ROAD TRAFFIC CRASH DATA ANALYSIS TRAINING COURSE

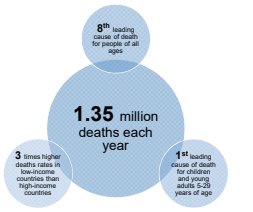
Contract No: CS 02

Results-based Road Maintenance and Safety Project (RRMSP)

World Bank Loan No. 8489-AL

MODULE 1: ROAD SAFETY NATIONAL AND INTERNATIONAL FRAMEWORK

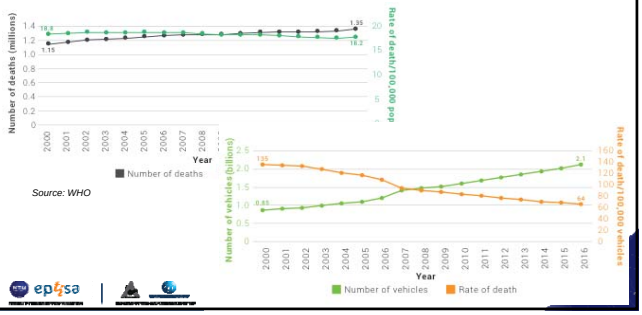
The Global burden of road traffic deaths



Source: WHO

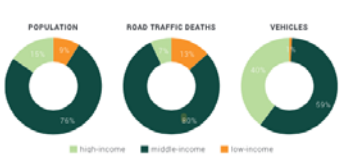
- The number of road traffic deaths on the world's roads remains unacceptably high
- Road traffic injuries are the leading killer of children and young adults
- More than a half of global road traffic deaths are amongst pedestrians, cyclists and motorcyclists who are still too often neglected in road traffic system design in many countries
- There is progress being made, however, it is far from uniform across countries
- Target to halve road deaths and injuries will not be met without drastic action

Rates of road traffic deaths



Source: WHO

Road traffic deaths and income levels



Source: WHO

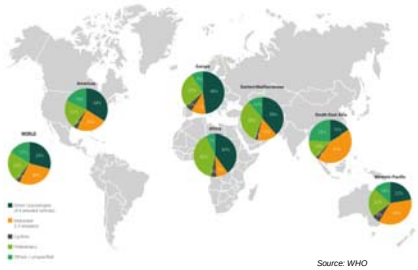
- The burden of road traffic deaths is disproportionately high among low- and middle-income countries in relation to the size of their populations and the number of motor vehicles in circulation
- Although only 1% of the world's motor vehicles are in low-income countries, 13% of deaths occur in these countries

Road traffic deaths and regions

Source: WHO

- Countries in Africa and South-East Asia have regional rates of road traffic deaths higher than the global rate
- In terms of progress made, in three of the six regions (Americas, Europe, Western Pacific), the rates of death have decreased since 2013
- With the exception of the Eastern Mediterranean region, the rate of road traffic deaths per 100,000 population generally decreases as income increases

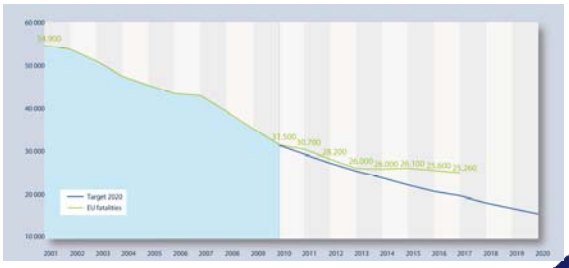
Road traffic deaths and road users



Source: WHO

Road traffic deaths among **pedestrians**, **cyclists** and **motorcyclists** are intolerably high

Road fatalities in EU



Source: European Commission

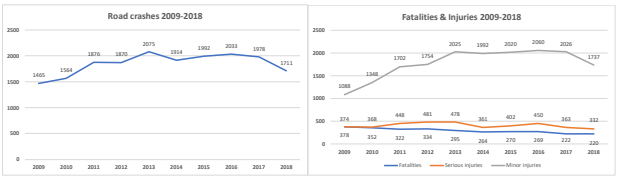
Road fatalities in EU

Fatalities 2010 - 2015

Source: European Commission

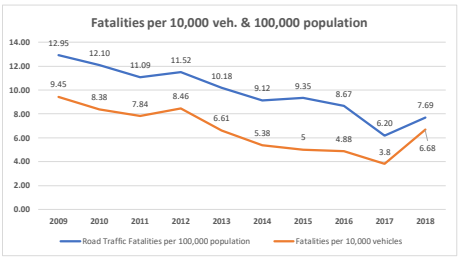
Fatalities per million inhabitants (2017)

