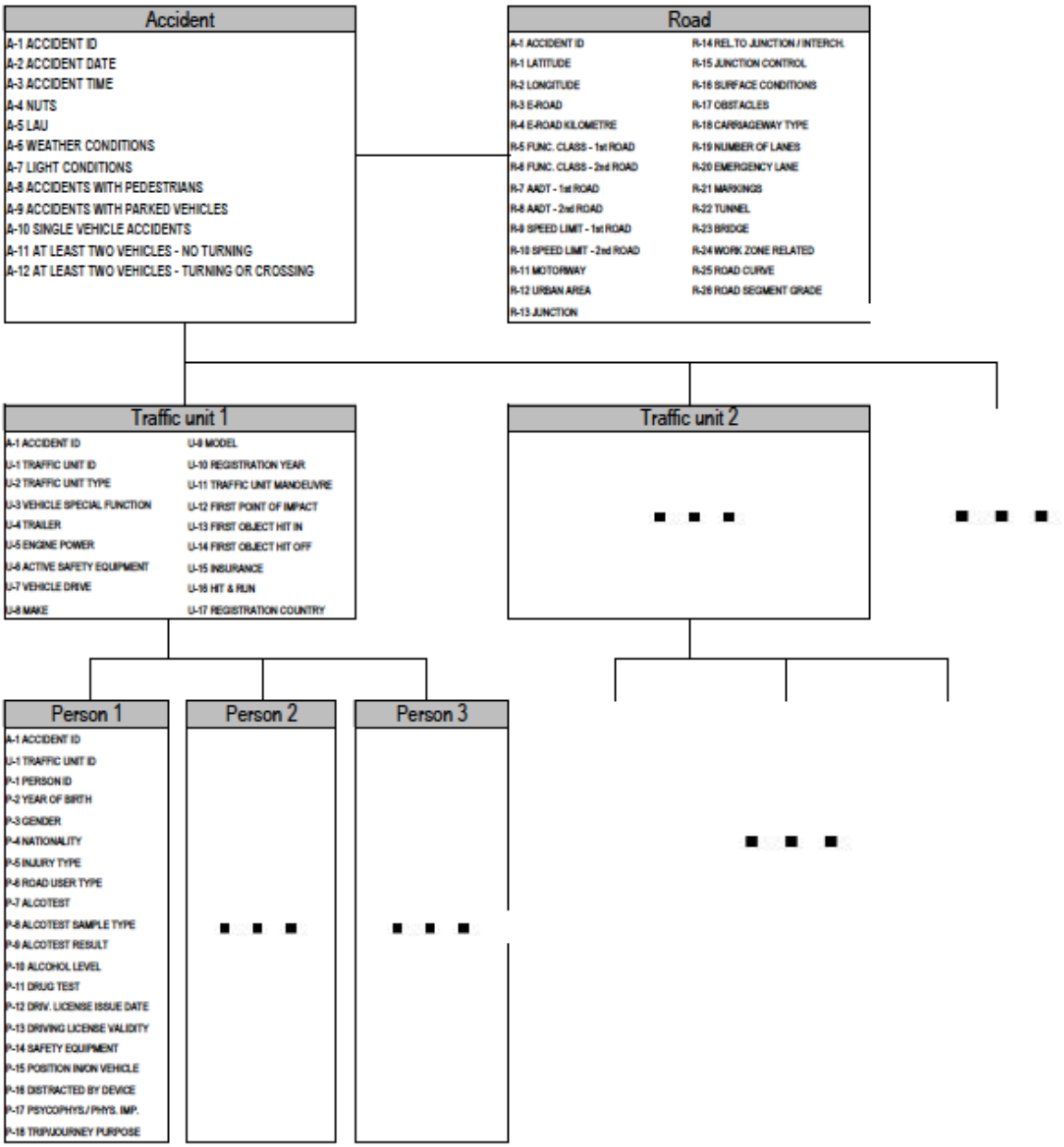
Indicators in CADAS were selected based on the following principles[27]:

- Relevance and usefulness in road crash analysis at the EU level;
- Indicators are meant for wider policy and programs instead of crash reconstruction and investigation;
- Countries have the flexibility to customize the dataset based on their capacity and needs;
- Indicators must be easy to collect, comprehensive, and concise; and
- The dataset only focuses on fatal and injury crashes.

Each data element falls under one of four categories: (1) Accident, (2) Road Related, (3) Traffic Unit (Vehicle and Pedestrian), and (4) Person details.[28] A list of all data elements and how they relate to each other is shown in Figure 6.

[26] Saurabh, V. 2017. *Common Accident Data Set*. [Online]. Available at: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/cadas_glossary_v_3_6.pdf [Accessed 1 July 2020].
[27] Ibid.
[28] Ibid.

Figure 6: List of Crash Data Elements Found in CADAS[29]



There is a total of 77 data elements which are further divided based on importance: 40 indicators are tagged as high importance and the rest are of low importance.[30] See Table 2.

[29] Saurabh, V. 2017. *Common Accident Data Set*. [Online]. Available at: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/cadas_glossary_v_3_6.pdf [Accessed 1 July 2020].
[30] Ibid.

Table 2: Number of High Importance and Low Importance Variables in CADAS and Corresponding Values[31]

category	Code	Number of Variables			Number of Values		
		High (H) importance	Lower (L) importance	Total	Detailed values	Alternative values (A)	Total
Accident	**A**	7	6	13	91	13	104
Road	**R**	12	13	25	92	13	105
Traffic Unit	**U**	8	10	18	181	15	196
Person	**P**	13	8	21	92	10	102
Total		40	37	**77**	456	51	**507**

During this pilot, the government has witnessed the power of merely recording crashes onto a map and how this can inform evidence-based decisions in road safety (see Figure 14).

African Road Safety Observatory – Recommendations for a Common Data Collection System and Definitions

The recommended minimum set of data elements by the African Road Safety Observatory are based on the WHO Data Systems Guide, EU's CADAS, and a survey of data collection systems in Africa.[32] A total of 42 crash data elements were identified which cover accident, road, vehicle, and person-related variables.[33] These indicators are also categorized by first and second priority in terms of data collection. There are 25 first priority indicators while the rest are second priority. A table showing how the indicators are categorized can be found in Table 3.

[31] Saurabh, V. 2017. *Common Accident Data Set*. [Online]. Available at: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/cadas_glossary_v_3_6.pdf [Accessed 1 July 2020].
[32] P. Thomas, R. Welsh, K. Folla, A. Laiou, S. Mavromatis, G. Yannis, D. Usami, and E. Meta. 2018. *Recommendations for a Common Data Collection System and Definitions*. [Online]. Available at http://www.africanroadsafetyobservatory.org/wpcontent/uploads/2020/06/D4.2.pdf. [Accessed 3 July 2020].
[33] Ibid.

