Saving lives through safer roads: future challenges

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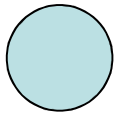
Nature of risks in road traffic

- Combination of *basic risk* factors (speed, physical vulnerability, mass/protection) and *risk increasing* factors (drinking and driving, speeding, inexperience, inattention, etc.)
- Everybody is a road user and can enter the system
- Safety is not a design requirement of the road transport system, but a 'compromise'
- Many actors/stakeholders have responsibilities to manage risks
- No single approach to achieving world-class results



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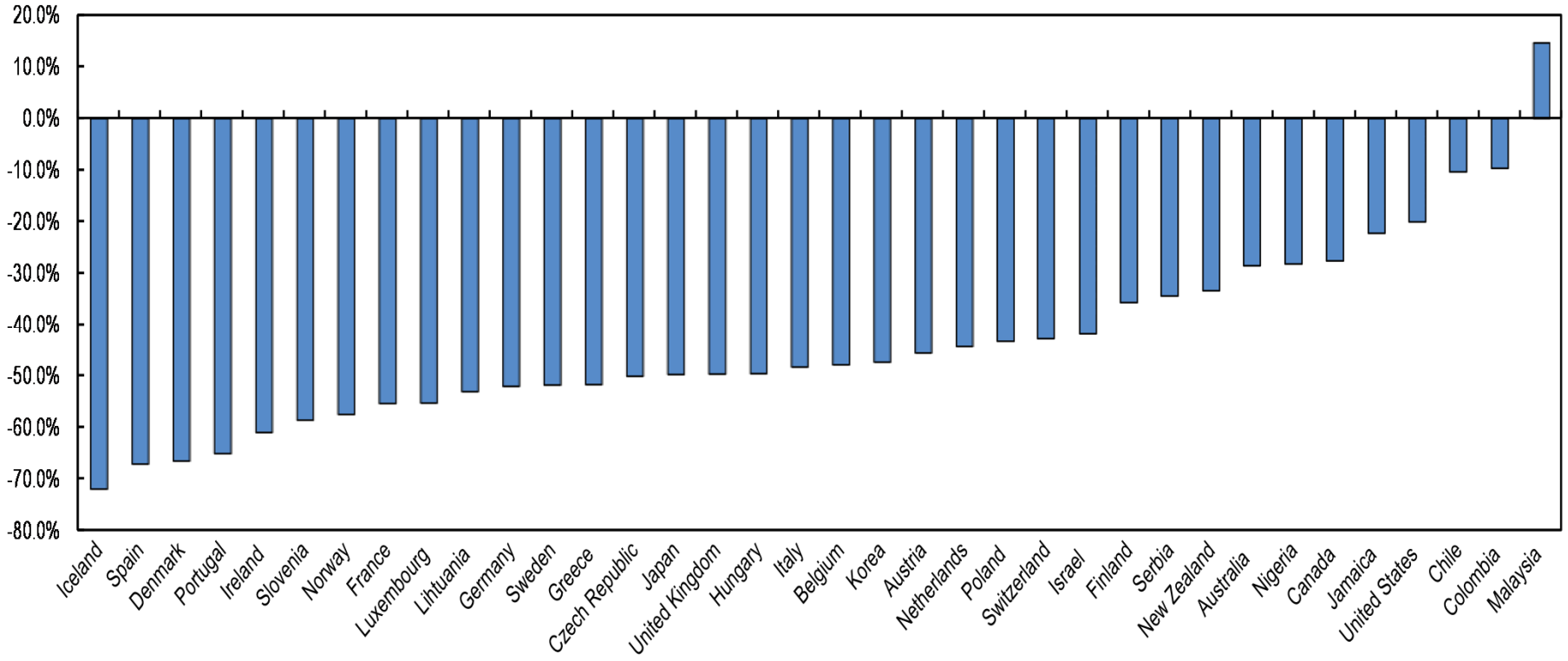
Change in road fatalities in OECD countries 2000-2012 (source: IRTAD)