Road traffic crashes in Albania



Consultant Service for Road Safety Technical Assistance 27/4/2021

Road traffic crashes in Albania



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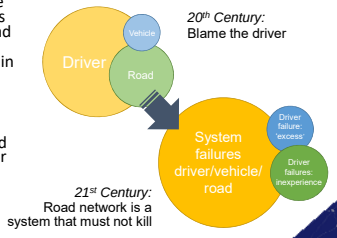
The safe system approach

October 2019

The safe system approach

- A **Safe System approach** within the road transport system is built around the premise that death and injury are **unacceptable** and are **avoidable**. This approach seeks to ensure that no road user is subject to **kinetic energy exchange** in a crash which will result in death or serious long-term disabling injury.
- The Safe System represents a major change to past approaches. It overturns the **fatalistic** view that road traffic injury is the price to be paid for achieving mobility. It sets a **goal** of eliminating road crash fatalities and serious injuries in the long-term.



20th Century: Blame the driver

21st Century: Road network is a system that must not kill

Safety principles

- Humans have **limitations** and are **fallible** (i.e. they make **mistakes**)
- There are known **physical limits** for energy exchange in crashes, beyond which the human body is seriously injured
- A **well-designed system** can ensure that the physical limits of the human body are not exceeded in a crash
- The **focus** is on the long-term elimination of fatalities and serious injury
- There is a **shared responsibility** for safe travel outcomes between 'system designers' (those who influence the level of safety experienced on the road network) and the road user

LONG-TERM GOAL

A Safe System will exist when road users are no longer exposed to death or serious injury on the network

The Safe System approach draws upon:

- **Vision Zero** (Sweden, 2005): 'It can never be acceptable that people are killed or seriously injured when moving within the road transport system'
- **Sustainable Safety** (the Netherlands, 2006): it is based on an ethical principle to eliminate death and serious injury from the transport system. It considers elimination of preventable crashes as the starting point and attaches greater weight to cost-effectiveness in determining interventions

Shared responsibility

It is no longer acceptable to expect the road user to carry all responsibility for avoiding serious crashes

The Safe System approach looks to:

- **Infrastructure design**
- **Speed limits**
- **Vehicle safety features**

that individually (and together) minimise violent crash forces.

It relies upon:

- adequate **education**, **legislation** and **enforcement** efforts to gain high levels of road user compliance with road rules
- effective **licensing** regimes to control the safety of drivers using the system (including cancellation of licences when serious offences are committed)

A good standard of **emergency post-crash care** is also needed

The Safe system model

Safe systems thinking

*Change **mindset** managing the interactions between travel speeds, road infrastructure and vehicle systems to reduce risk of serious injury crash outcomes*

Single intervention approach (vehicle overloading **OR** treat blackspots **OR** helmet wearing …)

Interacting safe system interventions (route based safety treatments **AND** speed limit reduction **AND** increased speed enforcement as well as improving individual interventions such as seat belt wearing …)

Safe System Road Safety Pillars

DECADE OF ACTION FOR ROAD SAFETY 2011-2020

- Pillar 1: Road safety management
- Pillar 2: Safe roads (focus on safe speed limits)
- Pillar 3: Safe Vehicles
- Pillar 4: Safe Road Users
- Pillar 5: Post-crash Response

Role of road crash data in road safety management

Road safety Science

*"Road safety management is in transition. The transition is from action based on experience, intuition, judgment, and tradition, to **action based on empirical evidence, science, and technology**; from consideration of road safety that is tacit and qualitative, to consideration of road safety that is explicit and quantitative. Other fields went through the same metamorphosis. It occurred in the military perhaps in the 1940s and in medicine and agriculture even earlier. In road safety, the transition from reliance on intuition to **reliance on science** is already in progress and is accelerating."*

(Ezra Hauer)

Using crash data

- There is a wide variety of uses for security data, with many different users
- Safety data can be used by decision-makers, traffic engineers, police, the health sector, the research community, insurance companies, prosecutors, vehicle manufacturers and others
- Although summary data (e. g. number of crashes, number of deaths, etc.) are available in most countries, more detailed information is required to meet the requirements of these users
- Without this data collection, it is not possible to adopt a factual approach to road safety management