Table 3: Recommended Variables Organized by First and Second Priority[34]

Accident related variables		Road related variables		Vehicle related variables		Person related variables	
1st priority	2nd priority	1st priority	2nd priority	1st priority	2nd priority	1st priority	2nd priority
Accident ID	Impact type	Type of roadway	Speed limit	Vehicle number	Engine size	Date of birth	Person ID
Accident date		Road functional class	Road obstacles	Vehicle type	Vehicle special function	Gender	Occupant's vehicle number
Accident time		Junction	Road surface conditions	Vehicle make		Type of road user	Pedestrian's linked vehicle number
Accident region - municipality			Traffic control at junction	Vehicle model		Seating position	Safety equipment
Accident location			Road curve	Vehicle model year		Injury severity	Pedestrian manoeuvre
Accident type			Road segment grade	Vehicle manoeuvre		Driving licence issue date	Alcohol use suspected
Weather conditions						Age	Alcohol test
Light conditions							Drug use
Accident severity							

APRSO – Task Force Document on Minimum Crash Data Elements

The APRSO Task Force on Minimum Crash Data Elements composed of voluntary countries and international partner organizations developed a document identifying minimum crash data elements.[35] The document consists of 49 individual crash data elements with at least 45 indicators which are tagged as mandatory data elements.[36] It is unclear whether the remaining elements are mandatory or not since they do not include any tagging. Like previous literature, the document categorizes crashes into crash, road, vehicle, and person-related variables.

Summary of Crash Data Elements

Table 4 compares the crash data elements described in each of the various reviewed literature. Those colored yellow are tagged as "high importance," "first priority," or "mandatory" data elements while those tagged as grey are "low importance" or "second priority."

[34] P. Thomas, R. Welsh, K. Folla, A. Laiou, S. Mavromatis, G. Yannis, D. Usami, and E. Meta. 2018. *Recommendations for a Common Data Collection System and Definitions*. [Online]. Available at http://www.africanroadsafetyobservatory.org/wpcontent/uploads/2020/06/D4.2.pdf. [Accessed 3 July 2020].
[35] APRSO. *Minimum set of* Indicators. Available at https://www.unescap.org/sites/default/files/Crash-related%20minimum%20data%20set%20and%20data%20sources.pdf
[Accessed 3 June 2020].
[36] Ibid.

Table 4: Summary of Crash Data Elements in Literature

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Crash identifier (unique reference)					
Crash Classification					
Reporting Unit					
Unit Receiving the Report					
Crash date					
Crash time					
Time of Roadway Clearance					
Day of Week					
Nomenclature of territorial units for statistics					
Crash County					
Crash municipality/place					
Crash location					
European road network					
E-road kilometer					
Street Name					
KM (House Number)					
First Harmful Event					
Location of First Harmful Event Relative to the Trafficway					
Source of Information					
Number of Deaths					
Number of Injuries					
Number of Vehicles Damaged					
Number of Motor Vehicles Involved					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Number of Motorists					
Number of Non-Motorists					
Estimated Physical Damage Cost					
Crash type (e.g. Crash with pedestrian, crash with parked vehicle, crash with fixed obstacle, among others)					
Impact type/ Collision Type (e.g. Rear end, Head on, Angle Impact, among others)					
Weather conditions					
Hit and Run					
Light conditions					
Crash severity					
Accident type variables (5 variables according to collision type, road user, among others, similar to movement codes)					
Location relative to roadway					
Bridge/Structure identification number					
Roadway curvature					
Grade					
Type of roadway (e.g. motorway, express road, urban road, among others)					
Part of national highway system					
Road functional class (e.g. national road, local road, among others)					
Road functional class - second road					
Annual average daily traffic					
Width of lane(s) and shoulder(s)					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Width of median					
Access control					
Speed limit					
Speed limit-second road					
Motorway					
Road obstacles					
Road surface conditions (e.g. dry, wet, among others)					
Contributing Circumstances - Roadway Environment					
Relation to Junction					
Type of intersection					
Carriageway type					
School bus-related					
Total lanes in roadway					
Roadway alignment and grade					
Junction (e.g. at-grade crossroad, at-grade roundabout, among others)					
Traffic control at junction (e.g. traffic police, traffic light, among others)					
Road curve (e.g. tight curve, open curve, among others)					
Road segment grade (e.g. steep gradient or not)					
Urban area					
Tunnel					
Bridge					
Number of Lanes					
Emergency lane					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Markings					
Work zone related					
Roadway lighting					
Presence/Type of bicycle facility					
Mainline number of lanes at intersection					
Cross-street number of lanes at intersection					
Total volume of entering vehicles					
Railway crossing ID					
Vehicle identification number/license plate					
Traffic ID (applies to both vehicle and pedestrian)					
Traffic type (includes both vehicle and pedestrian)					
Vehicle type					
Vehicle make					
Vehicle model					
Vehicle model year of manufacture					
Motor vehicle body type category					
Total occupants in motor vehicle					
Engine size					
Engine power					
Vehicle special function					
Trailer					
Emergency motor vehicle use					
Motor vehicle posted/statutory speed limit					
Direction of travel before crash					
Trafficway description					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Vehicle maneuver					
Vehicle damage					
Vehicle owner					
Sequence of events					
Most harmful event for this motor vehicle					
Hit and run					
Towed due to disabling damage					
Contributing circumstances, motor vehicle					
Address of vehicle owner					
Vehicle inspection expiration					
Motion before accident					
Active safety equipment					
Vehicle drive					
Vehicle registration place and year, country					
Vehicle registration number					
Vehicle steering wheel position					
Traffic unit manoeuver (includes vehicle and pedestrian)					
First point of impact					
First object hit in carriageway					
First object hit off carriageway					
Insurance					
Hazardous materials					
Person ID					
Full Name					
Occupant’s vehicle number					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Pedestrian's linked vehicle number					
Date of birth					
Year of birth					
Sex/Gender					
Type of road user (e.g. Driver, Passenger, Pedestrian)					
Nationality					
Address					
Number of Working Years					
Seating position					
Injury severity					
Safety equipment (e.g. Seatbelt, Helmet)					
Air bag deployed					
Ejection					
Pedestrian manoeuver					
Alcohol confirmed					
Alcohol use suspected					
Alcohol test					
Traffic violation					
Occupation					
Drug use					
Drug use suspected					
Drug test					
Driver license jurisdiction					
Driving license issue date					
Driving license number					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Driving license expiry date					
Driver license restrictions					
Driving license validity					
Driver license status					
Speeding-related					
Age					
Distracted by					
Distracted by device					
Psychophysical/Physical impairment or condition					
Driving license class and jurisdiction					
Driving manoeuver					
Trip/journey purpose					
Injury MAIS Scale					
Method of Case-Handling					
Condition at time of the crash					
Victim act before the accident					
Driver actions at time of crash					
Violation codes					
Narrative					
Accident Diagram					
Accident Cause Description					
Transported to first medical facility by					
Injury area					
Injury diagnosis					
Alcohol test type and results					

Crash Data Elements	WHO	MMUCC	CADAS	African Road Safety Observatory	APRSO Task Force
Alocohol level					
Drug test type and results					
Large Vehicles and Hazardous Materials crash data elements					
Non-motorist section data elements					
Dyanimic data elements					
TOTAL NUMBER OF DATA ELEMENTS	**42**	**115**	**77**	**42**	**49**

2.4 Road Safety Indicators

To properly describe road safety and its condition it is necessary to augment the crash data with other characteristics that describe and relate the crash data to various socio economic parameters and conditions that provide a contextual aspect to the analysis. This enables and facilitates better analysis and presentation of the results and in an international context enables cross-country comparisons to be made. The list of data and information requirements has been determined based on global trends in presentation of t=results, review of other Observatory websites and road safety information guides such as those prepared by the WHO, GRSF and FIA Foundation.