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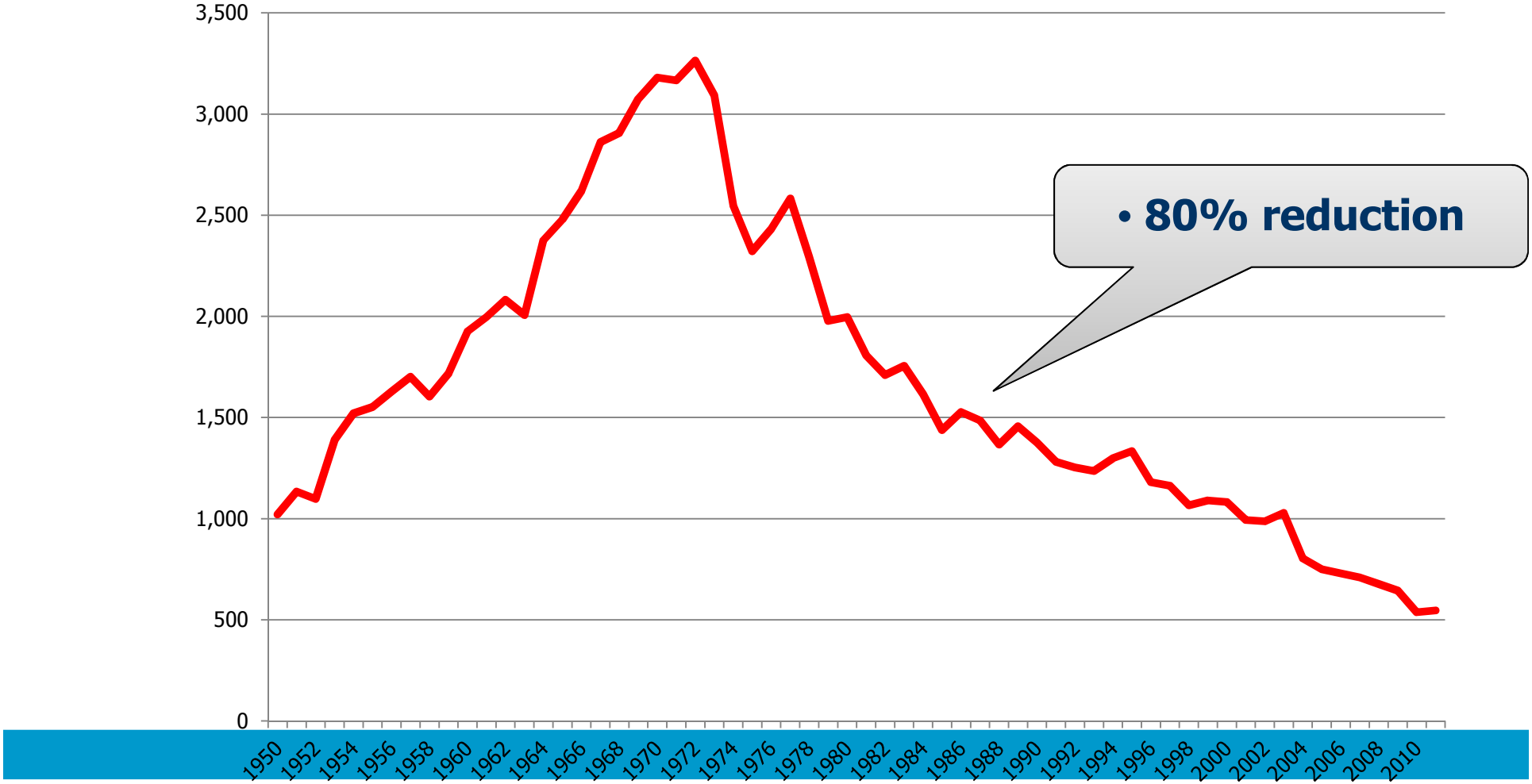
Development number of road fatalities in the Netherlands