Road safety management and data

- Road safety management requires more data than usual on crashes
  - Crash statistics do not give a complete picture of the road safety situation
- Crash data must be interpreted in the light of other information that cannot usually be obtained from police records
  - Population size / number of vehicles on the road /...
- Crash data do not capture information on risk factors
  - Use of headphones / speeding /...
- Other road safety data are important for monitoring performance and achieving results

Road safety management system

Road safety monitoring system

Final outcomes	Deaths, economic cost
Exposure measures	Demographic data / Number of licensed drivers / Traffic volume data / Infrastructure factors
Intermediate outcomes	Speed limits, travel speeds / seatbelt and correct helmet wearing rates / drink–driving / overloaded vehicles
Outputs	Enforcement hours, number of challans issued, % penalties paid

Roles and functions (1/2)

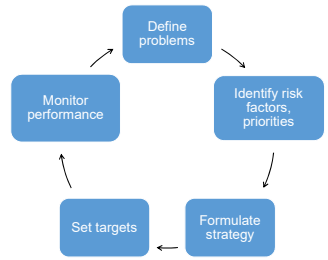
Police	• Crash reporting, including key factors • Traffic law enforcement • Issue challans • Evidence (data) based enforcement • Monitor legal proceedings
Transport	• Identify locations, time periods, road types with high road crashes frequencies • Identify vehicle types involved in crashes • Identify high risk sections / 'blackspots' • Review speed limits on high crash roads • Select appropriate treatments for high-risk locations and monitor the effects • Develop and implement policies • Establish a case for new legislation

Roles and functions (2/2)

Health	• Estimate the impact of serious road traffic injuries on health systems • Assess impact of road safety interventions • Plan for trauma care, rehabilitation services • Plan and advocate for Emergency Medical Services policies and legislation • Advocate for legislation to address high-risk behaviours • Evaluate effectiveness of trauma care management systems
Crash investigator (multi-fatality or high profile crashes only)	• Undertake a detailed investigation to establish the actual crash cause including road, vehicle, human, environmental factors and the overlapping connection between these factors • Prepare reports including recommendations for Government and key agency interventions and changes legislation, standards and rules

Benefits and requirements of road crash data: the importance of evidence base analysis

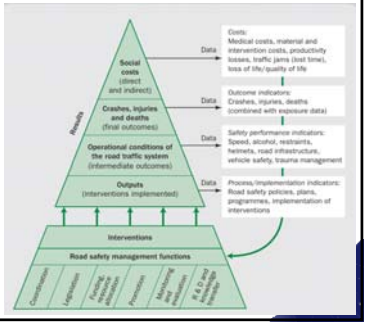
Purpose of data collection



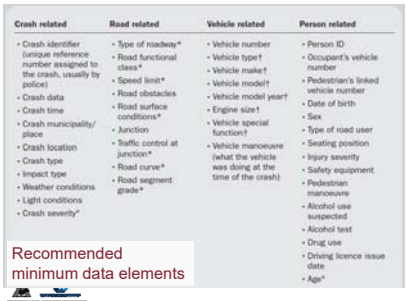
Which data to collect?

Only 1 in 5 countries can provide data on fatalities, non-fatal injuries and economic impact

- **Crash data**
- **Extra-accident** data (exposure data):
  - road layout, design and environment
  - traffic flows and characteristics
  - vehicle fleet
  - driver information



WHO data recommendations



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*

Recommended minimum data elements

Road data

- Number, class and length of road
- Road type, by number of lanes, median width
- Number of lanes and lane width
- Crossing type, intersection design
- Type of traffic control (signals, roundabouts, Stop or give way)
- Alignment (horizontal and vertical curvature, grade, etc.)
- Road surface (bitumen, concrete, unsurfaced)
- Surface condition (roughness, rutting, potholes)
- Shoulders: width, type and condition
- Drainage
- Speed limits
- Lighting by type and location
- Parking regulations

Traffic data

- Location data (x,y coordinates, route number and nearest km post or a node-link system)
- Traffic volumes as vehicles per day, or short specific counts at given locations
- Traffic composition by types of vehicles in the traffic mix
- Traffic variation (as required by time of day, day of week, month or annually)
- Turning movements at junctions
- Vehicle speed data

