# SOUTH AFRICA ROAD FEDERATION

# Non-Motorised Transport Practitioner's Course

# 13 NOVEMBER 2020

## Session 13: NMT Crash Analysis and Monitoring Techniques

SARF
founded in 1950

# Approaches to promote/improve road safety

## Reactive assessment methods

- 1. Hazardous location identification & improvement
- 2. Star rating method (e.g. iRAP)
- 3. Traffic conflict analysis

## Pro-active assessment methods

- 1. Road safety appraisals (also Reactive)
- 2. Road safety audits
- 3. Road safety assessments

# Reactive assessment methods

# 1. Hazardous location identification and improvement

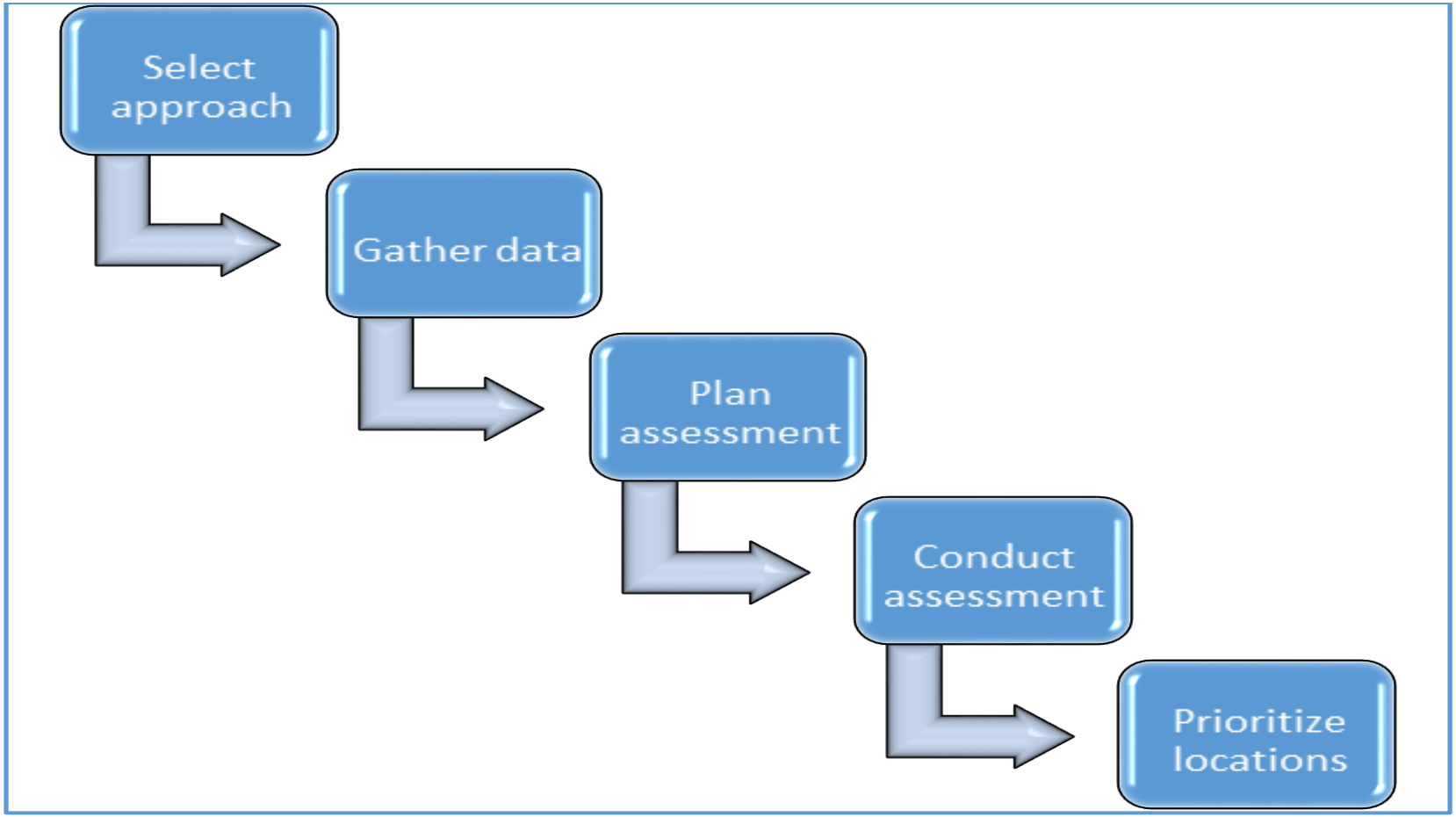
- Important step in the process of improving pedestrian and bicycle safety is to identify locations or areas where accident problems exist and where infrastructure improvements will be most beneficial.
- One of the most successful short-term solutions to a road safety problem is to identify the most hazardous sections of the road network and to eliminate these hazards either:
  - while the road network is being upgraded; or
  - by improving specific individual sites identified as hazardous.

# General steps in analysis process

- Collection of accident data
- Assessment of accident data
- Identification of accident locations
- Analysis of accident sites
- Identification of appropriate countermeasures
- Implementation of countermeasures
- Monitoring of site
- Evaluation of implemented measures

# Identification of High Pedestrian Crash Locations

FHWA-HRT-17-107 March 2018



# Identification of High Pedestrian Crash Locations

## FHWA-HRT-17-107 March 2018

**Lessons learnt from synthesis study**:

- Most agencies now have available the geographic coordinates of crashes, improve ability to quickly illustrate where crashes occur.
- Agencies generally start with identifying high crash intersections and then group the sites into facilities and/or areas.
- GIS tools are used to aid in the grouping; however, several agencies noted that visually confirming the grouping is how they set the limits for their corridors and areas.
- Agencies have considered surrogates to identify locations of concern, such as activity centres, walk scores, or citizens' comments.
- The agencies noted that pedestrian and bicycle crashes are different from motor vehicle crashes and require unique efforts.
- The current skill sets needed to work with crash data include familiarity with a GIS, the ability to work with attribute tables, and programming skills

# Identification of High Pedestrian Crash Locations

## FHWA-HRT-17-107 March 2018

**Lessons learnt from synthesis study (continued)**:

- Several methods should be used to rank sites to ensure consensus.
- Not considering pedestrian exposure in some manner could significantly affect results.
- Other measures (e.g., walkability score) should be considered along with crash data, since crashes are rare events.
- If evaluating segments, a minimum segment length is needed (suggested as at least 0.2 miles).
- During evaluation of pedestrian crashes, a longer period may be needed due to the relatively small number of reported pedestrian crashes (e.g., 5 years rather than 3 years).

# Strategies for improving hazlocs

There are ***four basic strategies for accident reduction through the use of countermeasures:***

- **Single site** - the treatment of specific types of accident at a single location.
- **Route action plans** - the application of known remedies along a route with a high accident rate (pedestrians along Mangusuthu Highway).
- **Area action plans** - the applications of various treatments over a wide area of a town or city, i.e. traffic management and traffic calming. (at schools)
- **Mass action plans** - the application of a known remedy to different locations with a common accident problem.

# Strategies for improving hazlocs

- The first three strategies differ in terms of the **size of the geological area over which various types of accident reduction treatments are applied.** The mass action plan involves the application of one specific treatment at various locations.

- The single site strategy is most probably be the most cost-effective method since specific locations with high accident rates are targeted.

- Such specific treatments most likely to have the greatest impact.

