



# PIARC is Boosting Road Safety in LMICs – Webinar 2

## Human factors/Behaviour

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# Summary

- **Human Factors Fundamentals**
- **Human Factors and Behavior Issues**
- **Human Factors Safety Measures**
- **Recommendations**

# Human Factors Fundamentals



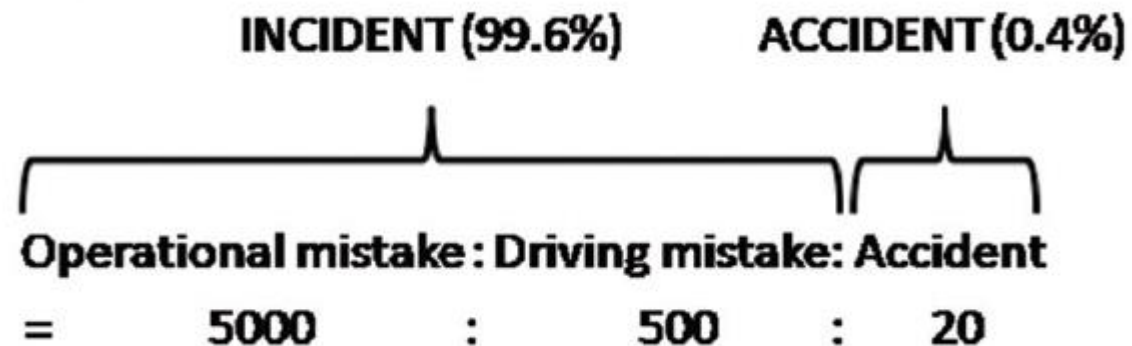
# Definition of Human Factors

- Human Factors has been a **technical term since 1930s**.
- The contribution of **stable psychological and physiological limits** of the human nature to the **development of a technical dysfunction** or failure in handling machines and vehicles.
- **Excluding** the temporary mental/physical conditions (e.g. intoxication, alcohol, age).
- Aiming the **identification of road characteristics** that are not according to human threshold limit values and therefore **trigger accidents**.



# Incidents and Accidents

- **Operational mistakes** are reactions of drivers to misreading road features that have been there for a long time.
- Operational and driving mistakes called **incidents**, amount to **99.6%** of all relevant **traffic offences**.
- Only **0.4%** of operational and driving mistakes leads to **accidents**.



# Human Factors and Behavior Issues

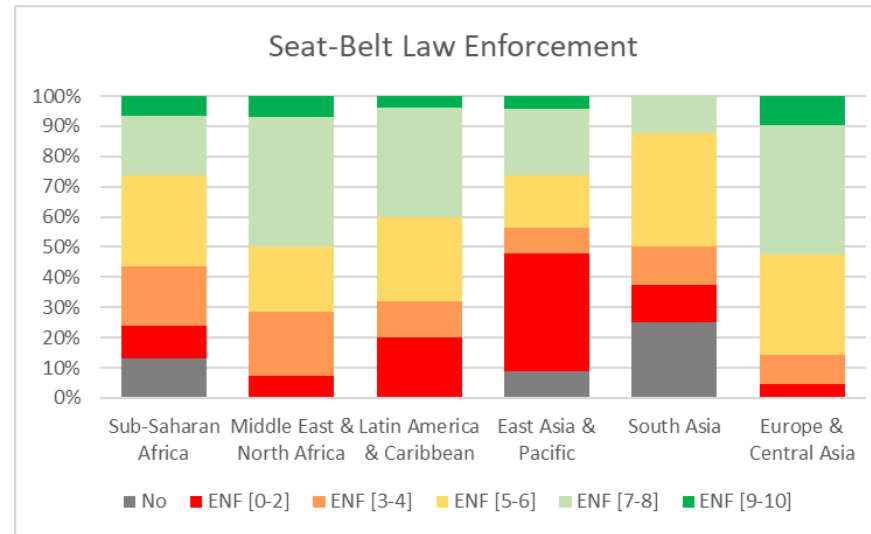
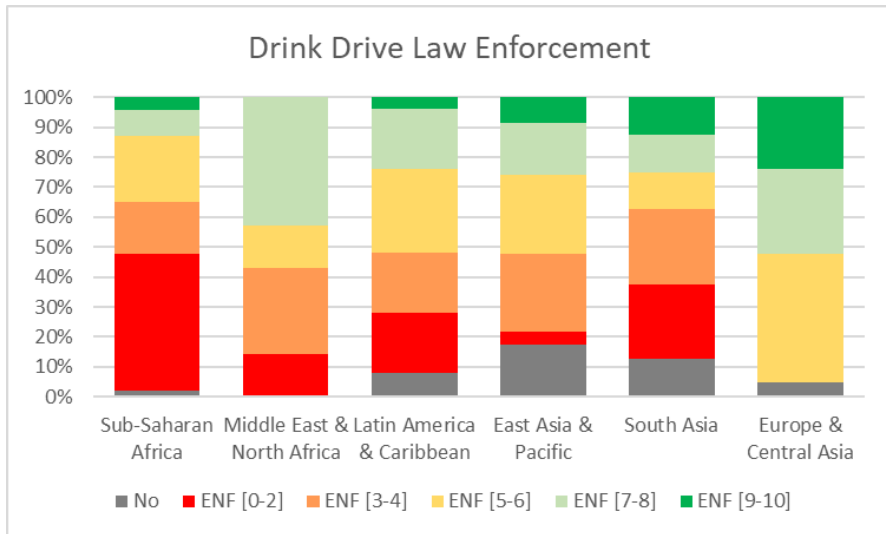