Vehicle data

- Vehicle (car, van, auto rickshaw, pick up, truck, etc.),
- Vehicle ownership details: date of birth, sex, name, address, year of ownership
- Vehicle registration number, chassis and engine number
- Engine Size
- Seating capacity
- Year of manufacture and year of first registration in country
- Body type (car, van, pick up, etc.), number of doors, together with details of modifications
- Roadworthiness certificate

Driver data

- Full name and address
- Date of birth, sex
- Licensed / unlicensed
- Type of licence held, i.e. learner or full license, and type of vehicle for which licence is valid
- Year and place of issue
- Record of offences committed / challans issued
- Record of driving suspensions
- Essential medical information

Main source of data

- **Police**
- **Health authorities**
- **Road / Transport agencies**

- Other stakeholders may include:
  - national statistics office,
  - the insurance industry,
  - non-governmental organizations working for road safety,
  - academic institutions…

Assessing data sources

- What variables are collected (particularly specific location data, road user type and transport mode)?
- What is the format of the data (is it hard-copy only or are there electronic records. How is it coded)?
- What is the professional reputation of the agency?
- What system is used to store the data and to process the data?

Sources and types of data (1/2)

Source	Type of data	Observations
Police	Number of road traffic incidents, fatalities and injuries Road users involved Age and sex of casualties Vehicles involved Police assessment of causes of crashes Use of safety equipment (e.g. helmets) Location and sites of crashes Prosecutions	Level of detail varies from one country to another. Police records can be inaccessible. Under-reporting is a common problem. Precise location data (e.g. map coordinates) may not be available.
Health settings (hospital in-patient records, emergency room records, trauma registries, ambulance or emergency technician records, health clinic records, family doctor records)	Fatal and non-fatal injuries Age and sex of casualties Costs of treatment Alcohol or drug use	Level of detail varies from one hospital to another. Cause of injury may not be properly coded, making it difficult to extract road traffic injury data for analysis. Difficult to define catchment population.
Vital registration	Fatal injuries Age and sex of casualties Type of road users involved	Cause of death may not be properly coded, making it difficult to extract road traffic injury data for analysis. Population coverage may be poor.
Insurance firms	Fatal and non-fatal injuries Damage to vehicles Costs of claims	Frequently regarded as commercially sensitive, so access to these data may be limited.

WHO, 2004

Sources and types of data (2/2)

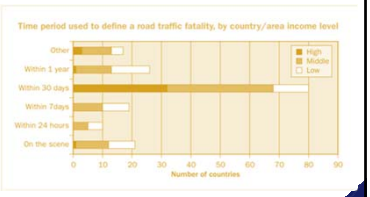
Other private and public institutions, including transport companies	Number of fatal and non-fatal injuries occurring among employees Damage and losses Insurance claims Legal issues Operational data	These data may be specific to the planning and operation of the firms.
Government departments and specialized agencies collecting data for national planning and development	Population estimates Income and expenditure data Health indicators Exposure data Pollution data Energy consumption Literacy levels	These data are complementary and important for analysis of road traffic injuries. The data are collected by different ministries and organizations, though there may be one central agency that compiles and produces reports, such as statistical abstracts, economic surveys and development plans.
Special interest groups (research institutes, advocacy nongovernmental organizations, victim support organizations, transport unions, consulting firms, institutions involved in road safety activities, and others)	Number of road traffic incidents, fatal and non-fatal injuries The type of road users involved Age and sex of casualties Vehicles involved Causes Location and sites of crashes Social and psychological impacts Risk factors Interventions	The various organizations have different interests. Data collection and research methods may not be sound.

WHO, 2004

What affects data quality?