# Collection of accident data (1)

- The identification of hazardous locations rely on the **availability of data describing accidents** and their l**ocations** to identify where accidents occur and what are the **common features** that contribute to them.
- **Accident data and the use of collision diagrams** are key analysis tools for identifying hazardous locations.
- Pedestrian and bicycle accident data should be collected over a relatively long period. Accident rates tend **to fluctuate substantially from year to year**, and to obtain a **statistically reliable sample,** it is necessary to **collect accident data over as long a period as possible**. However (word of caution), where there are **rapid changes** in the environment, such as new roads being built, or where there are high levels of growth in traffic, the **accident data collected over a too long a period would not be representative of current conditions.**

# Collection of accident data (2)

- The following periods for collecting accident data are therefore recommended:

  - 2 Years in areas where there is relatively rapid change in the environment.

  - 3 Years in areas where there is a relatively moderate change in the environment.

  - 5 Years in areas where the environment is relatively stable.

# Collection of accident data (3)

- The accident data should be collected for each location in a format as indicated.
  - *Type of accident* (pedestrian, bicycle, single vehicle, rear-end, etc.).
  - *Severity of accidents*. The following severity classification is used:
    - **Fatal accidents** are accidents involving **death** as a direct result of the accident.
    - **Serious accidents** are those in which people where seriously injured. Serious injuries include fractures, concussions, severe cuts and lacerations, shock necessitating medical treatment and any other injuries **necessitating hospitalisation.**

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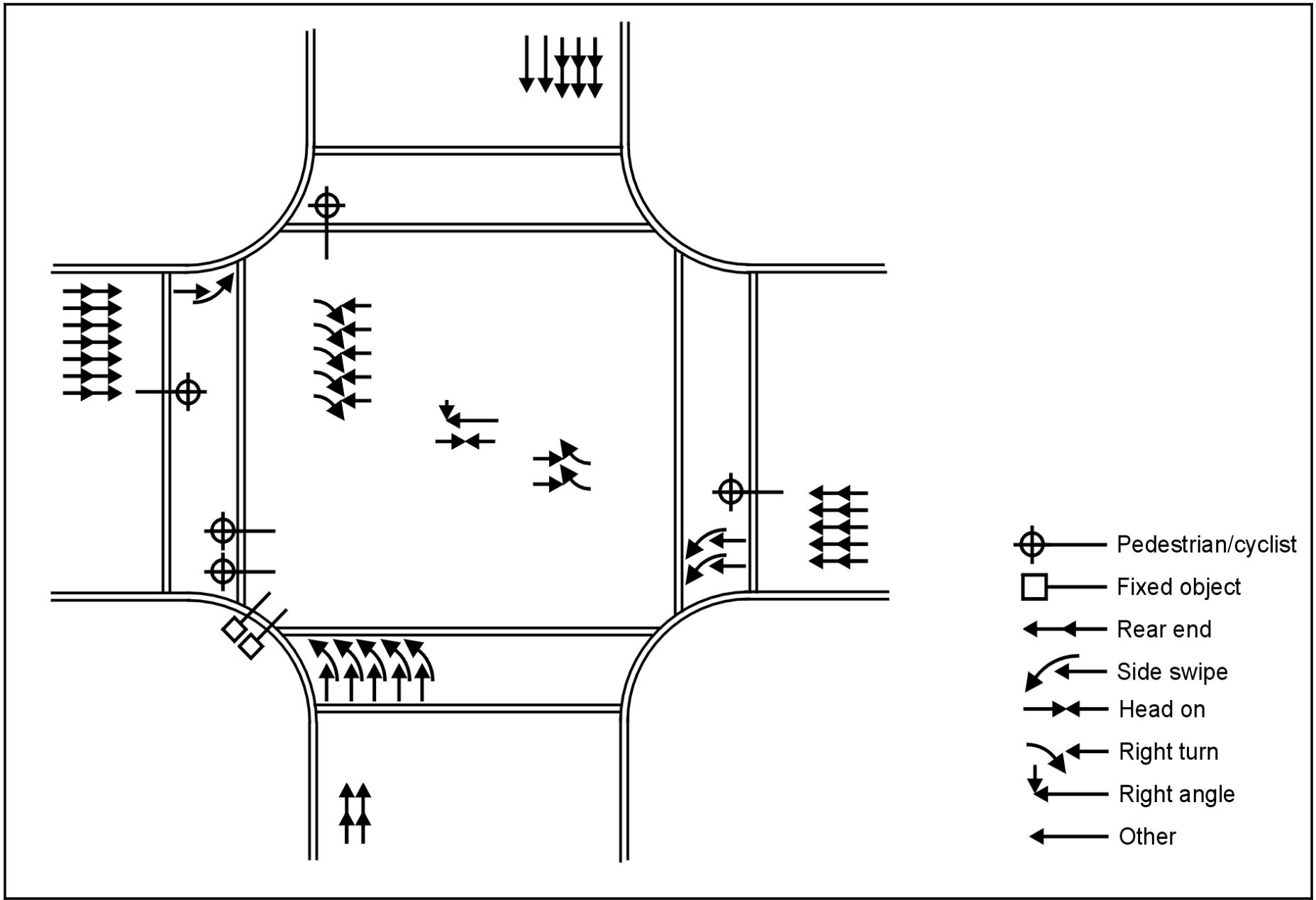
# Collection of accident data (4)

- **Slight accidents** are those in which people where slightly injured. Slight injuries include cuts and bruises, sprains and slight shock **not requiring hospital treatment.**
- **Damage only accidents** in which there is no personal injury but damage to property only.

- *Day of the week* and *time of the day* during which accidents occurred.
- The *probable causes of the collision* should be established if possible, e.g. alcohol involvement of driver and pedestrian.