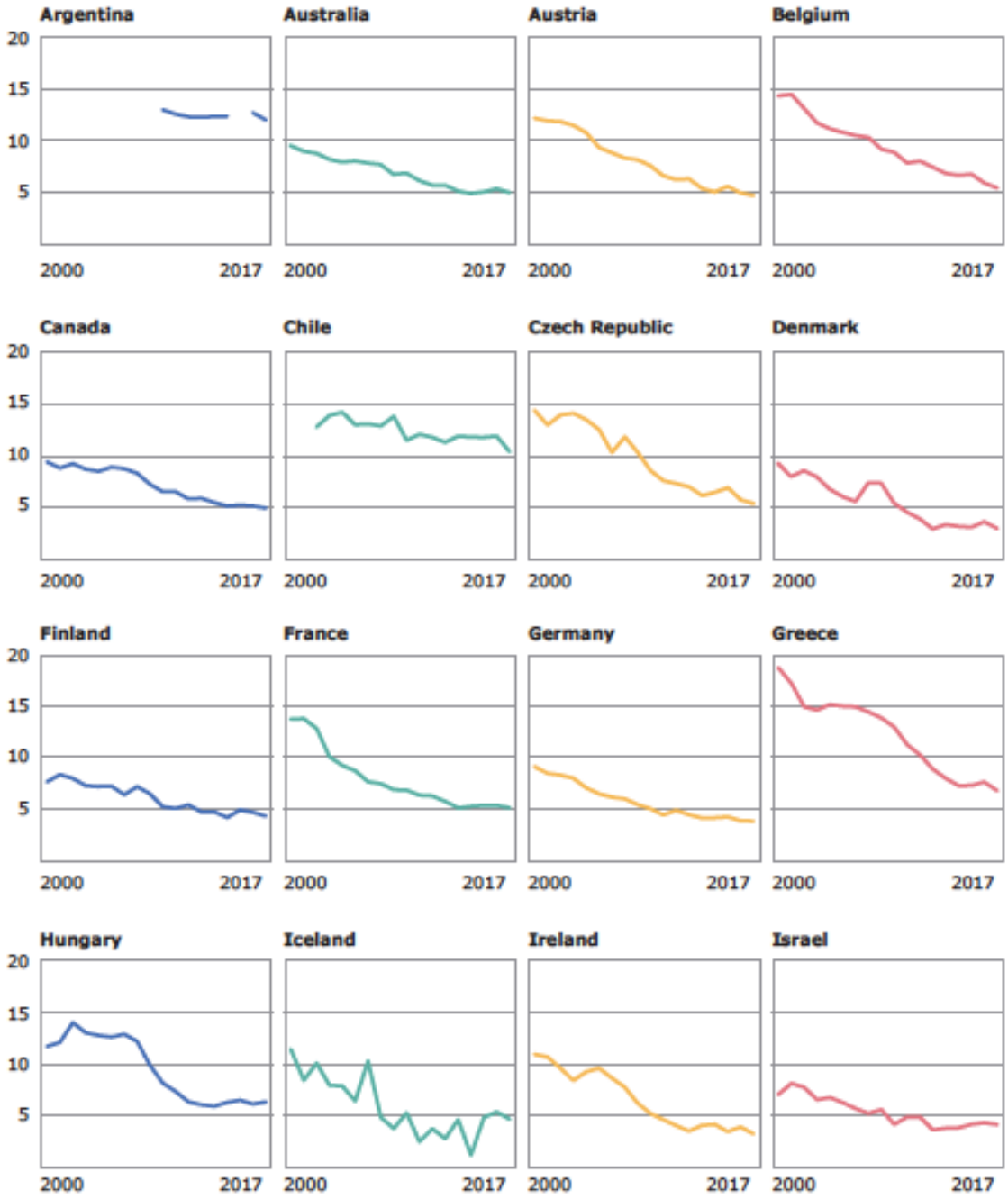
2.5 Reporting to an International Road Safety Body

In a regional observatory perspective, the most crucial indicator for cross-country comparison is the number of fatalities. Standardizing the definition of fatality among countries as fatality occurring within 30 days of a crash is the beginning point for such a comparison. Fatality data will be helpful in regional benchmarking and identifying regional priorities and programs for road safety. This also applies to the number of serious injuries where implementing a standardized system to classify injuries is key. Aside from crash data however, various international organizations collect other road safety indicators such as Exposure and Performance Data.

The International Road Traffic and Accident Database (IRTAD) of the International Transport Forum (ITF) collects data from its member countries in a common and standardized format and data definitions decided by the IRTAD Group.[37] Data that are collected include fatality and injury crash data disaggregated by road type, road user, age, and gender. They also collect Exposure Data such as vehicle-kilometers, modal split, vehicle fleet by type of vehicle, population, and data on driving licenses. In addition, they collect safety performance data on seatbelt and helmet wearing rates. A sample country analysis is shown in Figure 7.

[37] ITF. 2019. *Road Safety Annual Report 2019*. [Online]. Available at: https://www.itf-oecd.org/sites/default/files/docs/irtad-road-safety-annual-report-2019.pdf. [Accessed 5 July 2020]

Figure 7: Evolution of Road Fatalities per 100,000 inhabitants from 2000-2017[38]



[38] ITF. 2019. *Road Safety Annual Report 2019*. [Online]. Available at: https://www.itf-oecd.org/sites/default/files/docs/irtad-road-safety-annual-report-2019.pdf. [Accessed 5 July 2020]

EU's CARE database aims to collect detailed data on crashes from each EU member country. CADAS was developed so that data reporting can be standardized and that comparisons can be made for each country.[39] Sample analytics that are generated through the CARE database are road deaths per million inhabitants, among others (see Figure 8). Mostly these types of analysis are aggregate and summary in nature.

Figure 8: Road Deaths per Million Inhabitants, 2009 from CARE[40]

[39] Villegas, M. 2011. *CARE Databse.* [Online]. Available at: https://www.unece.org/fileadmin/DAM/trans/doc/2011/wp6/ECE-TRANS-WP6-2011-pres08e.pdf. [Accessed 5 July 2020].
[40] Ibid.

2.6 Summary of Findings

The following are the key findings based on the literature review on crash data elements:

- Road safety data is not limited to crash data alone. Under the road safety management framework, indicators can also be developed under institutional management functions, interventions, and immediate outcomes. Data on legislation and budget, road infrastructure, vehicles, road user behavior, road assessments, and contextual data such as population, the number of vehicle kilometers driven by type of road users, are essential to understanding the nature of road safety issues as well as designing effective programs.

- There is a strong need to improve the reporting of crash data in the Asia Pacific region. Institutional arrangements within and between agencies are important to support data collection and management. These include standardization of forms and definitions, sustainable funding, and other related functions such as regular training in data entry, crash investigation and injury assessment.

- Updating of crash data systems should also consider using digital forms and devices for collection purposes as this improves data collection, quality and ease of subsequent analysis.

- With the exception of MMUCC, minimum indicators are often categorized by crash, road, vehicle, and person-related variables.