Definition of road crash fatality

- The classification of the severity of injuries and crashes varies among countries.
- The endorsed best practice definition of a road traffic fatality is:
  - *"any person killed immediately or dying within 30 days as a result of a road traffic injury accident, excluding suicides"* (WHO, 2009)



However…

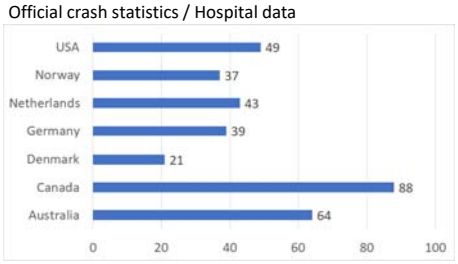
Under-reporting of road crashes

- Under-reporting refers to the situation where not all crashes and injuries that occur are documented in the data system
- Common causes for under-reporting include:
  - police may not be informed when a crash occurs
  - police do not always attend the crash scene
  - police may go to the crash scene, but not formally register the crash

- Differences due to:
  - Official statistics are limited to 30 days after the incident (-)
  - Some data will be lost (-)
  - Official statistics include deaths from illness (+)
  - Official statistics include suicides (+)
  - Official statistics include foreigners (+)

Reporting of road crash injuries in some countries

Official crash statistics / Hospital data



Differences are due to

- In many cases those injured in a road crash go to the hospital (emergency ward) without the accident being reported to Police (-)
- Some data will be lost during and following the crash (-)
- Different definitions of serious injury/ injury (e.g. in Canada the definition of serious injury used is admission to hospital)

Loss of information

Information available	Lost information
All crashes	Crashes are not reported to / detected by the Police
Crash defined as reportable	Injury only crashes & injured people not reported to police
Crashes recorded	Data not collected on field No follow up with or hospital Died at scene – not 30 days
Data elements recorded	Data fields not completed Transcription & other errors
Accuracy of recorded data	Data difficult to collect

Reducing under reporting: example in italy

Year	Road Crash (Police)	Death Certificates	Difference %
1991	7,499	9,609	28.2
1992	7,434	9,645	29.7
1993	6,645	8,434	26.9
1994	6,578	8,379	27.4
1995	6,512	8,054	23.7
1996	6,193	7,565	22.2
1997	6,226	7,811	25.5
1998	6,342	8,092	27.6
1999	6,688	7,829	17.1
2000	6,649	7,369	10.8
2001	6,691	7,370	10.1
2002	6,739	7,119	5.6

Addressing loss of information

Lost information	Actions - direct / indirect
Accidents are not detected by the Police	Train and support for police to improve data collection and recording Collect health statistics, insurance
Data are not collected at the crash scene	Use of IT tools Redefinition of the data collected
Errors field collection	Use of IT tools
Crashes are not entered into a database	Local control of the transmission procedures Use of IT tools
Health consequences follow-up (arrival, 7 days, 30 days) not monitored	Local control of procedures for exchanging information with hospitals
Died after 30 days from the accident date	Health statistics data collection
Transcription errors	Use of IT tools
Data are difficult to collect	Use of IT tools

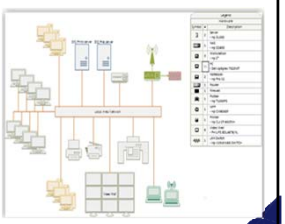
Requirements for road safety data systems

- Capture nearly all crashes that result in death and a significant proportion of those that result in serious injuries
- Provide adequate detail on vehicles, road users, road and environment to assist with identification of causes, and selection of countermeasures
- Include accurate crash location information
- Provide reliable output in a timely manner to facilitate evidence-based decisions

Information systems for data collection, management and analysis

National road crash database

- Central storage of all sources of road crash data
  - All Police forces
  - Health data (e.g. hospital, Rescue 1122)
- Tools allow storage of a large quantity of data
- Established security protocols (e.g backup, data recovery)to avoid information loss



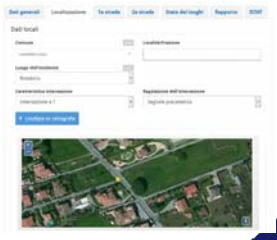
Functions of a local database

Personnel	Functions
Information system expert	• Maintenance of information system and of database • Security backup • Maintenance of local web network …
Officer for treatment and analysis of data	• Entering and recording road crash data • Localisation of road crash on map • Quality control • Transfer of data to national database • Analysis of data and monthly reporting • Annual reporting …