# Collision diagrams (junctions)



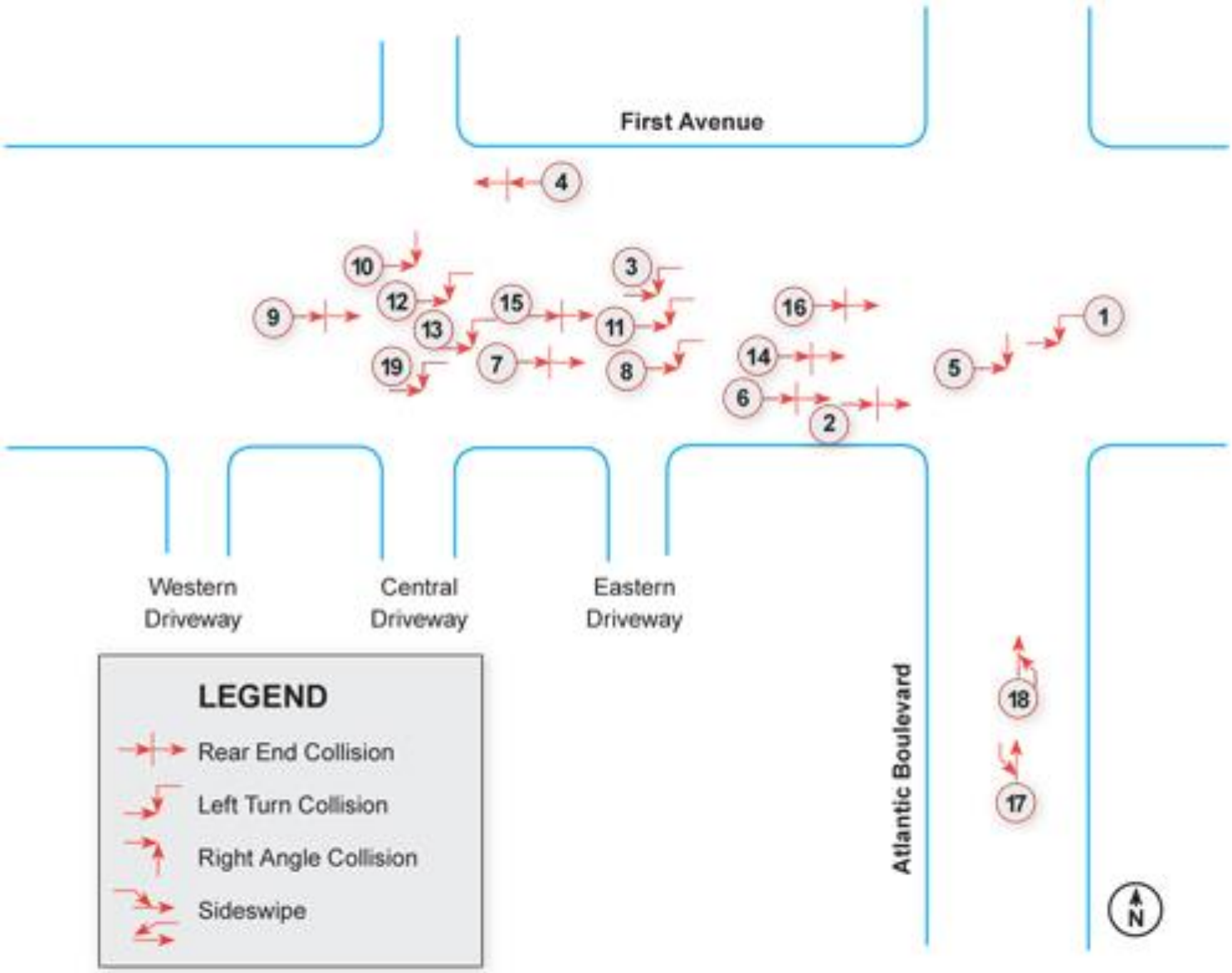
**1. BikeMaps.org: a global tool for collision and near miss mapping**
**https://www.frontiersin.org/articles/10.3389/fpubh.2015.00053/full**

Released in 2014, BikeMaps.org is a global mapping system that allows citizens to map locations of cycling incidents and report on the nature of the event. Attributes collected are designed for spatial modeling research on predictors of safety and risk, and to aid surveillance and planning.

**2. CONFLICT PARTNERS AND INFRASTRUCTURE USE IN SAFETY CRITICAL EVENTS IN CYCLING – RESULTS FROM A NATURALISTIC CYCLING STUDY Katja Schleinitz*, Tibor Petzoldt*, Luise Franke-Bartholdt*, Josef F. Krems* & Tina Gehlert+ *Technische Universität Chemnitz, + German Insurers Accident Research**

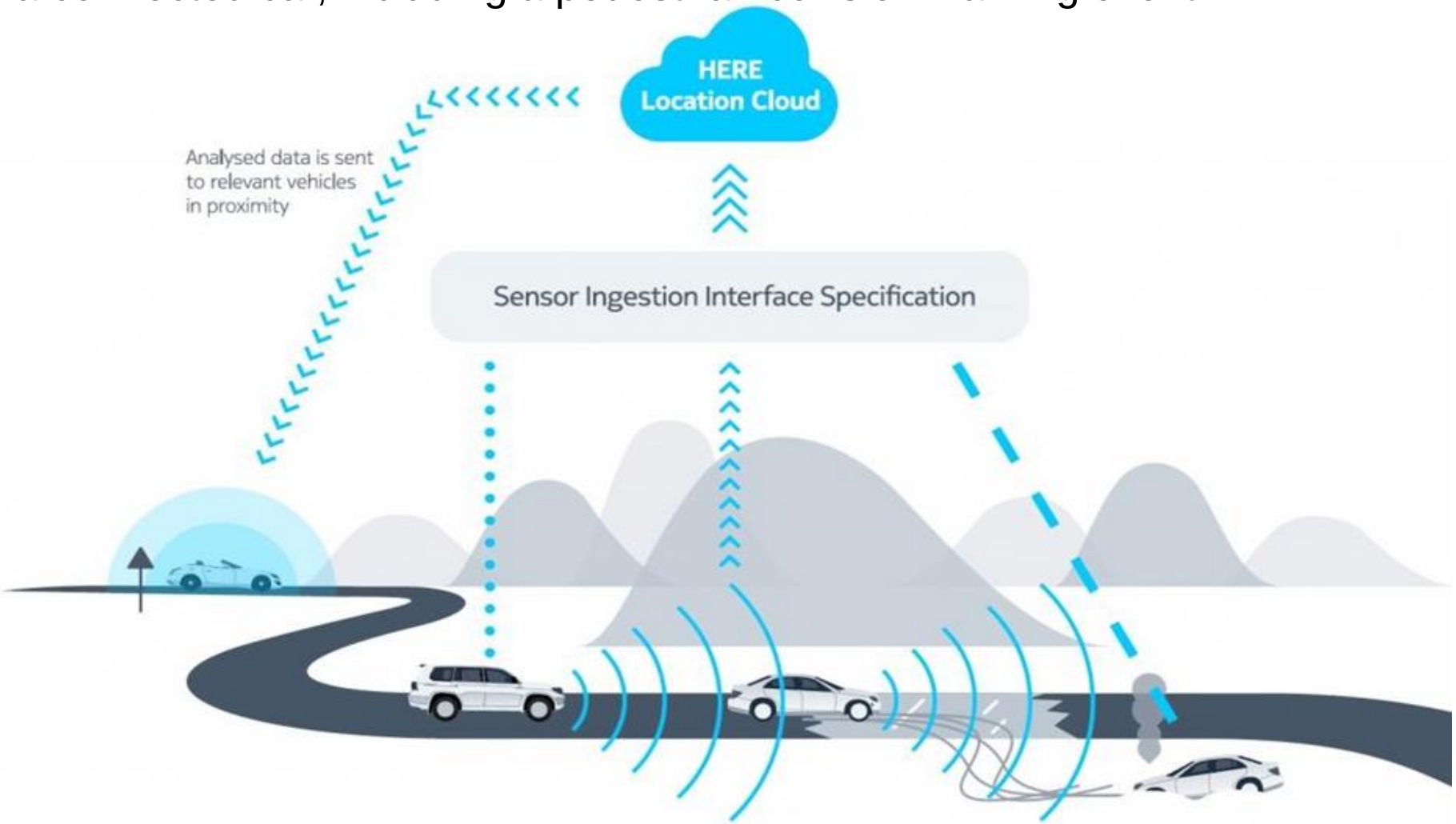
Accident statistics show that cyclists are at considerable risk of being involved in a crash. However, statistics based on police reports are often heavily biased towards on-road, bicycle-motor vehicle crashes. Crashes that do not involve motorised vehicles or that occur on other types of infrastructure are neglected. Naturalistic cycling methodology appears to be a promising approach to address these issues. The data show that although motorised vehicles are still the single biggest threat to cycling safety, and roads still constitute one of the most crash prone types of infrastructure, the importance of crashes that do not involve motorised road users or occur not on-road should not be underestimated.

# Collision diagrams (midblock example)



# Simplified concept of HERE's car-to-cloud data transmission specification

This example can be extended to all types of events that might occur in a connected car, including a pedestrian collision warning event.