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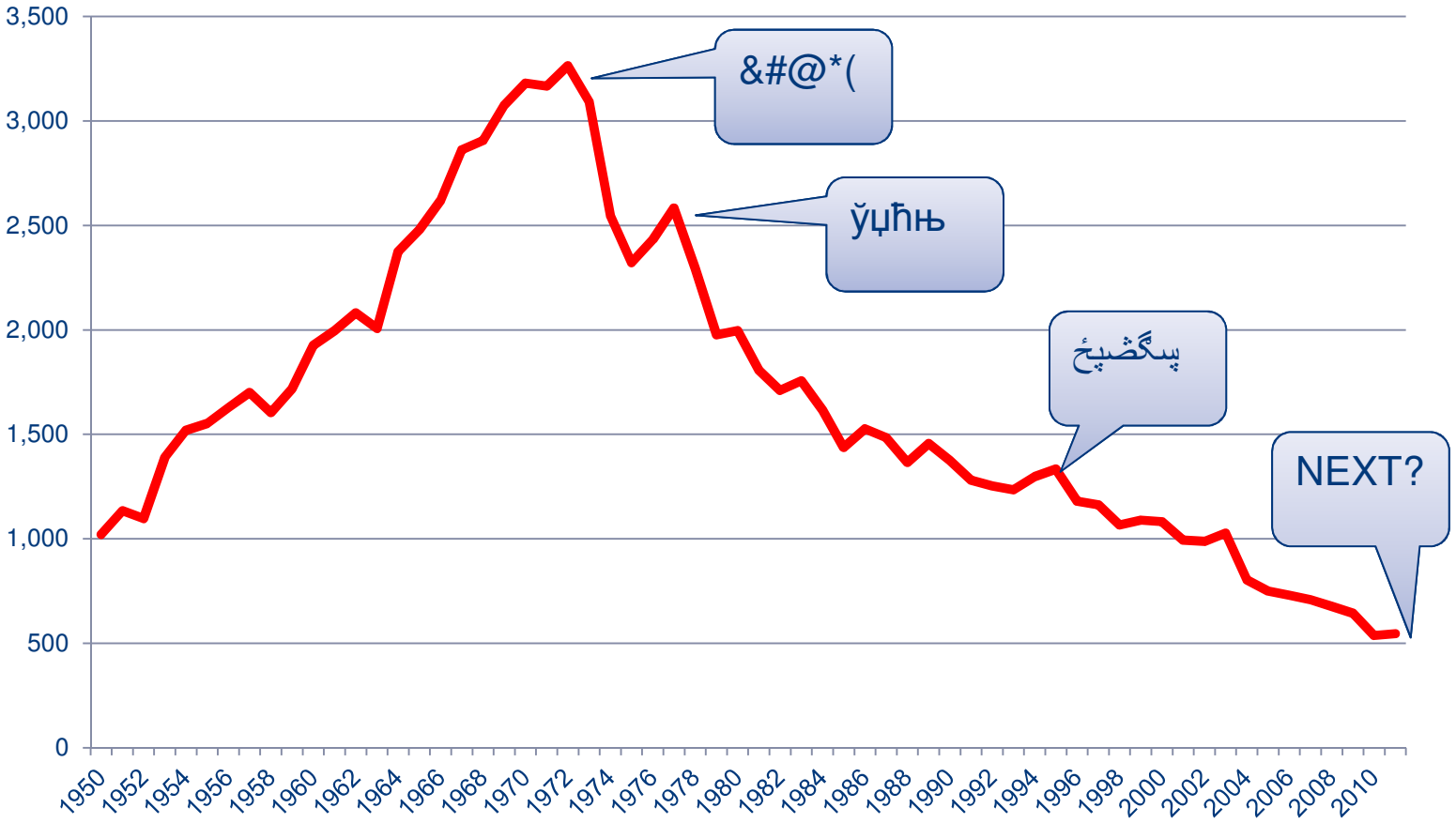
Explaining downward trend is not so easy; successes claimed by many