- These categories are further subdivided into high importance or first priority and low importance or second priority, indicating that within a minimum set of indicators, there is still a core or mandatory set of indicators.

- All of the above examples emphasize the flexibility of the dataset and how individual countries must customize and contextualize the indicators based on their capacity and needs. What works in one place cannot simply be copied onto another country.

- All have identified the need for collaboration among government ministries and integration of different datasets and database systems. As much as possible, countries must leverage existing datasets and integrate it with the crash database system such as the road infrastructure database and licensing and vehicle registration database systems.

- Data collection primarily includes fatal and injury crashes and not property damage only crashes.

- Based on the table, out of all the data elements, 16 are common “high importance” or “first priority” among all the lists. Namely, these are:

    - Crash identifier (unique reference)
    - Crash date

    - Crash time
    - Crash location
    - Weather conditions
    - Light conditions
    - Crash severity (in CADAS, it falls under the Injury severity category and MMUCC has different assigned values)
    - Road functional class
    - Junction type (in MMUCC, it is in a subfield under Relation to Junction)
    - Vehicle type (in CADAS, it falls under Traffic unit type which includes both vehicles and pedestrians)
    - Vehicle Maneuver (in CADAS, it falls under Traffic unit maneuver which includes both vehicle and pedestrian maneuver)
    - Date of Birth
    - Sex/Gender
    - Type of road user
    - Seating position
    - Injury Severity

- Regional reports on road safety often focus on aggregate and summary-level data while standardizing data elements and indicators across the region.

CHAPTER 3: RECOMMENDATIONS

3.1 Recommendations on Crash Data Elements

The primary goal of collecting data is not to have a perfect dataset but rather, to have a sufficient dataset that can be collected reliably and accurately and can be used to inform meaningful decisions in road safety. While there is a large set of crash data elements, not all are equally important and not all are urgently needed to already create meaningful interventions. The dataset must strike a balance between information overload and absence of data. It is in this regard that the proposed minimum crash data elements are selected as part of a program to strengthen the crash database data collection and management. As observed in the literature, each member country of the APRSO will need to consider the priority data elements that are appropriate for their jurisdiction. These will help them initiate or improve evidence-based road safety programs even without a complete dataset. It is recommended that the data improvement program is divided into three stages: 1) Collecting Core Crash Data Elements, 2) Expanding the Coverage of Data Collection, and 3) Data Integration. While there are three stages, it does not necessarily mean that governments will only collect data elements on one stage before moving on to the next. The stages only signify that data improvement strategies be prioritized for the core data elements, then include items on the expanded list, and finally incorporate elements that will require integration of crash data with other related datasets.

The goal of the first stage, *Collecting Core Crash Data* Elements, is to provide the basic core mandatory elements which are crucial to ensure a good understanding of safety to facilitate preparation of appropriate remedial actions and counter measures and implement appropriate road infrastructure treatments. Countries should be able to undertake regular assessment of their performance in collecting these mandatory indicators. Crucial in this stage is the establishment of institutional mechanisms for collecting, analyzing, and sharing data, identifying required complementary equipment such as GPS devices for procurement, preparation and development of a national crash database system, and standardizing definitions of fatality and injury, among many other necessary tasks. If these parameters are established, then the resulting data and information collected should achieve a reasonable level of accuracy and reliability. The data elements that result from this stage of the process are the common highly important elements as discussed in literature. Other elements such as vehicle maneuver, road functional class and seating position, however, are placed under the second stage since it makes more sense if they are collected simultaneously with the other road, person, and vehicle data elements.

The second stage, *Expanding the Coverage of Data Collection*, includes the collection of datasets that are crucial but are less of a priority than the core crash data elements. These include data that has to be primarily collected during the crash investigation and will not necessarily require or benefit from the integration of database systems (except for Junction Type, Road Functional Class, and Speed Limits). A key departure from the APRSO document is the proposed introduction of Movement Codes which replaces the Crash Type and Impact Type parameters. Using movement codes also replaces the requirement for data elements such as maneuver and road obstacles. Movement codes are used in the MMUCC and CADAS data collection systems. Movement Codes are discussed later in this chapter.

Finally, the third stage, Data Integration, includes data elements that can be acquired by integrating the crash database with other database systems such as the road infrastructure database, and the licensing and vehicle registration database systems. This stage also includes linking to other relevant external database systems such the International Road Assessment Program (iRAP). Table 5 shows the data elements found in each stage.

Table 5: Crash Data Elements for the Data Improvement Program

Core	Expanded	Integration
• Crash identifier (unique reference) • Crash date • Crash time • Crash location • Weather conditions • Light conditions • Crash severity • Vehicle type • Sex • Date of birth • Age • Type of road user (e.g. Driver, Passenger, Pedestrian) • Injury severity	• Movement Code* • Hit and Run • Road functional class (e.g. national road, local road, among others) • Speed limit • Road obstacles • Road surface conditions (e.g. dry, wet, among others) • Junction type • Vehicle Number • Person Number • Occupant's linked vehicle number • Pedestrian's linked vehicle number • Safety Equipment • Nationality • Alcohol use suspected • Alcohol test • Drug use • Seating position	• Traffic control at junction (e.g. traffic police, traffic light, among others) • Road curve (e.g. tight curve, open curve, among others) • Road segment grade (e.g. steep gradient or not) • Vehicle identification number/license plate • Vehicle make • Vehicle model • Vehicle registration number • Vehicle country of registration • Vehicle steering wheel position • Engine size • Vehicle model year of manufacture • Vehicle special function • Person ID • Driving license issue date • Licensed vehicle category

The definitions and assigned values will still follow the APRSO Task Force document. These are enumerated below for easier reference.

Crash identifier

Definition: The unique identifier (e.g. a 10-digit number) within a given year that identifies a particular crash.
Data improvement classification: Core
Data type: Numeric or character string
Comments: the police usually assign this value, as they are responsible at the crash scene. Other systems may reference the incident using this number.

Crash date

Definition: The date (day, month and year), on which the crash occurred.
Data improvement classification: Core
Data type: Numeric (DDMMYYYY)
Comments: If a part of the crash date is unknown, the respective places are filled in with 99 (for day and month). Absence of year should result in an edit check. Important for seasonal comparisons, time series analyses, management/ administration, evaluation and linkage.

Crash time

Definition: The time at which the crash occurred, using the 24 hour-clock format (00.00-23:59).
Data improvement classification: Core
Data type: Numeric (HH:MM)
Comments: Midnight is defined as 00:00 and represents the beginning of a new day. Variable allows for analyses of different time periods.

Crash location

Definition: The exact location at which the crash occurred. Optimum definition is route name and GPS/GIS coordinates if there is a linear referencing system (LRS), or other mechanism that can relate geographic coordinates to specific locations in road inventory and other files. The minimum requirement for documentation of crash location is the street name, the reference point, and distance from reference point and direction from reference point.
Data improvement classification: Core
Data type: Character string, to support latitude/longitude coordinates, linear referencing method, or link node system.
Comments: Critical for problem identification, prevention programs, engineering evaluations, and mapping and linkage purposes.