FHWA-HRT-17-107 March 2018

# Example of crash analysis

| ACCIDENT DATA | TYPE OF COLLISION | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Pedestrian & cyclist | Fixed object | Rear end | Side swipe | Head on | Right turn | Right angled | Other | |
| **DEGREE:** | | | | | | | | | |
| **Fatal** | 3 | | | | 1 | 2 | | | 6 |
| **Serious injury** | 1 | 1 | | | | 1 | 1 | | 4 |
| **Slight injury** | 1 | 1 | 2 | 1 | | 3 | | | 8 |
| **Damage only** | | | 15 | 7 | | 1 | | 2 | 25 |
| **DAY:** | | | | | | | | | |
| **Weekdays** | 1 | 1 | 13 | 5 | | 7 | | 2 | 29 |
| **Saturdays** | 3 | 1 | 3 | 2 | 1 | | 1 | | 11 |
| **Sundays** | 1 | | 1 | 1 | | | | | 3 |
| **TIME:** | | | | | | | | | |
| **00:00–06:00** | | 1 | | | | | 1 | | 2 |
| **06:00–09:00** | | | 5 | 3 | 1 | 6 | | 2 | 17 |
| **09:00–12:00** | | | 1 | | | | | | 1 |
| **12:00–03:00** | | | 2 | 1 | | | | | 3 |
| **03:00–06:00** | | | 7 | 4 | | | | | 12 |
| **06:00–09:00** | 2 | | 2 | | | 1 | | | 4 |
| **09:00–12:00** | 3 | 1 | | | | | | | 4 |
| **TOTAL** | 5 | 2 | 17 | 8 | 1 | 7 | 1 | 2 | 43 |

# Equivalent Accident Number (EAN) Prioritisation

- The equivalent accident number (EAN) is the weighted number of accidents per annum at a particular location. The following weighting is recommended for the calculation of the EAN:

| | | | |
|---|---|---|---|
| - Fatal accidents | 12 X 3 | = | 36 |
| - Injury accidents | 3 X 2 | = | 6 |
| - Slight and damage only accidents | 1 X 6 | = | 6 |
| | **Total** | **=** | **48** |

- The EAN of each location is calculated by multiplying the above accidents with the weighting of accidents in each category, and dividing the total number by the number of years over which accident data were collected.

# Hazloc investigation

- Locations that have been identified as hazardous should be visited and various studies undertaken to obtain additional information. **Site visits are an essential part of the investigation process**. The following information should be collected during the site visit:
  - Information on the layout of the existing facility.
  - Design elements that are substandard and which could contribute to accidents involving pedestrians and bicycles.
  - Counts of traffic conflicts and infringements of road regulations.
  - Various classified traffic counts as well as measurements of the 85$^{th}$ percentile speeds.
- The above information is used to identify possible causes of accidents and to establish which remedial measures would be beneficial.

# Improvement of hazlocs

- Once all information has been collected for a hazardous location, possible remedial measures that can address the problems should be identified. Where pedestrians and cyclists are involved, improvements to the following could be considered:
  - Sight distances.
  - Road signs and traffic signals.
  - Midblock crossings and road junctions.
  - Sidewalks, walkways, bicycle lanes or bicycle roads.
  - Traffic calming measures and speed limits.
  - Street lighting.
- A preliminary design should be made of each improvement and the cost of each improvement established. Benefit-cost analysis can then be undertaken to establish whether the improvement would be cost-effective.

# Implementation of countermeasures (1)

| | Measure | Location & Purpose | Advantages and Disadvantages |
|---|---|---|---|
| Improving of Facilities for Road Users | Bridge | Located where heavy traffic flows mean that there is no other alternative for pedestrians to cross the road safely.<br>Allows pedestrians to cross any busy road without risk of collision and without disrupting traffic flows | A Very safe segregated crossing for pedestrians<br>D *Forces pedestrians to take a longer route to cross the road and climb stairs.*<br>D *Require installation of long sections of pedestrian barrier to channel pedestrians to use bridge.*<br>HIGH COST |
| | Underpass | As for bridge.<br><br>Decision as to whether bridge or underpass constructed based on pros and cons, cost and physical situation at site | A As above.<br>A Less visually intrusive than bridge.<br>D *As above.*<br>D *Requires installation of vandalism-resistant lighting for pedestrian security and confidence.*<br>D *Requires provision of appropriate drainage.*<br>D *Worries about crime at night*<br>HIGH COST |
| | **Segregation** | Required in areas where there are conflicts between motorised, non-motorised and pedestrian traffic.<br>Aim to reduce the number of seriously-injured casualties.<br>One of the most important measures available to traffic and safety engineers. | A Fewer conflicts involving vulnerable and motorised road users, and thus fewer serious accidents.<br><br>D *Additional construction, land-take and maintenance costs.* |
| | Pedestrian Guard Rail - Centre | Used on crossing roads carrying heavy volumes of traffic as a means of preventing pedestrians from crossing at points other than where there are crossing facilities. | A Reduce locations where pedestrians and vehicles may be in conflict.<br><br>D *Force people to walk further to cross the road, thus if overused, pedestrians will ignore them and climb over/through them.*<br>D *Visually intrusive*<br>D *Liable to damage/theft*<br>MEDIUM COST |
| | Pedestrian Guard Rail – Edge | Channel pedestrian traffic onto a crossing and away from dangerous sites.<br>Can also be used to prevent vehicles from parking on the footpath | A Reduce locations where pedestrians and vehicles may be in conflict.<br>A Reduces temptation to cross to centre of road.<br>D *Force people to walk further to cross the road, thus may be climbed.*<br>D *Both sides, thus more expensive*<br>D *Visually intrusive*<br>D *Liable to damage/theft*<br>MEDIUM COST |

# Implementation of countermeasures (2)

| | Measure | Location & Purpose | Advantages and Disadvantages |
|---|---|---|---|
| Improving of Facilities for Road Users | Raised Crossing | Located where there is a need for the pedestrian crossing to be more visible for drivers and ensure low speeds.<br>Aims to increase pedestrian conspicuity to drivers<br>Used in conjunction with round-top and flat top humps | A Drivers are more likely to stop if pedestrians are more visible and they are already slowing to negotiate hump.<br>D *Requires additional drainage as it should be constructed kerb to kerb to avoid trip.*<br>D *Drivers may still not give way to pedestrians already on crossing.*<br>MEDIUM COST |
| | Pelican | Pedestrian light controlled crossings can be located where there are larger volumes of pedestrians (particularly children, elderly or infirm) crossing the road, requiring traffic lights to stop traffic<br>To allow them to do so safely.<br>Can have tactile knob as signal for blind/partially sighted pedestrians. | A Vehicles are more likely to stop at traffic lights than at a zebra crossing<br>A Reduces pedestrian delay and casualty numbers<br>A By platooning pedestrians, can reduce vehicle delays when pedestrian flows are heavy.<br>D *Requires pedestrian to know that request button must be pressed.*<br>D *Can lead to unnecessary vehicle delay when pedestrians cross early.*<br>HIGH COST |
| | Toucan Source:DFT | Located where pedestrians and cyclists cross the carriageway at the same location (ie. 'two-can')<br>On major roads where there are many pedestrian/cyclist-vehicle conflicts | A Similar advantages to the above<br>A Allows both pedestrians and cyclists to cross a busy carriageway safely together.<br>D *Requires additional road space to accommodate both road user groups.*<br>HIGH COST |
| | Pedestrian Refuge | Where there are 2 or more lanes of relatively heavy traffic & pedestrian crossing movements do not justify a more formal crossing.<br>Provide a safe haven for pedestrians when crossing more than one traffic stream. | A Allow easier crossing for pedestrians since they only have to make decision about 1 traffic stream at a time.<br>A Helps to segregate traffic streams and reduce overtaking.<br>D *Require arrow marker sign or bollard*<br>D *Risk of vehicles colliding with refuge, particularly at nighttime.*<br>MEDIUM COST |
| | Pedestrian Crossing/Refuge | At a pedestrian crossing where there are 2 or more lanes of heavy traffic & pedestrian crossing movements<br>Design from Nepal uses sloping profile of edge kerbing to avoid effects of nighttime collisions | A Allows easier crossing for pedestrians since it divides the task into two stages<br>A Helps to segregate traffic streams and reduce overtaking.<br>A Lower risk of vehicle damage/loss of control if refuge hit.<br>D *Requires reflectors*<br>MEDIUM COST |