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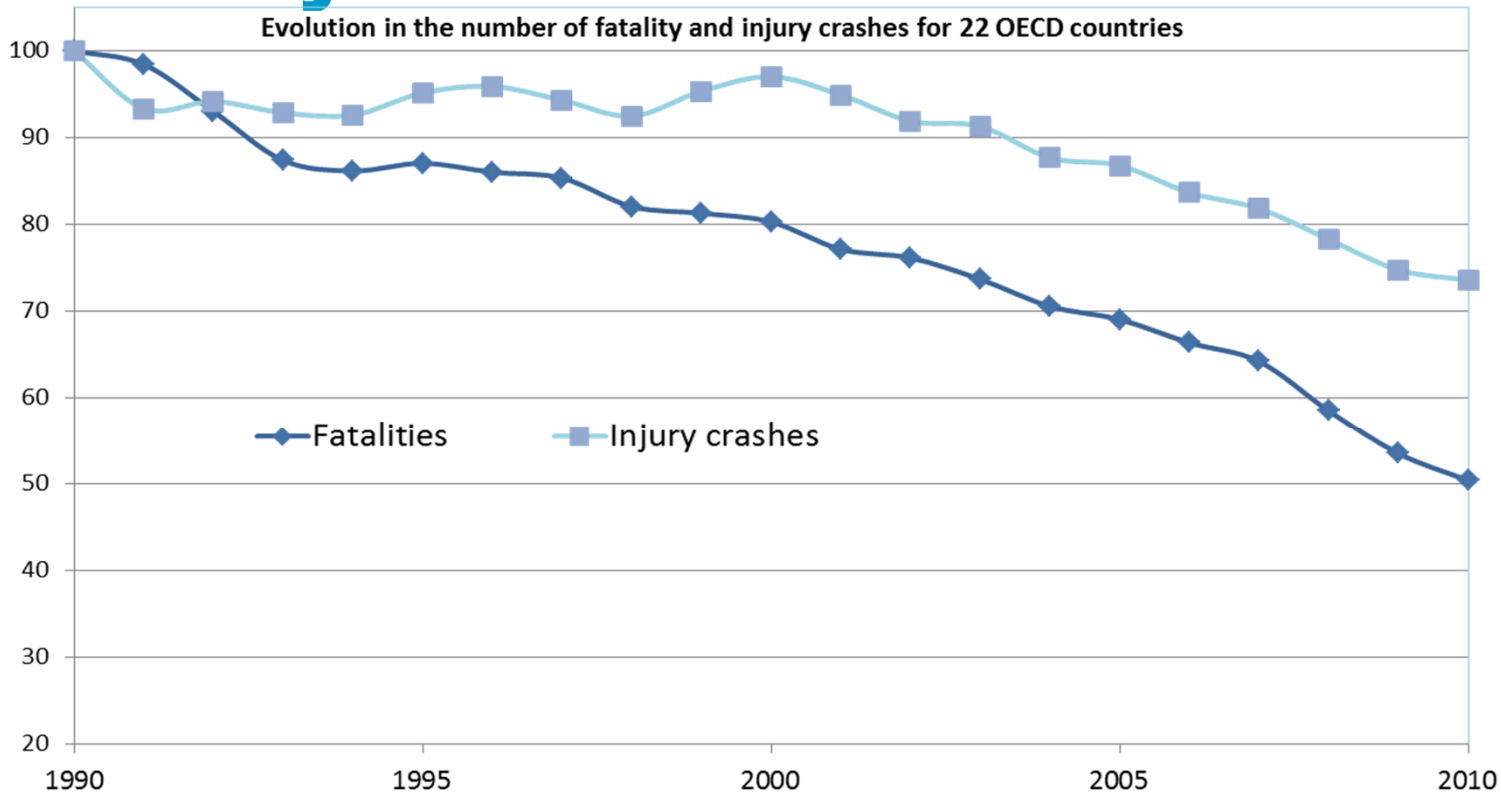
OECD/High motorized countries: more progress with fatalities than serious injuries