# Behavioral Risk Factors

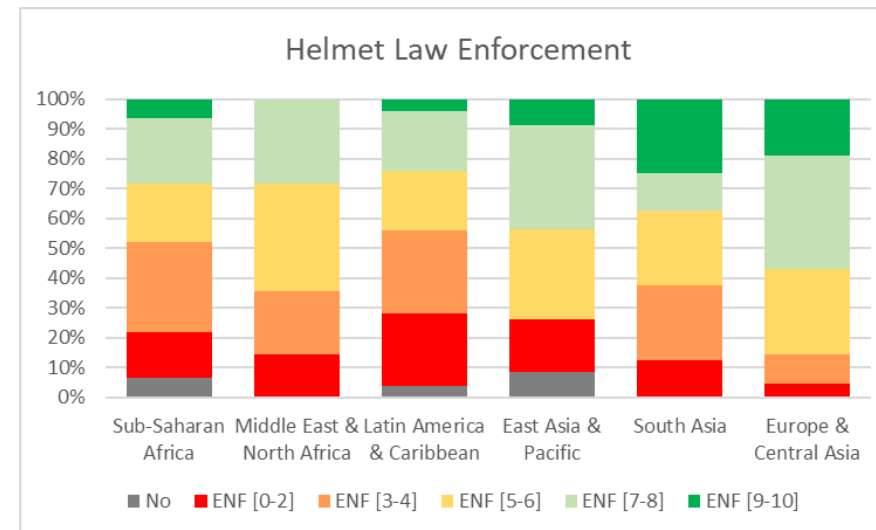
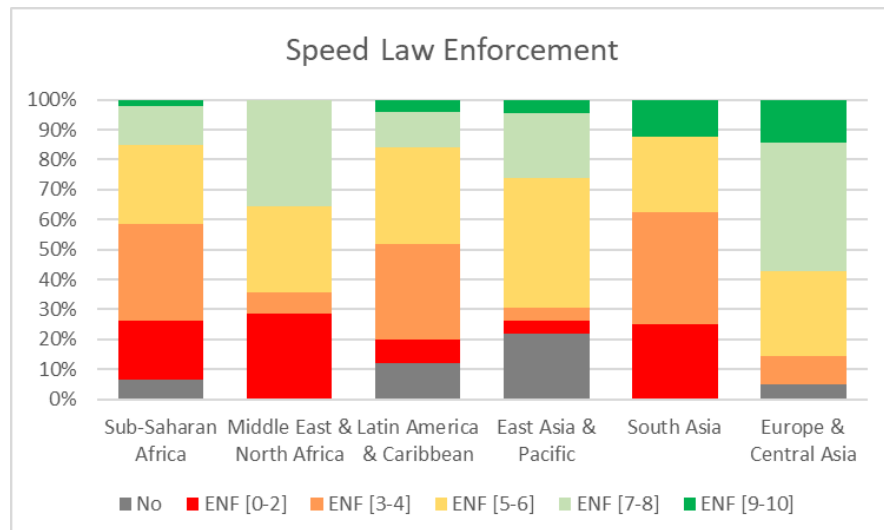
1. **Speeding**
2. **Drink-driving:** 5%-35% of road deaths are reported as alcohol-related
3. **Seat-belt use:** wearing seat-belt reduces the risk of death and serious injuries among drivers and front seat occupants by 45%-50% and among rear seat occupants by 25%.
4. **Helmet use:** head injuries are the leading cause of death and major trauma for 2 and 3-wheeled motor vehicles users
5. **Child-restraints:** lead to 60% reduction in deaths
6. **Driver fatigue**
7. **Distracted driving**

Despite the progress made in improving legislation across the key risk factors, **enforcement remains a major challenge** in most countries.