# Implementation of countermeasures (3)

| | Measure | Location & Purpose | Advantages and Disadvantages |
|---|---|---|---|
| Improving of Facilities for Road Users | **Pedestrian Facilities** | | |
| | Footpaths | Footpaths should cover a whole area and link all the important generators of pedestrian traffic, e.g. schools, shops, residential areas, parks etc.<br>Aim is to clearly segregate vulnerable pedestrians from motorised traffic. | A Reduce and eliminate pedestrian-motorised transport conflicts.<br>D *Can become encroached by traders or parked vehicles forcing pedestrians into carriageway.* |
| | Raised Kerb footpaths | Located adjacent to busy carriageways and in residential areas.<br>Purpose is to segregate pedestrians and vehicular traffic with a footpath raised above the level of the carriageway.<br>Shallow slope dropped kerbs for driveways preferable so as not to deter pedestrian use. | A Reduce & eliminate pedestrian-motorised transport conflicts<br>D *High cost if installed along most routes*<br>D *Additional kerbside drainage gulleys required.*<br>HIGH COST |
| | Barrier Kerb footpaths | Located where footpaths are adjacent to busy carriageways<br>Aim to segregate vehicular traffic and pedestrians with a physical barrier. | A Defines footpath<br>A Prevents vehicles from encroaching the footpath i.e. for parking etc<br>A Much lower cost than raised footpaths.<br>D *Can cause sever injuries in motorcycle collisions.*<br>MEDIUM COST |
| | Segregated footpath | Located adjacent to busy and high speed carriageways .<br>Purpose is to segregate pedestrians and vehicular traffic with the footpath separated away from the carriageway. | A Maximises segregation between pedestrians and high speed traffic conflicts<br>A Drainage channel can be located between carriageway and footpath<br>D *Greater land take necessary.*<br>HIGH COST |
| | Crossings | Located where there are large numbers of pedestrians crossing carriageways<br>Aim to allow pedestrians to cross the road safely | A Reduce the number of pedestrian casualties<br>D *Disrupts vehicle traffic flow.* |
| | Zebra | Located in a highly visible location where there are already large numbers of pedestrians choosing to cross the road.<br>Allow pedestrians to cross with higher priority, and thus more safely. | A Low maintenance<br>D *May require installation of barriers to channel pedestrians to crossing and also of special lighting.*<br>D *Drivers often fail to observe legal requirement to give way to pedestrians.*<br>LOW COST |

# Implementation of countermeasures (4)

| | Measure | Location & Purpose | Advantages and Disadvantages |
|---|---|---|---|
| Improving of Facilities for Road Users | *Guard Rail – Climb over deterrent* | Novel barrier design from Chile that has a rolling top bar that makes it almost impossible for pedestrians to climb over. The wire mesh is flush with the bottom rail so that there is nowhere to place the foot. | A As above.<br>A Prevents pedestrians climbing over the guard rail at dangerous locations<br>D *As above.*<br>D *More expensive*<br>D *Requires a degree of maintenance as ingress of dirt/corrosion may inhibit bar rotation.*<br>HIGH COST |
| | High-Visibility Guard Rail | Located close to pedestrian crossings which may have high child usage to enable drivers to see children and low objects behind the barrier.<br>Channel pedestrians to crossing points. | A At oblique angle, drivers able to see through barrier – gives better warning of children liable to run out into road.<br>A Stronger and less likely to suffer vandalism.<br>D *Both sides, thus more expensive*<br>D *Visually intrusive*<br>D *Occupies slightly more pedestrian footpath space.* HIGH COST |
| | Carriageway Divider | Located in the centre of a carriageway with three or more lanes in one direction of traffic.<br>Enforces driver lane discipline but also assists pedestrians to get across multi-lanes.<br>***Pedestrians should never be allowed to cross three or more lanes*** | A Assists pedestrians get across urban arterials when multiple pedestrian crossings or bridges not practical.<br>A Promotes smooth flow of traffic<br>D *Pedestrians being allowed to cross such multi-lane urban freeways is not desirable, and suggests poor planning.*<br>D *Pedestrians should only be allowed to cross such highways if speeds controlled to 50 kph or less*<br>HIGH COST |
| | Rickshaw Lane | Located in areas where there are many conflicts between slow moving vehicles and motorised traffic.<br>Faster through traffic uses two centre lanes.<br>Segregates rickshaws and other slow moving vehicles from motorised traffic. | A Produces segregation (if enforced) and feeling of security for slow moving vehicles.<br>A Assists pedestrians in the task of crossing the road.<br>D *Requires land take from the carriageway or footpath.*<br>HIGH COST |
| | Cycle Lanes | Located in areas where there are many conflicts between cycles and motorised traffic, especially at or near junctions<br>Segregate cycles from motorised traffic<br>Also allows motorcycles to be segregated from other larger vehicles | A Produces segregation (if enforced) and feeling of security for cyclists.<br>D *Requires land take from the carriageway or footpath.*<br>D *Can cause safety problems at junctions – if lane on raised kerb , best to set crossing place of minor road ~15m upstream.*<br>MEDIUM COST |

# Monitoring of road improvement projects

The monitoring studies for measuring the effect of a safety scheme are usually by *before* and *after* analysis of factors that are likely to have a bearing on the safety of road users at the particular treated site(s). Although not an exhaustive list these may include:

- spot speed;
- speed variance;
- traffic conflict studies;
- traffic volumes;
- journey time/delay;
- compliance with traffic control devices;
- skid resistance;
- sight line/passing sight distance/super elevation;
- pedestrian safety gaps/kerb delay/crossing times;
- road accidents; and
- weather/season.

# Evaluation of road improvement projects

- Having devoted considerable effort and expenditure to improving hazardous sites, there is a need to evaluate these improvements.
- To obtain statistically reliable results for accident changes, it is normally **necessary to wait several years** after introducing the counter measure or package of measures has been introduced. It is, however, assumed that the practitioner will need to interpret accident and other data practically without necessarily having a full understanding of the underlying statistical theory, which can be quite complex. It is, however, important that the user is sufficiently confident with his or her analysis. If in doubt, it is strongly advised that help is sought from a professional statistician.

# 2. Star Rating Assessment Method

- Star Ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is 'built-in' to the road for vehicle occupants, motorcyclists, cyclists and pedestrians.

- Five-star roads are the safest while one-star roads are the least safe.