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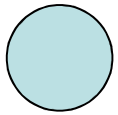
Not only fatalities, but also serious injuries

- Fatal crashes and injury crashes are not telling the same story
- Fatal crashes are not telling the whole story
- Injuries form a substantial proportion of road crash costs (NL 50%) and deserve more attention in road safety strategies and action plans
- It seems to be a wrong assumption to expect a reduction in injuries if reducing fatalities
- To reduce injury crashes requires another strategy than to reduce fatal crashes



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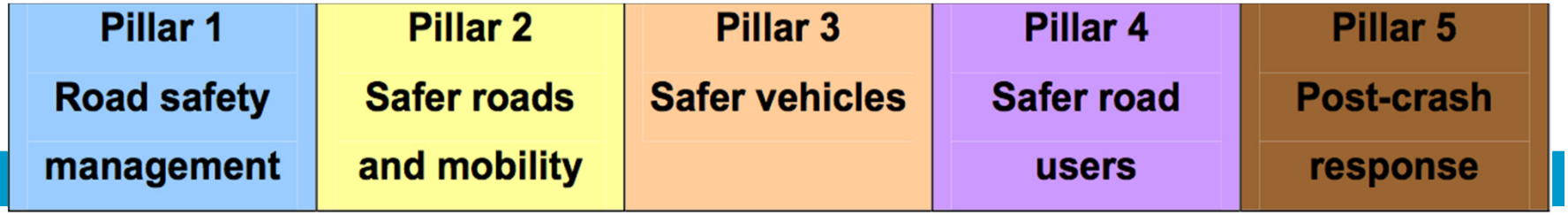
Effective interventions in traditional areas ('evidence based interventions')

- Human behaviour
  - Speed, alcohol, seat belts and safety helmets: legislation + enforcement + campaigns
  - Driver education, schools, mass-media
- Infrastructure: black spots, safe designs, manuals
- Safe vehicles, crashworthiness, inspection, special attention for trucks/buses and motorised two wheelers
- Post-crash response: trauma care, crash notification, transport, medical treatment



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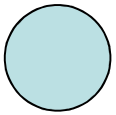
Instruments for road authorities to assess safety quality

- For existing roads/streets/highways
  - Black spot/higk risk location approach
  - Road safety inspection
- For new road designs
  - Road safety impact assessment
  - Road safety audit
- Transparant and evidence based decision making
- Just complying with existing design manuals and guidelines does not necessarily result in safe designs!



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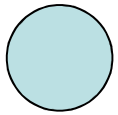
Form of Crash Prediction Models

Traditionally, CPMs for road segments are of the following form:

$$\mu = \alpha \cdot L^{\beta} \cdot AADT^{\gamma} \cdot e^{\sum_{i=1}^{n} \delta_i \cdot x_i}$$

- μ is the expected number of crashes on a road segment;
- L is the length of the road segment in metres;
- $AADT$ is the average amount of daily traffic on that segment;
- x_i are other explanatory variables (road characteristics, such as road way width, or number of exits)