Weather conditions

Definition: Prevailing atmospheric conditions at the crash location, at the time of

the crash.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Clear (No hindrance from weather, neither condensation nor intense movement of air. Clear and cloudy sky included)
2 Rain (heavy or light)
3 Snow
4 Fog, mist or smoke
5 Sleet, hail
6 Severe winds (Presence of winds deemed to have an adverse effect on driving conditions)
8 Other weather condition
9 Unknown weather condition
Comments: Allows for the identification of the impact of weather conditions on road safety. Important for engineering evaluations and prevention programs.

Light conditions

Definition: The level of natural and artificial light at the crash location, at the time of the crash.
Data type: Numeric
Data improvement classification: Core
Data values:
1Daylight: Natural lighting during daytime.
2 Twilight: Natural lighting during dusk or dawn. Residual category covering cases where daylight conditions were very poor.
3 Darkness: No natural lighting, no artificial lighting
4 Dark with streetlights unlit: Streetlights exist at the crash location but are unlit.
5 Dark with streetlights lit: Streetlights exist at the crash location and are lit.
6 Dark with streetlights unknown if lit or unlit: Streetlights exist at the crash location, but it is unknown if they are lit or unlit.
9 Unknown: Light conditions at time of crash unknown
Comments: Information about the presence of lighting is an important element in analysis of spot location or in network analysis. Additionally, important for determining the effects of road illumination on nighttime crashes to guide relevant future measures.

Crash severity

Definition: Describes the severity of the road crash, based on the most severe injury of any person involved.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Fatal: At least one person was killed immediately or died within 30 days because of the road crash.

2 Serious/severe injury: At least one person was hospitalized for at least 24 hours because of injuries sustained in the crash, while no one was killed. Mini Cadas proposes MAIS3+[41]
3 Slight/minor injury: At least one of the participants of the crash was hospitalized less than 24 hours or not hospitalized, while no participant was seriously injured or killed.
Comments: Provides a quick reference to the crash severity, summarizing the data given by the individual personal injury records of the crash. Facilitates analysis by crash severity level. Several crash-related variables can be derived from collected data, including number of vehicles involved (total), number of motorized vehicles involved, number of non-motorized vehicles involved, number of fatalities, number of non-fatal injuries, day of week, and more. These variables provide counts or other information without the user having to go back to individual records. Depending on the type of reports generated, deriving these data elements can save time and effort.

Type of roadway

Definition: Describes the type of road, whether the road has two directions of travel, and whether the carriageway is physically divided. For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the road where the vehicle with priority was moving is indicated.
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 Motorway/freeway: Road with separate carriageways for traffic in two directions, physically separated by a dividing strip not intended for traffic. Road has no crossings at the same level with any other road, railway or tramway track, or footpath. Specially sign-posted as a motorway and reserved for specified categories of motor vehicles.
2 Express road: Road with traffic in two directions, carriageways not normally separated. Accessible only from interchanges or controlled junctions. Specially sign-posted as an express road and reserved for specified categories of motor vehicles. Stopping and parking on the running carriageway are prohibited.
3 Urban road, two-way: Road within the boundaries of a built-up area (an area with sign-posted entries and exits). Single, undivided street with traffic in two directions, relatively lower speeds (often up to 50 km/h), unrestricted traffic, with one or more lanes, which may or may not be marked.
4 Urban road, one-way: Road within the boundaries of a built-up area, with entries and exits sign-posted as such. A single, undivided street with traffic in one direction, relatively lower speeds (often up to 50 km/h).
5 Road outside a built-up area: Road outside the boundaries of a built-up area (an area with sign-posted entries and exits).
6 Restricted road: A roadway with restricted access to public traffic. Includes cul-de- sacs, driveways, lanes, private roads.
8 Other: Roadway of a type other than those listed above.
9 Unknown: Not known where the incident occurred.

[41] MAIS3+ is the Abbreviated Injury Scale (AIS) severity score applied in the UK. It is an ordinal scale of 1 to 6 (1 indicating a minor injury and 6 being maximal). A casualty that sustains an injury with a score of 3 or higher on the AIS is classified as clinically seriously injured (MAIS3+).

Comments: Important for comparing crash rates of roads with similar design characteristics, and for conducting comparative analyses between motorway and non-motorway roads.

Road functional class

Definition: Describes the character of service or function of the road where the first harmful event took place. For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the road where the vehicle with priority was moving is indicated.
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 Principal arterial: Roads serving long distance and mainly interurban movements. Includes motorways (urban or rural) and express roads. Principal arterials may cross through urban areas, serving suburban movements. The traffic is characterized by high speeds and full or partial access control (interchanges or junctions controlled by traffic lights). Other roads leading to a principal arterial are connected to it through side collector roads.
2 Secondary arterial: Arterial roads connected to principal arterials through interchanges or traffic light controlled junctions supporting and completing the urban arterial network. Serving middle distance movements but not crossing through neighborhoods. Full or partial access control is not mandatory.
3 Collector: Unlike arterials, collectors cross-urban areas (neighborhoods) and collect or distribute the traffic to/from local roads. Collectors also distribute traffic leading to secondary or principal arterials.
4 Local: Roads used for direct access to the various land uses (private property, commercial areas etc.). Low service speeds not designed to serve interstate or suburban movements.

Road surface conditions

Definition: The condition of the road surface at the time and place of the crash.
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 Dry: Dry and clean road surface.
2 Snow, frost, ice: Snow, frost or ice on the road.
3 Slippery: Slippery road surface due to existence of sand, gravel, mud, leaves, oil on the road. Does not include snow, frost, ice or wet road surface.
4 Wet, damp: Wet road surface. Does not include flooding.
5 Flood: Still or moving water on the road.
6 Other: Other road surface conditions not mentioned above.
9 Unknown: The road surface conditions were unknown.
Comments: Important for identification of high wet-surface crash locations, for engineering evaluation and prevention measures.

Speed limit

Definition: The legal speed limit at the location of the crash.
Data improvement classification: Expanded
Data type: Numeric
Data values:
nnn: The legal speed limit as provided by road signs or by the country's traffic laws for each road category, in kilometers per hour (km/h).
Unknown: The speed limit at the crash location is unknown.
Comments: For crashes occurring at junctions, where the crash cannot be clearly allocated in one road, the speed limit for the road where the vehicle with priority was moving is indicated.

Road obstacles

Definition: The presence of any person or object, which obstructed the movement of the vehicles on the road. Includes any animal standing or moving (either hit or not), and any object not meant to be on the road. Does not include vehicles (parked or moving vehicles, pedestrians) or obstacles on the side of the carriageway (e.g. poles, trees).
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 Yes: Road obstacle(s) present at the crash site.
2 No: No road obstacle(s) present at the crash site.
9 Unknown: Unknown presence of any road obstacle(s) at the crash site. Countries where a large proportion of the road network is unpaved may wish to include the variable 'road surface type' to allow for analysis of crash rates by road surface type.

Junction type

Definition: Indicates whether the crash occurred at a junction (two or more roads intersecting) and defines the type of the junction. In at-grade junctions, all roads intersect at the same level. In not-at-grade junctions, roads do not intersect at the same level.
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 At-grade, crossroad: Road intersection with four arms.
2 At-grade, roundabout: Circular road.
3 At-grade, T or staggered junction: Road intersection with three arms. Includes T intersections and intersections with an acute angle.
4 At-grade, multiple junction: A junction with more than four arms (excluding roundabouts).
5 At-grade, other: Other at-grade junction type not described above.
6 Not at grade: The junction includes roads that do not intersect at the same level.
7 Not at junction: The crash has occurred at a distance greater than 20 meters from a junction.
9 Unknown: The crash location relative to a junction is unknown.