- Importantly, Star Ratings can be completed without reference to detailed crash data, which is often unavailable in low-income and middle-income countries.

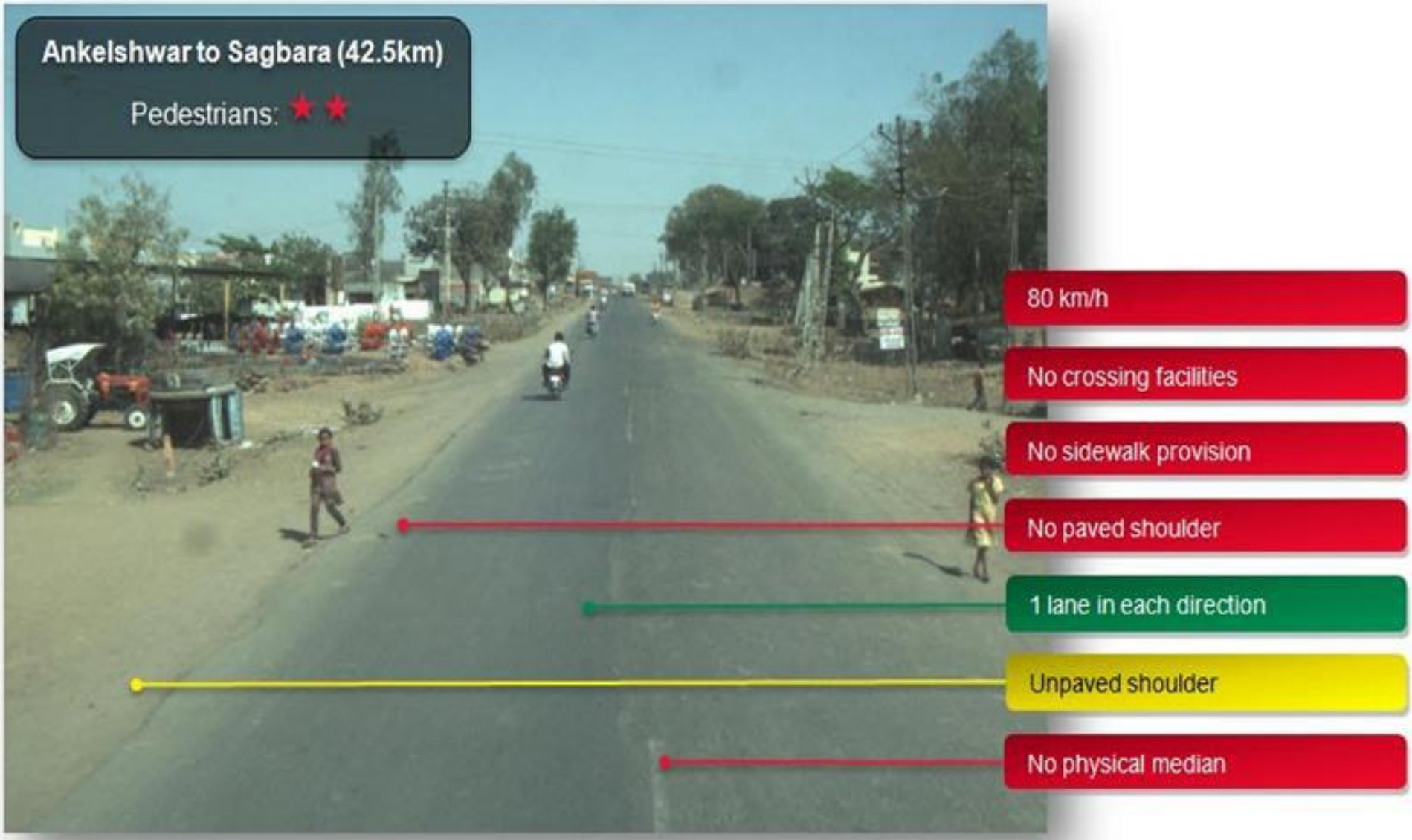
- Black spot (hazardous location) analysis can tackle only a few of the very worst roads – and only works after people have died. The Star Rating Method economically analyse all the worse roads – and prioritise it to most urgent improvements/upgrades.

- The iRAP online software assists in identifying and improving safety on high risk roads - *https://vida.irap.org/en-gb/home*

# Star Rating Assessment Method

- <24 mph
- Street lighting
- Signalised pedestrian crossing
- Adequate sight distance
- Straight horizontal curvature
- Pedestrian footpath both sides
- Pedestrian fencing
- Adequate skidding resistance
- Parking restrictions

# Star Rating Assessment Method



# 3. Conflict Analysis Technique

- Accident data can not always provide an indication of why accidents occur at a location. **One of the problems with accident data is that sample sizes are often small and that several years of data must be collected before conclusions can be made**. A further problem is that the **quality of accident data could be poor**, either because **accidents are poorly reported**, or because of problems with the capturing of accident data.
- The Traffic Conflict Study technique is a method according to which potential accidents and causes of accidents can be identified without the use of accident data. A traffic conflict is an undesired event in the traffic stream, such as a **near-accident or a violation of a traffic rule.** A few hours or days of observations would often reveal undesirable driver, pedestrian and cyclist behaviour which could lead to traffic accidents.

# Conflict Analysis Technique

- In 1991, the Department of Technology and Society at Lund University in Sweden was awarded the Volvo Traffic Safety Award for developing the Conflict Analysis Technique. The method is used to chart the safety in traffic. It has been refined through the years and its applicability is not only in motorised countries but even in developing countries world-wide.
- **Serious conflicts are in the same way as traffic accidents, the result of a breakdown in the interaction between the road user, environment and vehicle.**
- A serious conflict is characterised by the fact that no one voluntarily gets involved in such a situation. The **necessary evasive action is usually braking, but may also be swerving or acceleration, or a combination of these.**
- Since the similarity between accidents and serious conflicts is striking, accidents can be avoided by circumventing conflict.

*http://www.tft.lth.se/fileadmin/tft/video_in_traffic/Swedish_conflict_technique.pdf*

- Various traffic conflict analyses tools have been developed – see the *Internet.*

# Conflict Analysis Technique

**What is a traffic conflict? Different approaches**

1. **Traffic conflicts marked by evasive actions**

According to this definition, whether an observed situation is a traffic conflict is identified by the appearance of evasive actions. A representative definition of evasive action based traffic conflict is "… *an event involving two or more road users, in which the action of one user causes the other user to make an evasive manoeuvre to avoid a collision*" (Parker and Zegeer 1989). This definition implies that conflicts and crashes are of similar nature except for the presence and the success of an evasive action.

2 . **Temporal (and (or) spatial) proximity based traffic conflicts**

According to this definition, whether an observed situation is a traffic conflict or not is determined by how close in time and (or) space of the involved road users. A representative definition of proximity based traffic conflict is *"… an observable situation in which two or more road users approach each other in space and time to such an extent that there is a risk of collision if their movements remain unchanged*" (Amundsen and Hydén 1977).

# Conflict Analysis Technique

**Traffic conflict data collection techniques.**

- **Field observation**

  Includes on-site observations and observing conflicts from videos collected at the survey sites. Observers are trained on the operational rules of recognizing the appearance of conflicts, the type of conflicts, and the severity of conflicts.