# LMICs Risk Factors Law Enforcement Fundamentals



Figures representing the levels of enforcement in different LMICs geographical groups. Based on the WHO Global Status Report on Road Safety 2018





# Human Factors and Human Behavior Issues

| Human Factors Issues   | Human Behavior Issues                               |
|--|---|
| A road user's reaction time  | Enforcement and education                           |
| Wrong directional orientation in optically unframed curves                     | Licensing   |
| Reading time for symbols/texts   | Intentional violation of traffic rules/speed limits |
| Upper limit for perception of a number of objects as a location                | Pathological personal traits like anxiety           |
| Optical illusions that lead to misperception and accidents                     | Driving under drugs/alcohol                         |
| Wrong responses to misleading/irritating optical features in the field of view | Lose control because of a disease                   |
|  | Impaired reaction time/ attention due to medication |
|  | Risky behavior                                      |

# Human Factors Accident Triggers

1. The **6-Seconds Rule**: The average driver needs **4-6 seconds** to adapt to a **new driving requirement**.
2. The **Field of View Rule**: the road must offer road users a **safe field of view** and pre-programme the correct choice of speed.
3. The **Logic Rule**: the road has to **follow the driver's perception logic**, formed by their experience and recent perceptions.

# The 6-Seconds Rule

## Critical locations:

- Junctions or crossings
- Access from private streets/parking places/farm tracks to main roads
- Lane losses/merges
- Bus/tram stops
- Motorway entrances/exits
- Entrance to towns/villages
- Changes from mono-functional road to a road with several mixed functions

# The Field of View Rule

## Critical locations:

- Monotonous approaching sections/surroundings, e.g. planting, buildings, landscapes
- Long/far visible approaching sections before critical locations
- Asymmetrical posts of a bridge or pitched bridges advertisements
- Incorrect optical setting of outer curves: curve without setting leads to destabilization of the driver
- Non-vertical appearance of roadside objects: trees, delineators, buildings
- Structures over the road that are asymmetrical or of different height

# The Logic Rule

## Critical locations:

- Discontinuous bends in roads
- Multiple critical locations leading to overload of information processing
- Sharp curves, traffic signs, intersections directly after tunnels
- Direction of sign differ significantly from the perceived road course
- Traffic control devices not visible against background

# Human Factors Safety Measures



# UN Decade of Action for Road Safety



# Safe System Approach

- **UN Second Decade of Action for Road Safety**, with a goal of reducing road traffic deaths and injuries by at least 50 per cent from 2021 to 2030
- Adoption of Safe System Approach is necessary to **prevent fatal and serious crashes**.
- Unless roads are designed and managed to **take account of human factors**, it is unlikely that a Safe System can be achieved
- The road transport system needs to **anticipate and accommodate for human errors** and prevents consequent death or serious injury





# Safe System Principles



**Death/Serious Injury  
is Unacceptable**



**Humans  
Make Mistakes**



**Humans Are  
Vulnerable**



**Responsibility  
is Shared**



**Safety is  
Proactive**



**Redundancy  
is Crucial**

# Safe Road Use Measures

- Enact and enforce **road safety legislation**
  - Set maximum **speed limits** considering the type and function of roads.
  - Establish **blood alcohol concentration (BAC) limits** to prevent impaired driving (drink- and drug-driving) with specific provisions for novice and professional drivers.
  - **Mandate the use of protective equipment** (safety belts, child restraints and helmets).
  - **Restrict the use of handheld electronic devices** while driving.
  - Establish a **dedicated enforcement agency**, provide training and ensure adequate equipment for enforcement activities
- Ensure **road infrastructure** takes account of the needs of all road users and is designed to **facilitate safe behaviors**, including:
  - clear **road signage** and road markings that are intuitive;
  - use of roundabouts and **traffic calming designs** such as speed humps;
  - physical **separation of road users** including use of protected bicycle lanes and pedestrian only zones

# The 6-Seconds Rule Countermeasures

| Policy   | Measures   |
|--|--|
| <b>Don't surprise the driver!</b><br>Ensure the perception and visibility of the critical location by road alignment and design allowing unobstructed view of the critical location. | <ul style="list-style-type: none"><li>• Remove visual obstacles such as crests, curves, vegetation and buildings prior to critical location</li><li>• Construct traffic islands.</li></ul> |
| <b>Ensure visibility by corrective measures!</b><br>Implementation of treatments guiding driver's attention directly to the critical driving demand.                                 | <ul style="list-style-type: none"><li>• Use attention guiding visual clues such as colored areas, pavement changes and special markings.</li></ul>   |
| <b>Give advice by warning measures!</b><br>Forewarn and seek to change driver's programme by installing traffic control devices.   | <ul style="list-style-type: none"><li>• Install speed limits</li><li>• Prohibit overtaking</li><li>• Set up warning signs</li></ul>  |