Comments: Crashes occurring within 20 meters of a junction are considered as crashes at a junction. Important for site-specific studies and identification of appropriate engineering countermeasures.

Traffic control at junction

Definition: Type of traffic control at the junction where crash occurred. Applies only to crashes that occur at a junction.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 Authorized person: Police officer or traffic warden at intersection controls the traffic. Applicable even if traffic signals or other junction control systems are present.
2 Stop sign: Priority is determined by stop sign(s).
3 Give-way sign or markings: give-way sign or markings determine Priority.
4 Other traffic signs: Priority is determined by traffic sign(s) other than 'stop', 'give way' or markings.
5 Automatic traffic signal (working): Priority is determined by a traffic signal that was working at the time of the crash.
6 Automatic traffic signal (out of order): A traffic signal is present but out of order at time of crash.
7 Uncontrolled: The junction is not controlled by an authorized person, traffic signs, markings, automatic traffic signals or other means.
8 Other: The junction is controlled by means other than an authorized person, signs, markings or automatic traffic signals.
Comments: If more than one value is applicable, (e.g. traffic signs and automatic traffic signals) record all that apply.

Road curve

Definition: Indicates whether the crash occurred inside a curve, and what type of curve.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 Tight curve: The crash occurred inside a road curve that was tight (based on the judgment of the police officer).
2 Open curve: The crash occurred inside a road curve that was open (based on the judgment of the police officer).
3 No curve: The crash did not occur inside a road curve.
9 Unknown: It is not defined whether the crash occurred inside a road curve.
Comments: Useful for identification and diagnosis of high-crash locations, and for guiding changes to road design, speed limits, etc.

Road segment grade

Definition: Indicates whether the crash occurred on a road segment with a steep gradient.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 Yes: The crash occurred at a road segment with a high grade.
2 No: The crash did not occur at a road segment with a high grade.
9 Unknown: It is not defined whether the crash occurred at a road segment with a high grade.
Comments: Useful for identification and diagnosis of high-crash locations, and for guiding changes to road design, speed limits, etc.

Vehicle number

Definition: Unique number on assigned to identify each vehicle involved in the crash.
Data improvement classification: Expanded
Data type: Numeric, sequential number
Comments: Allows the vehicle record to be cross-referenced to the crash record and person records.

Vehicle VIN number

Definition: Unique vehicle number attached to the engine compartment of the vehicle by the manufacturer to identify each vehicle involved in the crash.
Data improvement classification: Integration
Data type: Numeric, sequential number
Comments: Allows the vehicle record to be cross-referenced with registration and person records.

Vehicle registration number

Definition: Unique vehicle registration number appearing on the number plate and registration documents.
Data improvement classification: Integration
Data type: numeric, sequential number
Comments: Allows cross-referencing with vehicle VIN number and identification.

Country of vehicle's registration

Definition: Identifies the country where the vehicle is registered.
Data improvement classification: Integration
Data type: Character string.

Vehicle type

Definition: The type of vehicle involved in the crash.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Bicycle: Road vehicle with two or more wheels, generally propelled solely by the energy of the person on the vehicle, in particular by means of a pedal system, lever or handle.
2. Animal powered vehicle: Road vehicle with two or more wheels generally propelled solely by the energy of animals drawing it.
3 Other non-motor vehicle: Other vehicle without engine not included in the list above.
4 Two/three wheel motor vehicle: Two or three-wheeled road motor vehicle (includes mopeds, motorcycles, tricycles and all-terrain vehicles).
5 Passenger car: Road motor vehicle other than a two or three-wheeled vehicle, intended for the carriage of passengers and designed to seat no more than nine (driver included).
6 Bus/coach/trolley: Passenger-carrying vehicle, most commonly used for public transport, inter-urban movements and tourist trips, seating more than nine
persons. Includes vehicles connected to electric conductors and which are not rail-borne.
7 Light goods vehicle (<3.5 t): Smaller (by weight) motor vehicle designed exclusively or primarily for the transport of goods.
8 Heavy goods vehicle (≥3.5 t): Larger (by weight) motor vehicle designed exclusively or primarily for the transport of goods.
9 Other motor vehicle: Other vehicle not powered by an engine and not included in the two previous lists of values.
10 Unknown: The type of the vehicle is unknown or it was not stated.
Comments: Allows for analysis of crash risk by vehicle type and road user type. Important for evaluation of countermeasures designed for specific vehicles or to protect specific road users.

Vehicle make

Definition: Indicate the make (distinctive name) assigned by motor vehicle manufacturer.
Data improvement classification: Integration
Data type: Character string. Alternatively, a list of motor vehicle makes can be composed, with a code corresponding to each. Such a list allows for more consistent and reliable recording, as well as for easier interpretation of the data.
Comments: Allows for crash analyses related to the various motor vehicle makes.

Vehicle model

Definition: The code assigned by the manufacturer to denote a family of motor vehicles (within a make) that have a degree of similarity in construction.
Data improvement classification: Integration
Data type: Character string. Alternatively, a list of motor vehicle models can be composed, with a code corresponding to each. Such a list allows for more consistent and reliable recording, as well as for easier interpretation of the data.

Comments: Record the name of the model as referred to in the country in which the crash occurred. Allows for crash analyses related to the various motor vehicle models.

Vehicle model year

Definition: The year assigned to a motor vehicle by the manufacturer.
Data improvement classification: Integration
Data type: Numeric (YYYY)
Comments: Can be obtained from vehicle registration. Important for use in identifying motor vehicle model year for evaluation, research, and crash comparison purposes.

Engine size

Definition: The size of the vehicle's engine is recorded in cubic centimeters.
Data improvement classification: Integration
Data type: Numeric
Data values:
nnnn: Size of engine
9999: Unknown engine size
Comments: Important for identifying the impact of motor vehicle power on crash risk.

Vehicle special function

Definition: The type of special function being served by this vehicle regardless of whether the function is marked on the vehicle.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 No special function: No special function of the vehicle.
2 Taxi: Licensed passenger car for hire with driver, without predetermined routes.
3 Vehicle used as bus: Passenger road motor vehicle used for the transport of people.
4 Police / military: Motor vehicle used for police / military purposes.
5 Emergency vehicle: Motor vehicle used for emergency purposes (includes ambulances, fire service vehicles etc.).
8 Other: Other special functions, not mentioned above.
9 Unknown: It was not possible to record a special function.
Comments: Important to evaluate the crash involvement of vehicles used for special uses.

Vehicle steering wheel position

Definition: Identifies whether the vehicle is left hand drive or right hand drive.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 Left hand drive: steering wheel is located on the left side of the vehicle.

2 Right hand drive: vehicle steering wheel is located on the right side of the vehicle.
9 Unknown: the side of the vehicle on which the vehicle steering wheel is located is unknown or not recorded.
Comments: allows for analysis of crash risk in countries where both left and drive and right hand drive vehicles are used.