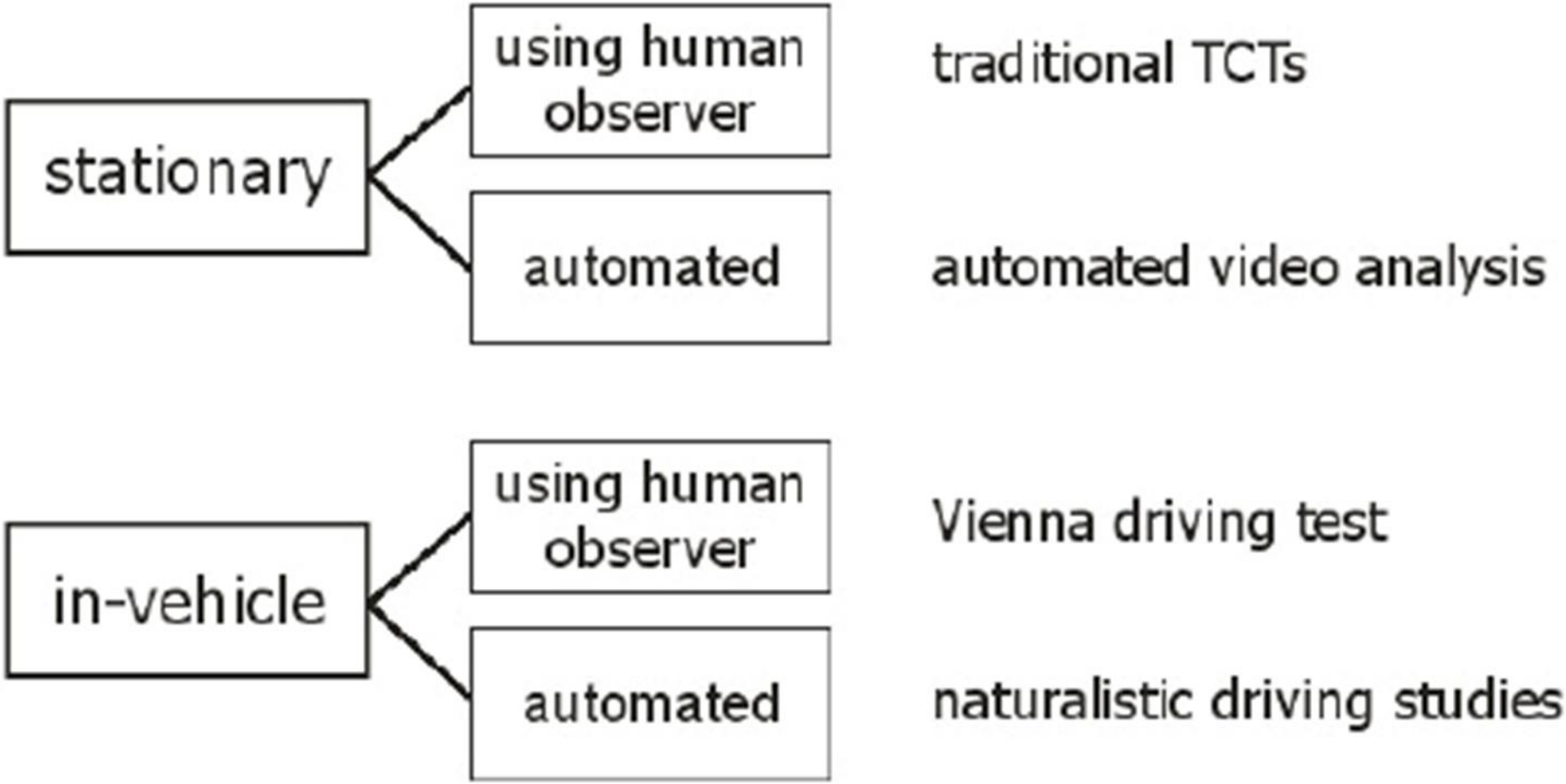
- **Computer vision technique**

  The use of computer vision technique for collecting traffic conflict data relies on computer algorithms to track moving objects and detect traffic conflicts from videos. A computer vision based traffic conflict detection system composed by two components: a video-processing module for detecting and tracking objects and an interpretation module for extracting information and detecting traffic conflicts.

- **Naturalistic driving studies**

  Naturalistic driving studies yield unique records of longitudinal traffic conflict data. Vehicles equipped with advanced data acquisition system including cameras and various sensors, continuously and inconspicuously register vehicle manoeuvres, driver behaviour and external conditions for several months and several years. From these data, traffic conflicts or near crashes can be identified by means of kinematic triggers and sometimes with the aid of video analysis.