POLICE / HEALTH / …

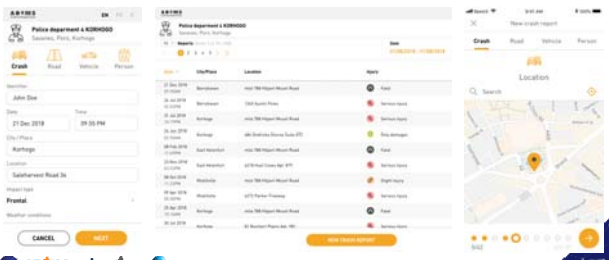
Data collection and information systems

MAPPING CRASH LOCATION



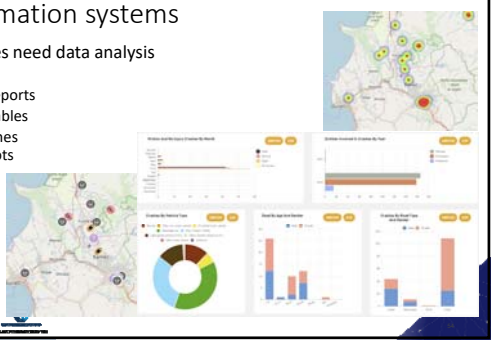
Data collection and information systems

COLLECTION OF INFORMATION ON THE FIELD OR AT THE OFFICE



Data information systems

- Local databases need data analysis functions:
  - creation of reports
  - graphs and tables
  - maps of crashes and black spots
  - inforgraphics



Functions of a national database

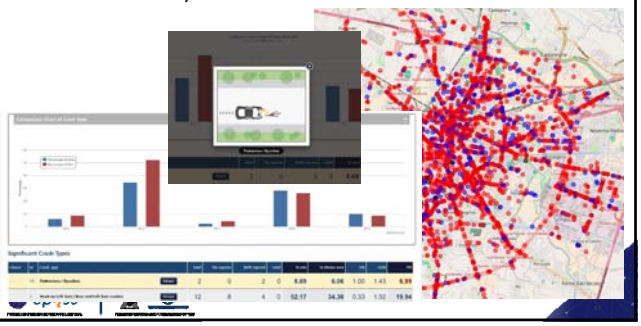
Personnel	Functions
Technicians for treatment, analysis of data and for dissemination of information	• Reporting on road crash data • Statistics preparation • Spatial analysis of data (e.g. blackspots maps, classification of road network, …) Definition of specific interventions based on road crash data • Merging of data with other sources • Research activities on road safety
Information system technicians	• Update and maintenance of the National Road Safety Observatory • Maintenance of centralised databases • Maintenance of the information system • Backup of the databases • Maintenance of the local web network

ANALYSIS CENTRE RS OBSERVATORY

National database information system

DATA STORAGE / ANALYSIS / ROAD SAFETY PLANNING

Information systems



EXERCISE 1 – ROAD TRAFFIC CRASH DATA COLLECTION, VALIDATION AND TREATMENT

Definitions

Injury Severity	Crash Severity
Fatal Person killed immediately or dies within 30 days as a result of a road traffic injury accident	**Fatal** Any road traffic crash resulting in a person killed immediately or dying within 30 days as a result of the crash
Serious/severe Injury that requires admission to hospital for at least 24 hours, or specialist attention, such as fractures, concussions, severe shock and severe lacerations	**Serious/severe** Any road traffic crash resulting in at least one serious injury, and no fatalities
Slight/minor Injury that requires little or no medical attention (e.g. sprains, bruises, superficial cuts and scratches)	**Slight/minor** Any road traffic crash resulting in at least one minor injury, and no serious injuries or fatalities
No injury	**Damage-only** Any road traffic crash which does not result in any injuries

Data set for Albania

- Data currently collected on road traffic crashes in Albania are quite complete collection
- They include the typical information needed for road safety analysis
- Some changes are useful to ensure compliance of the Albanian procedures with international standards
  - Especially compliance with **CADaS -** Common Accident Data Set recommended by European Commission

Data set for Albania

- CADaS data elements are divided into four basic categories:
  - Crash related variables (A)
  - Road related variables (R)
  - Traffic Unit (vehicle and pedestrian) related variables (U)
  - Person related variables (P)

Exercise 1a

- Fill in one data collection form for:
  - a road crash in urban environment at junction with pedestrian involved
  - a road crash on national highway with 1 truck, 1 car and 1 motorcycle involved
  - a road crash on motorways with 1 bus, 1 truck
- All fields have to be filled in
- All cases have to include at least 1 death