Person number

Definition: Number assigned to uniquely identify each person involved in the crash.
Data improvement classification: Expanded
Data type: Numeric (two-digit number, nn)
Comments: The persons related to the first (presumed liable) vehicle will be recorded first. Within a specific vehicle, the driver will be recorded first, followed by the passengers. Allows the person record to be cross-referenced to crash, road and vehicle records to establish a unique linkage with the Crash ID and the Vehicle number.

Occupant's vehicle number

Definition: The unique number assigned for this crash to the motor vehicle in which the person was an occupant.
Data improvement classification: Expanded
Data type: Numeric (two-digit number, nn)
Comments: Allows the person record to be cross-referenced to the vehicle records, linking the persons to the motor vehicle in which they were travelling.

Pedestrian's linked vehicle number

Definition: The unique number assigned for this crash to the motor vehicle that collided with this person. The vehicle number assigned under to the motor vehicle that collided with this person.
Data improvement classification: Expanded
Data type: Numeric (two-digit number, nn, from V1)
Comments: Allows the person record to be cross-referenced to the vehicle records, linking the person to the motor vehicle that struck them.

Date of birth

Definition: Indicates the date of birth of the person involved in the crash.
Data improvement classification: Core
Data type: Numeric (date format – dd/mm/yyyy, 99/99/9999 if birth date unknown)
Comments: Allows calculation of person's age. Important for analysis of crash risk by age group, and assessing effectiveness of occupant protection systems by age group. Key variable for linkage with records in other databases.

Sex

Definition: Indicates the sex of the person involved in the crash.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Male: Based on identification documents / personal ID number or determined by the police.
2 Female: Based on identification documents / personal ID number or determined by the police.
9 Unknown: Sex could not be determined (police unable to trace person, not specified).
Comments: Important for analysis of crash risk by sex. Important for evaluation of the effect of sex of the person involved on occupant protection systems and motor vehicle design characteristics.

Type of road user

Definition: This variable indicates the role of each person at the time of the crash.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Driver: Driver or operator of motorized or non-motorized vehicle. Includes cyclists, persons pulling a rickshaw or riding an animal.
2 Passenger: Person riding on or in a vehicle, who is not the driver. Includes person in the act of boarding, alighting from a vehicle or sitting/stranding.
3 Pedestrian: Person on foot, pushing or holding a bicycle, pram or a pushchair, leading or herding an animal, riding a toy cycle, on roller skates, skateboard or skis. Excludes persons in the act of boarding or alighting from a vehicle.
8 Other: Person involved in the crash who is not of any type listed above.
9 Unknown: It is not known what role the person played in the crash.
Comments: Allows for analysis of crash risk by road user type (in combination with Vehicle type, V2). Important for evaluation of countermeasures designed to protect specific road users.

Seating position

Definition: The location of the person in the vehicle at the time of the crash.
Data improvement classification: Expanded
Data type: Numeric
Subfield: Row
Data values:
1 Front
2 Rear
3 Not applicable (e.g. riding on motor vehicle exterior)
8 Other
9 Unknown
Subfield: Seat
Data values:
1 Left

2 Middle
3 Right
4 Not applicable (e.g. riding on motor vehicle exterior)
8 Other
9 Unknown
Comments: Important for full evaluation of occupant protection programs.

Injury severity

Definition: The injury severity level for a person involved in the crash.
Data improvement classification: Core
Data type: Numeric
Data values:
1 Fatal injury: Person was killed immediately or died within 30 days, as a result of the crash.
2 Serious/severe injury: Person was hospitalized for at least 24 hours because of injuries sustained in the crash.
3 Slight/minor injury: Person was injured and hospitalized for less than 24 hours or not hospitalized. MAIS3+ in MiniCadas
4 No injury: Person was not injured.
9 Unknown: Injury severity was not recorded or is unknown.
Comment: Important for injury outcome analysis, evaluation, and appropriate classification of crash severity (PD1). Important element for linkage with records in other databases.

Safety equipment

Definition: Describes the use of occupant restraints, or helmet use by a motorcyclist or bicyclist.
Data improvement classification: Expanded
Data type: Numeric
Subfield: Occupant restraints
Data values:
1 Seat-belt available, used
2 Seat-belt available, not used
3 Seat-belt not available
4 Child restraint system available, used
5 Child restraint system available, not used
6 Child restraint system not available
7 Not applicable: No occupant restraints could be used on the specific vehicle (e.g. agricultural tractors).
8 Other restraints used
9 Unknown: Not known if occupant restraints were in use at the time of the crash.
10 No restraints used
Subfield: Helmet use
Data values:
1 Helmet worn
2 Helmet not worn
3 Not applicable (e.g. person was pedestrian or car occupant)

9 Unknown
Comments: Information on the availability and use of occupant restraint systems and helmets is important for evaluating the effect of such safety equipment on injury outcomes.

Alcohol use suspected

Definition: Law enforcement officer suspects that person involved in the crash has used alcohol.
Data improvement classification: Expanded
Data type: Numeric
Data values:
1 No
2 Yes
3 Not applicable (e.g. if person is not driver of motorized vehicle)
9 Unknown

Alcohol test

Definition: Describes alcohol test status, type and result.
Data improvement classification: Expanded
Data type: Numeric
Subfield: Test status
Data values:
1 Test not given
2 Test refused
3 Test given
9 Unknown if tested
Subfield: Test type
Data values:
1 Blood
2 Breath
3 Urine
8 Other
9 Test type unknown
Subfield: Test result
Data values
1Pending
9Result unknown
Comments: Alcohol-related crashes are a major road safety problem. Information on alcohol involvement in crashes facilitates evaluation of programs to reduce drink-driving.

Drug use

Definition: Indication of suspicion or evidence that person involved in the crash has used illicit drugs.
Data improvement classification: Expanded
Data type: Numeric

Data values:
1 No suspicion or evidence of drug use
2 Suspicion of drug use
3 Evidence of drug use (further subfields can specify test type and values)
4 Not applicable (e.g. if person is not driver of motorized vehicle)
9 Unknown

Driving license issue date

Definition: Indicates the date (month and year) of issue of the person's first driving license, provisional or full, pertaining to the vehicle they were driving.
Data improvement classification: Integration
Data type: Numeric (MMYYYY)
Data values:
Value (MMYYYY)
1 Never issued a driving license
9 Date of issue of first license unknown
Comments: Allows calculation of number of years' driving experience at the time of crash.

Licensed vehicle category

Definition: Whether the driving license allowed the driver to operate the vehicle s/he was operating.
Data improvement classification: Integration
Data type: Numeric
Data values:
1 Yes
2 No
9 Unknown

Age

Definition: The age in years of the person involved in the crash.
Data improvement classification: Core
Data type: Numeric
Comments: Derived from Date of birth and Crash date. Important for analysis of crash risk by age group, and assessing effectiveness of countermeasures by age group.

Driver Nationality

Definition: The nationality of the driver of the vehicle.
Data improvement classification: Expanded
Data type: Character string

Hit and run

Definition: The behavior of a driver of a vehicle who is involved in a collision with another vehicle, property or human being, who knowingly fails to stop to give his/her name, license number, and other information as required by statute to the injured party, a witness, or law enforcement officers.
Data improvement classification: Expanded
Data type: *Yes* or *No*
Comments: Information captured when more than one vehicle involved in the crash but only one vehicle's data available.