# Types and examples of traffic conflict studies

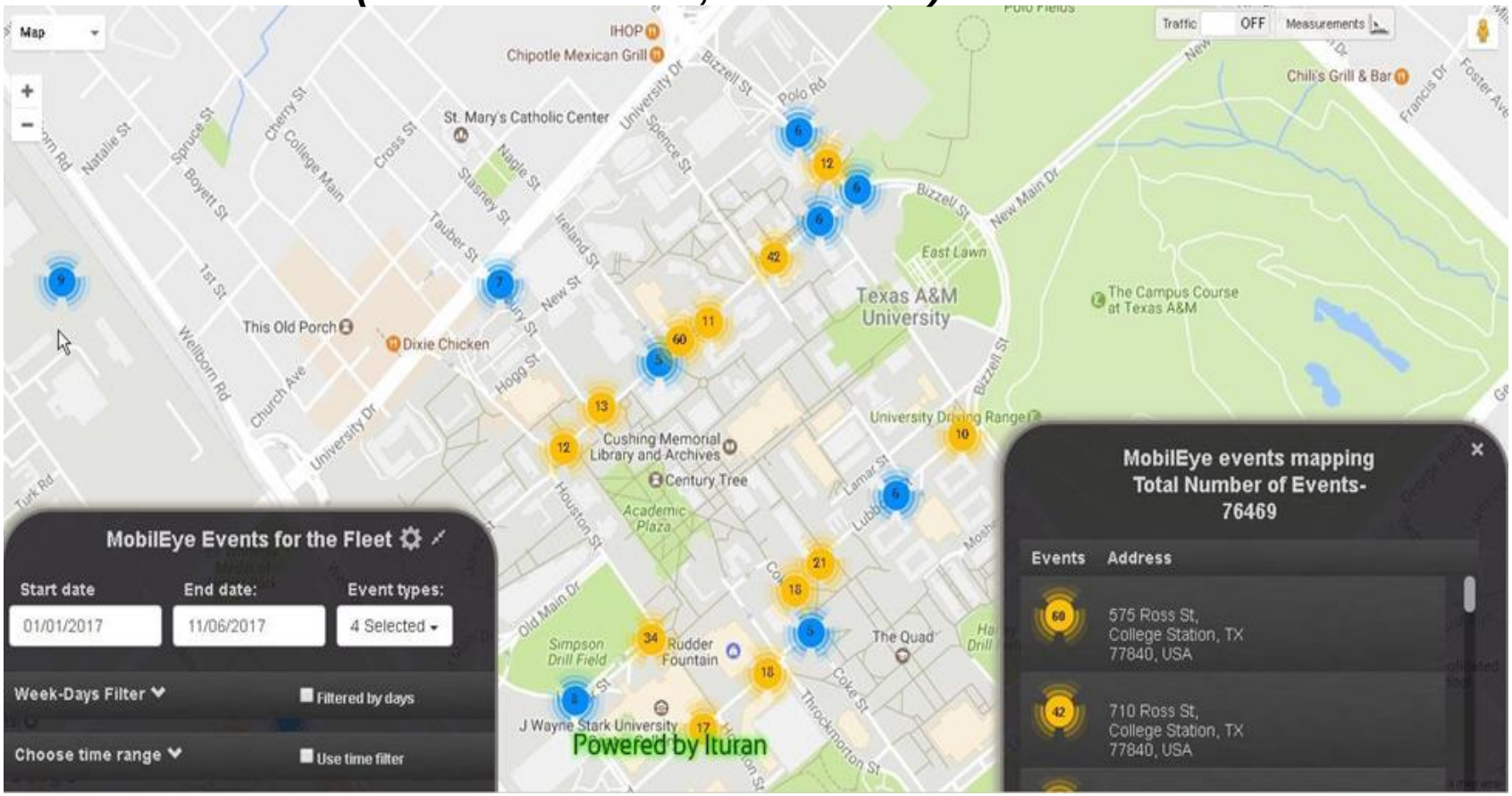


# Vienna & Dover Driving Tests

- Vienna Test Systems - numerous tests compiled into a battery to more accurately assess all the necessary skills. The candidate's hand-eye-foot co-ordination, auditory discrimination, sustainability of concentration despite overwhelming environmental factors as well as visual perception are among others assessed in order to determine the driver's ability to operate a vehicle.
- The Dover system is very effective in accident reduction (as no industry will ever have accident-free candidate performance). No available assessment tool that can completely eliminate 'human error', as many other factors contribute to crashes.

# Mobileye Shield+™ fleet-vehicle-based systems

- Exact location of each collision warning event logged by system.
- Events mapped show the frequency of these events.
- Hot spot locator created enabling a crash frequency map to be generated in a point-and-click Web browser interface.
- Hot spot locations shared with Texas A&M bus operators and dispatchers, who confirmed they knew locations where bus/pedestrian/ cyclist conflicts were common. ***(FHWA-HRT-17-107, March 2018)***



# Pro-Active Assessment methods

1. Road safety appraisals
2. Road safety audits
3. Road safety assessments

# Conducting Road Safety Appraisals, Audits and Assessments

*http://www.nra.co.za/content/South_African_Road_Safety_Manual_Final_Draft_Aug_2010.pdf* ***(Final version to be published soon)***

# Road safety appraisals, audits and assessments

- **Road Safety Appraisal**: A *systematic examination of an existing road location*, in which an independent and qualified team reviews on-site conditions and historical evidence to identify *existing or potential* road safety problems and suggest measures to mitigate those problems.

- **Road Safety Audit**: *A formal examination of a new or upgrading project* where interaction with road users takes place, in which an independent and qualified team identifies potential road safety problems and suggest measures to mitigate those problems.

- **Road Safety Engineering Assessment**: The *screening process utilised to establish the road safety status of sections of an existing road network resulting in a list of prioritised locations that should be further investigated.*

  *(SA Road Safety Audit Manual, p.15)*

# Objectives of Road Safety Auditing

- To minimise the severity and crash risk of road traffic crashes that may be influenced by the road facility or adjacent environment.

- To minimise the need for remedial measures after the opening of a new road project.

- To reduce the full life-cycle cost of a road project by reducing its crash cost.

- To create and maintain an awareness of safe design practice during all stages of a road project.

*(SA Road Safety Audit Manual, p.16)*

# Road safety appraisals, audits and assessments

## Contents of SA Road Safety Audit Manual (2010)

- **Part A: Introduction to Road Safety Audits**
  - Chapter 1: Road Traffic Safety Management
  - Chapter 2: The Road Safety Audit Concept
  - Chapter 3: The Road Safety Audit Process

- **Part B: Conducting Road Safety Audits**
  - Chapter 4: Road Safety Audits of New Projects
  - Chapter 5: Road Safety Audits of Existing Roads (Road Safety Appraisals)
  - Chapter 6: Other Road Safety Audits

- **Part C: Legal Environment**
  - Chapter 7: Legal Implications of Road Safety Audits

- **Appendices (Prompt lists, etc.)**

# The Road Safety Audit Process

- Commissioning of Audit
- Selecting the Road Safety Audit Team
- Audit Brief
- Commencement Meeting
- Information Review
- Site Inspection
- Road Safety Audit Report
- Completion Meeting
- Responding to the Audit Report

# Road safety audit team (South Africa)

- **The Client**: Road authority or organisation responsible for the road project
- **Audit team**: Group of one or more individuals with the necessary training as road safety auditors having skills in road safety engineering, crash investigation and prevention, traffic engineering or road design (*what about human factors specialist and traffic law enforcer involvement?).*
- **Audit team leader:** The lead auditor that is responsible for compiling the road safety audit report and representing the audit team in liaising with the client
- **Audit team member:** Possible second auditor that assists in and contributes to the road safety audit
- **Design team:** Group of one or more individuals responsible to plan, design or supervise the construction of a new road project appointed by the client

# Road safety audit team (International)

- Road safety audits should be undertaken independent of the project design team to ensure that those who are unbiased and those who may have a different perspective are reviewing the project.
- The road safety audit team should have:
  - **Experience in road safety engineering principles and practices**, **accident investigation and prevention, traffic engineering and road design.**
  - Additionally, members with **experience in law enforcement, road maintenance, and human factors** can be added to the team when required.
- Where pedestrians and cyclists are involved, it is imperative that the audit team has substantial experience in the needs of these users. Audit checklists are provided for these users, but these should only serve as to remind the audit team members of aspects that should be evaluated.

# Road safety audit team at work

# Road safety audit prompt lists (1)

- The South African Road Safety Manual provides various reminder lists for the undertaking of road safety audits.
- It is comprehensive, covering a range of aspects, including those related to pedestrians and cyclists.
- The aim of these reminder is to identify possible safety problems for pedestrians and cyclists and to ensure that measures to eliminate or reduce the problems are considered fully.

# Road safety audit prompt list (2)

- It covers questions such as the following:
  - Are there any pedestrian desire lines crossing a project, requiring that provision should be made for pedestrians?
  - Was consideration given to the need of cyclists?
  - Will the project cause the division of existing communities, or separation of communities from basic commodities like water, firewood or retail facilities?
  - Are pedestrians guided or prevented from crossing the road at dangerous locations?

# Road safety audit prompt lists (3)

- More questions covered are:
  - Is there a need for pedestrian refuge islands and are they wide enough to ensure safety?
  - Is there a need for pedestrian crossings? Are pedestrian crossings provided along desire lines?
  - Has sufficient measures been provided to ensure that pedestrians do not walk on the highway?
  - Is provision made for paved footpaths where there are pedestrian generators in the adjacent land uses?
  - Is there a need for bicycle lanes, or can shared pedestrian-cycle facilities be provided?

# Road Safety Audits – Land use development projects

**AustRoads** lists the following reasons for these audits:

- Land-use developments accommodate road users like pedestrians, car parks, delivery vehicles, etc.
- Safety problems can arise where a development connects with the public road system
- Developments can result in safety problems on the public road network some distance away
- Some developments become public roads
- Designers of land-use developments typically do not have road safety engineering experience
- Development projects neglecting road safety measures transfer crash costs to later road users.

# Road Safety Audits – Legal Implications

## Criminal Law and Law of Delict

- An injured road user can file a lawsuit if he/she can show that a road authority has done something that a reasonable road authority would not have done, or has failed to do something that a reasonable road authority would have done.

- A road safety audit demonstrates a pro-active approach to identify and mitigate possible road safety problems and can thus be used as a defence in liability litigation.