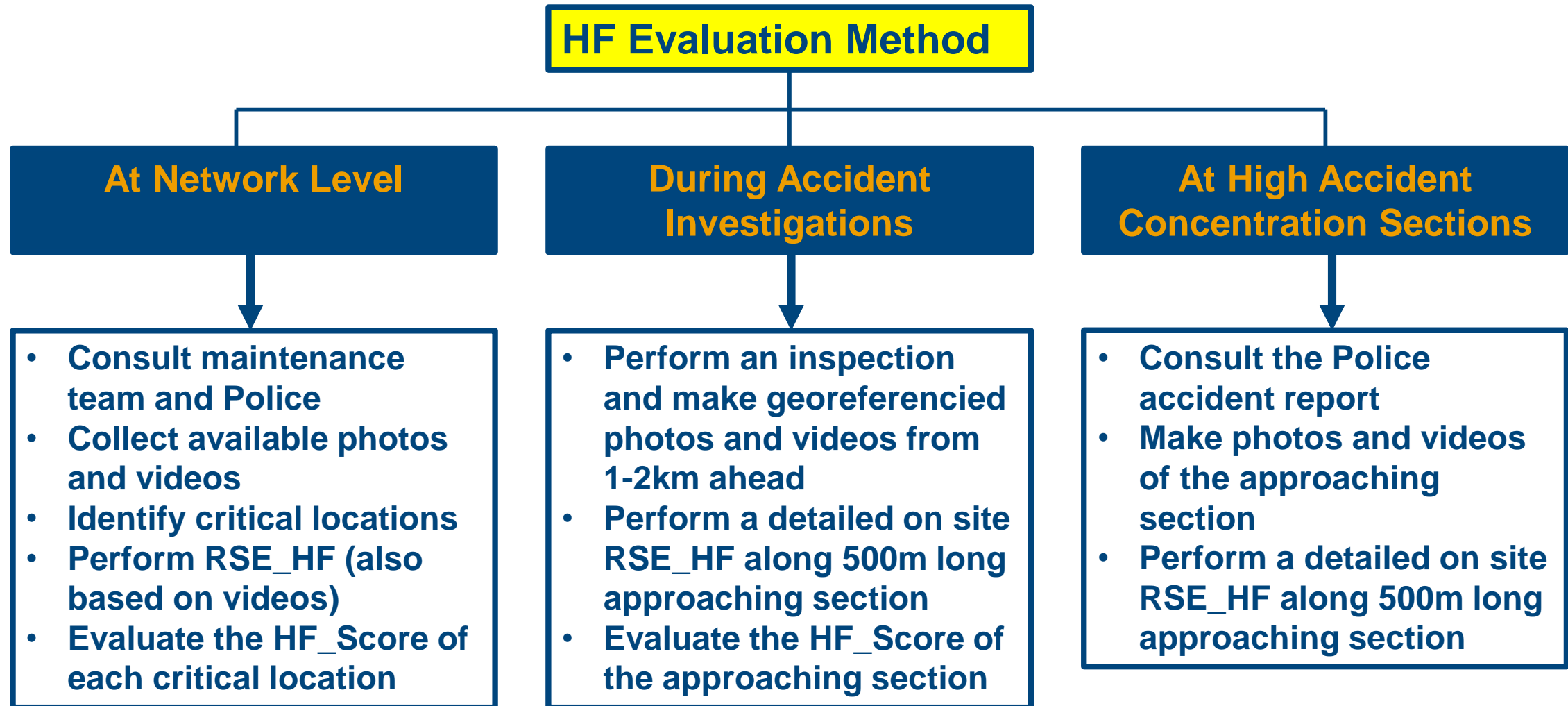
# The Field of View Rule Countermeasures

| Policy   | Measures  |
|--|---|
| <b>Design the field of view!</b><br>Remedy the identified deficits in the field of view by design                                      | <ul style="list-style-type: none"><li>• Create sinuous road alignment against monotony</li><li>• Create symmetry of superstructures by constructive measures</li></ul>  |
| <b>Correct the field of view!</b><br>Permanently remedy the identified deficits in the field of view by improving the optical guidance | <ul style="list-style-type: none"><li>• Use eye-catching objects,</li><li>• Create complete setting of outer curves</li><li>• Cover non-parallel optical guiding lines that lead to optical illusions</li></ul> |
| <b>Place warnings in the field of view!</b><br>Address the identified deficit in the field of view by signs and instructions           | <ul style="list-style-type: none"><li>• Install speed limits</li><li>• Ban overtaking</li><li>• Set up warning signs</li></ul>  |