3.2 Recommendations on the Use of Movement Codes

As discussed earlier, it is recommended that a more detailed system of effectively classifying crash types is implemented. This system can be most appropriately illustrated in the form of movement codes. A Movement Code is a system of classifying crashes using standard and predefined diagrams based on road users and their movements and activities leading to a crash. It is also referred to as Definition for Coding Accidents (DCA) in Australia.[42] There are code systems which are sophisticated and detailed and consist of primary crash types which are further sub-divided into secondary and more specific types. For example, a primary crash type would be 'Hit Pedestrian' and the secondary type is 'Hit Pedestrian on a Crossing.' An example of a sophisticated coding system is the Movement Codes in New Zealand which have at least 50 Movement Codes (see Figure 9).[43]

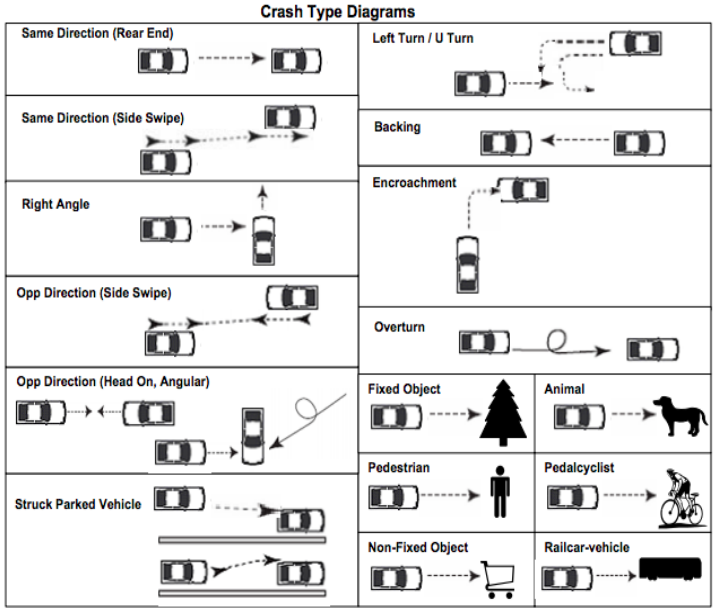
[42] Turner, B., Tziotis, M., Hillier, P., Beck, D., and Makwasha, T. 2015. *Guide to Road Safety Part 8: Treatment of Crash Locations*. Australia: Austroads.
[43] Ibid.

Figure 9: Movement Codes in New Zealand

A simpler coding system is used in New Jersey, United States which only uses 18 Movement Codes[44]:

[44] *State of New Jersey Police Crash Investigation Report*. [Online]. Available at: https://www.state.nj.us/transportation/refdata/accident/pdf/NJTR-1.pdf. [Accessed 5 July 2020].

Figure 10: Movement Codes in New Jersey[45]



Movement codes can provide a more detailed description of the crash which are crucial for the development of effective road treatments. Movement codes can replace crash data elements such as crash and impact type and vehicle and pedestrian maneuver. Visual pictorals are generally easier for data gathers to assign a crash type than prepare a text description and this can significantly result in better quality and consistent data.

3.3 Recommendations on Road Safety Indicators

In addition to the actual crash data it is useful to compile a set of supporting information that can be used to describe the characteristics of road safety in a national context and can also then be usefully applied across country comparisons. This information can be disaggregated into 3 types of descriptors: the first set describes the institutional framework of road safety in the country while the second set identifies the potential exposure of road users to "crash risk"; the third set of descriptors provides road safety performance indicators that relate to the three core elements comprising the road, the vehicles and the road users.

Institutional Management Indicators

Description: Road safety is a public good and as a consequence the national effort to address road safety in the country can be identified by the financial resources allocated for road safety in the annual budget. Budgetary resources are likely spread in several different ministries or

[45] *State of New Jersey Police Crash Investigation Report*. [Online]. Available at: https://www.state.nj.us/transportation/refdata/accident/pdf/NJTR-1.pdf. [Accessed 5 July 2020].

organizations and it is necessary to identify allocations made for (i) traffic policing (ii) highway agency budgets for road safety elements such as road safety audit and blackspot programs, (iii) transport agency programs for road safety programs, and (iv) health agency budget elements for emergency services that relate to road safety trauma.

Frequency: Annual

Information Required:

Is there a National Road Safety Organization? Y/N: Annual budget _____

Is there a Road Safety Unit in Transport Ministry? Y/N : No of Staff _____? Annual budget _____

Is there a Road Safety Unit in Highways Ministry? Y/N No of Staff ____? Annual budget _____

Total Annual budget for road safety _____(USD million)

Road Transport Exposure Characteristics/Immediate Outcome Indicators

The road transport exposure elements can be described under 2 types of information (i) data relating to the road network, and (ii) information relating to exposure risk.

(i) **Information on the road network**:

Core information required:

(a) Length of the total road network _____km

(b) Vehicle fleet size and composition: table of vehicle fleet by vehicle type by year over 10-year period

Frequency: Annual

Preferred information required:

(c) Total vehicle km/year: _____

Frequency: Annual

(ii) **Information relating to exposure risk**:

Core information:

(a) Population: A table indicating total population disaggregated by gender and age composition should be provided.

(b) Driver population (number of driving licenses)/year for last 10 years;

The number of first time licenses issued/year for past 10 years.

Frequency: Annual

Preferred information:

© Average number of person trips/day? _____ trips

(c) Average time a person is in traffic/day _____ minutes

(d) Average person km/day _____ km

Frequency: Annual

Performance Indicators

Performance indicators provide information that help to describe the performance of the road sector and focus on 3 types of indicators, namely, the road network, vehicles and road users. This information consists of all preferred indicators.

a) Road:

Is road safety audit compulsory? Y/N

Number of road safety audits/year: No _____ Km _____

Number of blackspot assessments/year: No_____

b) Vehicles:

Age of vehicle fleet by type of vehicle: provide table of vehicle types per year for past 10 year period.

Is vehicle inspection required? Y/N for: Private vehicles older than _____years
Public transport older than ____years
Trucks older than ____ years

Number of vehicle inspections undertaken annually: provide a table of vehicle types/year for past 10-year period.

c) Road Users:

Seat belt wearing rate: _____%:

Helmet wearing rate: driver _____%:
passenger _____%

Speeding: Is speeding a road safety issue? Y/N. Number of cases/year over past 10-years

Number of drink/drug driving under the influence cases: _____/yr

Number of distracted driving cases: _____/yr

Daylight running compulsory: Motorcycles/2-wheelers Y/N
Cars and trucks Y/N

***Post-Crash Care**:*

Number of ambulances: _____

Emergency telephone number Y/N tel:_____

3.4 Recommendations on Reporting to the APRSO

In the short-term, it is recommended that fatality and injury data disaggregated by vehicle and road user type, age, and sex are provided to the APRSO by member countries on a regular basis. Exposure data that are readily available such as population and vehicle registration data are also recommended to be required from member countries. In the long-term, this list is expected to grow especially when member countries have already improved their data collection and management.

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