- Use the templates for data collection provided

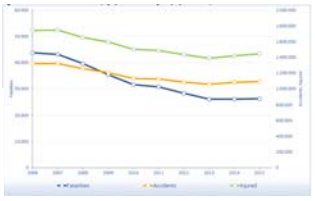
MODULE 2 – ANALYSIS OF ROAD TRAFFIC CRASH DATA, IDENTIFICATION OF CAUSES

Road traffic crash data analysis

- Analysing road crash data is essential for taking evidence-based decisions to improve road safety
- Many actors benefit from effective data
  - Politicians who must approve new laws
  - Ministries who determine strategies and policies
  - Road authorities who decide on infrastructure program priorities
  - Police who identify what behaviours should be targeted for enforcement

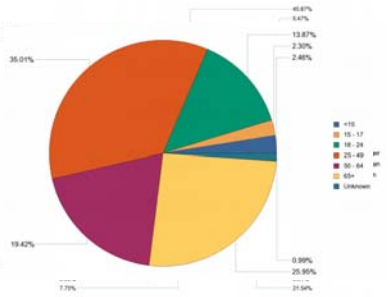
Typical road safety statistics

- Road safety evolution over the years
  - Persons killed in road crashes
  - Persons killed by population



Typical road safety statistics

- By road user class
  - Driver / Passenger / Pedestrian / Pillion Rider / Other
- By transport mode
  - Car / Truck / Bus / …
- By range of ages
- By gender
- By month
- By area
  - Urban / Motorway…



More complex statistics

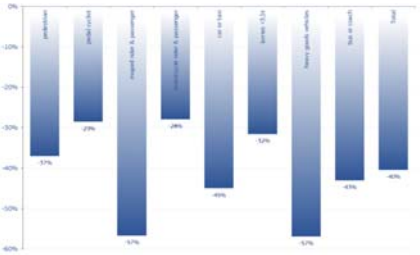
- Comparison with baseline year (shows evolution)

Merging data elements

- Distribution by gender and road user

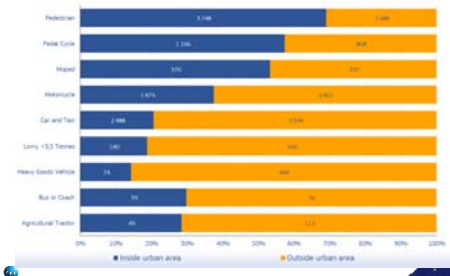
Merging data elements

- Time series by transport mode



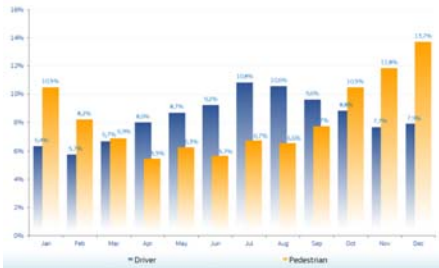
Merging data elements

- Type of area and transport mode



Merging data elements

- Month and road user



Merging data elements

- Hour of the day and road user

Identification of crash causes

Definition of Crash Cause

- Important distinctions must be made between crash **factor**, **responsibility** and **cause**
- Police identify key crash **factors**
- Police determine responsibility for a road crash 'at fault vehicle'
  - Task related to potential prosecution against a person
- Identifying **crash cause** is usually the role of specialist investigators / engineers

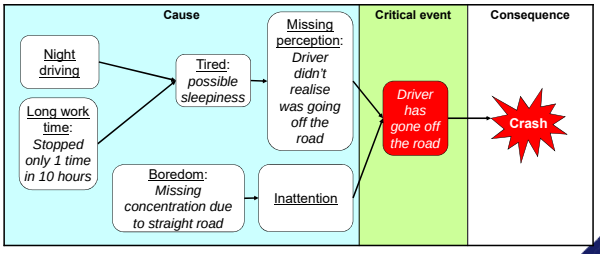
Key crash factors

- **Worldwide speed is the Number 1 cause of fatal road crashes** (speed limits that are too high and drivers exceeding the speed limit)
- There can be more than one factor contributing to road crashes. Examples:
  - Speeding combined with bad weather (rain, fog, etc.)
  - Speeding and running a red light
  - Overloading a heavy vehicle with faulty brakes
  - Unsafe overtaking on a motorway