# The Logic Rule Countermeasures

| Policy  | Measures  |
|---|---|
| <b>Design logical road sections!</b><br>Ensure early visibility and clear comprehension of critical locations, including parking lot exits, entrances and other gateways. | <ul style="list-style-type: none"><li>• Avoid logical breaks in sections with the same function</li><li>• Indicate change of function by change of alignment, cross section and roadside facilities</li></ul> |
| <b>Correct illogical road sections!</b><br>Announce critical locations early enough by special road surfacing, changes of road's course                                   | <ul style="list-style-type: none"><li>• Use special road surfacing such as colored areas, pavement changes and special markings to indicate critical locations</li></ul>                                      |
| <b>Place warnings in illogical road sections!</b><br>Forewarn drivers of the logical inconsistencies by traffic control devices and instructions                          | <ul style="list-style-type: none"><li>• Install speed limits</li><li>• Ban overtaking</li><li>• Set up warning signs</li></ul>  |

# Human Factors Method



# Safety evaluation based on Human Factors Method

- Special **on-site inspections** made by an interdisciplinary team of designers, safety engineers and Human Factor experts, following a specific inspection protocol.
- Checking the **compliance with road standards**
- Visit the location **under different weather** and lighting conditions or when accident occurred
- Inspection at **network level** to identify safety deficiencies
- Inspection at **high accident concentration sections**



# Human Factors' Evaluation Tool

- Outcome of the Human Factors' Method is the determination on a **Human Factors Evaluation Score** of the location, representing the percentage rate in which the locations fulfil the Human Factors demands.
- The HF\_Score can be determined using the tool developed by PIARC; **Human Factors – Evaluation Tool for the Man-Road-Interface 2017**
- This tool contains validated and reliable road characteristics that cause misperceptions, driving mistakes and can result in accidents.





# Recommendations



# Human Factors Safety Recommendations

- Include **human factors in the road design** process to achieve a self-explaining road design.
- Measure based on the three classes of **human-factor related triggers**:
  1. **The 6-Second Rule**: a user-friendly road will allow drivers to adapt to new and unexpected situations and use signings/markings to indicate before any critical location;
  2. **The Field of View Rule**: a self-explaining road will provide drivers with a well-designed field of view with sufficient contrast, good optical guiding and orientation facilities;
  3. **The Logic Rule**: road characteristics should flow in a logical sequence; changes to the road environment should be introduced as early as possible and exclude elements that would confuse the driver.
- An improved approach to implement road safety inspections is to perform a road safety evaluation based on the **Human Factors Method (RSE\_HF)**, mainly by including human factor **experts** into the RSI team. This approach **supports LMICs** that are still at the starting phase of the road safety management process.

# Relevant PIARC reports

- [Road Safety Manual. Planning, Design & Operation. Roles, Responsibilities, Policy Development and Programmes](#)
- [Road Safety Manual. Planning, Design & Operation. Designing for Road Users](#)
- [Road Safety Manual. Planning, Design & Operation. Risks and issue identification](#)
- [Road Safety Manual. Planning, Design & Operation. Intervention Selection](#)
- [Proceedings of the PIARC International Seminar on: “Road Safety in Low- and Middle-Income Countries: Issues and Countermeasures”](#)
- [Proceedings of the “International Seminar and Workshop on Safer Roads by Infrastructure Design and Operation”](#)
- [Road Safety Catalogue of Case Studies](#)
- [Proceedings of the Internal Workshop “Policies and Programs for Road Safety Management”](#)
- [1st Webinar on COVID-19 and Road Safety](#)
- [2nd Webinar on COVID-19 and Road Safety](#)
- [Addressing Road Safety Worldwide: Vulnerable Road Users, Human Factors & RS in LMIC](#)
- [Human Factors Guidelines for a Safer Man-Road Interface](#)
- [State of the art in road design standards. A PIARC literature review](#)

# Relevant PIARC reports

- [The Role of Road Engineering in Combating Driver Distraction and Fatigue Road Safety Risks](#)
- [Road Safety Evaluation based on Human Factors Method](#)
- [Land use and Safety: An introduction to understanding how land use decisions impact safety of the transportation system](#)

# Thank you for your attention!



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