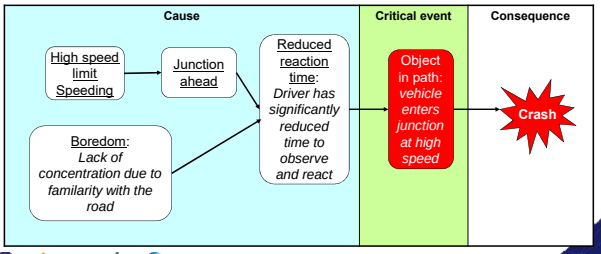
Different factors

Driver	Vehicle	Infrastructure	Organisation
Observation	Temporary HMI issues	Communication driver-environment	Organisation
Interpretation	Permanent HMI issues	Road maintainence	
Planning	Equipment	Road design	
Temporary limitation of function (fatigue, distraction, drugs)	Vehicle maintenance		
Permanent limitation of function	Vehicle design is of poor safety standard		
Communication driver-driver			
Skills, knowledge when licensed / Experience			

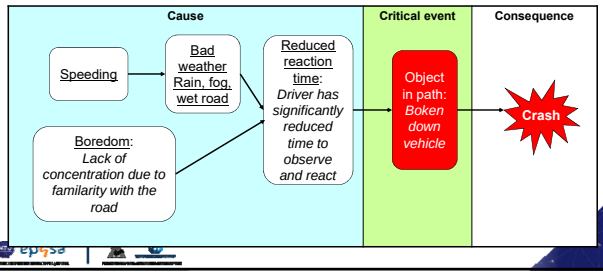
Example 1: diagram for driver



Example 2: diagram for speeding and road design



Example 3: diagram for speeding and bad weather



Exercise 2a

- Live example of data analysis:
  - Selection of 10 entries and analysis the relevant data fields
- Based on the data provided, identification of factors that may have contributed to the crash
- Examine data fields such as:
  - Time of day
  - Vehicles involved
  - Type of crash
  - Key factor
  - Location
  - Severity of crash
- Discussion on these additional causes

Selection of main risk factors

Road crash risk factors

- The Safe System Approach views the road network as a system
- A road crash results from the interaction of roads, vehicles, road users, and the environment
- There is usually a crash causation key factor recorded
- Other factors may also contribute to the crash and resulting injury severity
- Identifying the key crash factors helps to identify effective interventions

Key risk factors (1/4)

- Factors influencing exposure to risk
  - economic factors such as level of economic development and social deprivation (e.g. **growth in number of motor vehicles**)
  - mixing high-speed heavy traffic with vulnerable road users and vehicles
  - unsafe speed limits, unsafe road layout and design
  - demographic factors such as age and sex
  - land-use planning practices which influence length of trip and mode of travel

Key risk factors (2/4)

- Key factors influencing crash risk
  - inappropriate and excessive speed
  - presence of alcohol, medicinal or recreational drugs
  - defects in road design, layout and maintenance
  - overloading
  - Fatigue, distraction
  - being a young male
  - being a vulnerable road user
  - travelling in darkness
  - vehicle factors (braking, steering and maintenance)
  - environmental factors

Key risk factors (3/4)

- Factors influencing crash severity
  - travel speed at the time of the crash
  - seat-belts and child restraints not used
  - crash-helmets not worn by users of two-wheeled vehicles
  - human tolerance factors
  - roadside objects not crash-protective
  - insufficient vehicle crash protection for occupants and for those hit by vehicles
  - presence of alcohol and other drugs

Key risk factors (4/4)

- Factors influencing post-crash outcome
  - delay in detecting crash and in transporting injured to a suitable health facility
  - fire / hazardous material resulting from collision
  - alcohol and other drugs
  - difficulty in rescuing / extracting people from vehicles –especially in multi-vehicle crashes
  - low standard/lack of pre-hospital care
  - poor standard of care in emergency rooms

Crash data analysis exercise

Exercise 2b

- Live example: Using the database to obtain figures for the following statistics
  - Trend of crashes, fatalities and injuries
  - Number of fatal and not fatal crashes
  - Fatalities by month
  - Fatalities by time
  - Fatalities by gender
  - Number of crashes with pedestrian involved
  - Number of crashes by type of vehicle

Exercise 2c

- Live example: Use the database to obtain figures for the following statistics
  - Number of single vehicle fatal crashes
  - Number of multiple vehicle fatal crashes
  - Motorcycle single vs multiple vehicle fatal crashes
  - Car single vs multiple vehicle fatal crashes
  - Truck single vs multiple vehicle fatal crashes

THANK YOU FOR THE ATTENTION