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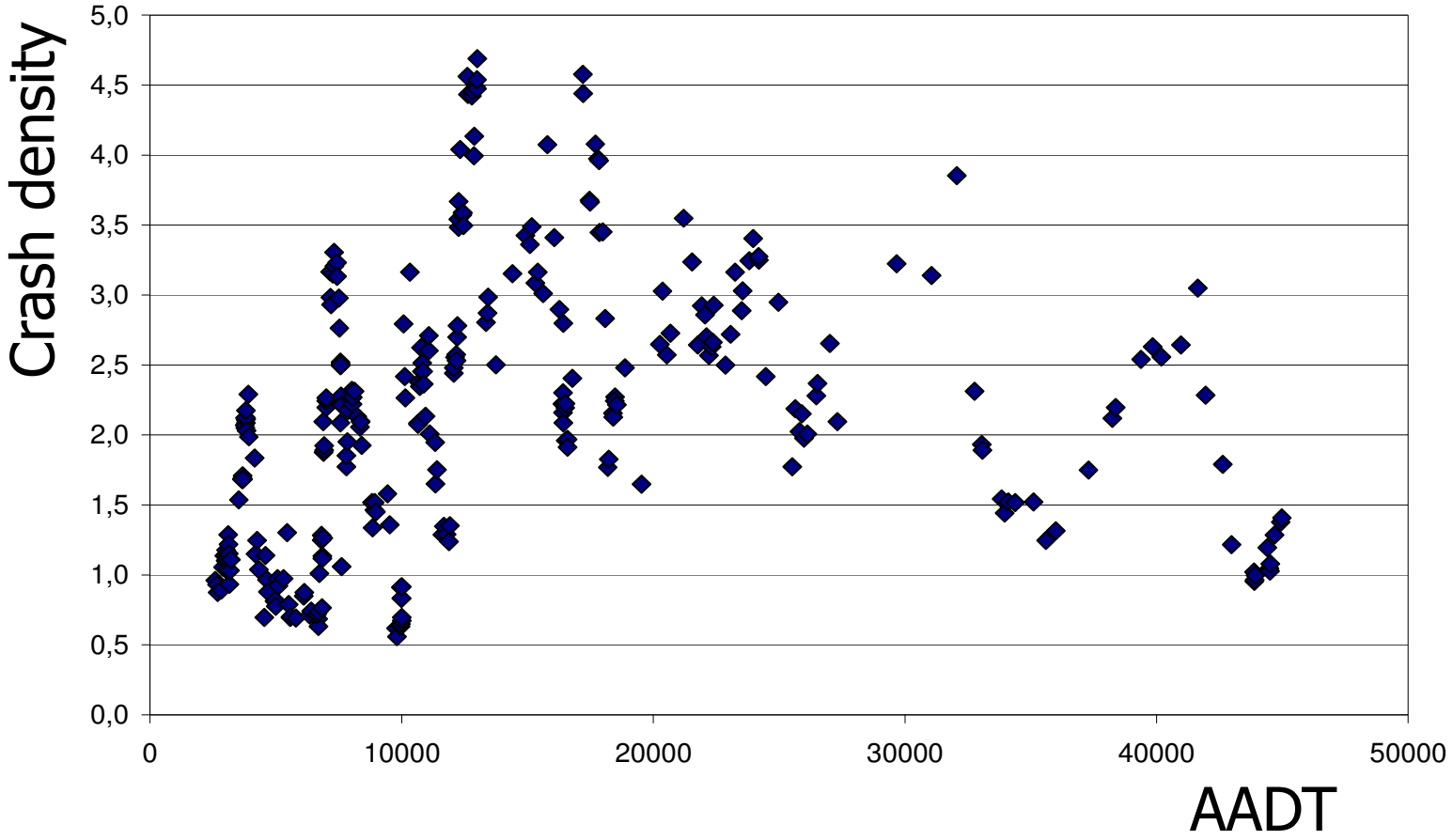
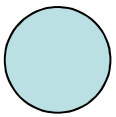
Crash density - AADT relationship for Dutch rural roads





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Go fishing where the fish are, ...

- Look for high risks, high proportions, high increases as a step in priority setting
  - e.g. novice drivers, elderly road users, powered two wheelers, high-risk locations
- However, road crashes can occur and will occur everywhere

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How to define and design a safe road?

- Today's road traffic is *inherently* unsafe
- The road system of today has not been designed with safety in mind, as is the case with air transport or rail transport
- Which means we are almost fully dependent on whether a road user makes a mistake or error in preventing a crash; and human beings are making mistakes and errors
- Another approach is needed: *Safe System Approach*

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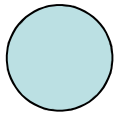
Putting people at the center of a Safe System

- The road system should be designed to expect and accomodate for *human error*, because it is inevitable that road users make mistakes and sometimes violate the law (and crashes occur)

  (This concept has been accepted and implemented in other sectors of transportation, high technology systems)
- In a crash, interaction between vehicle – roadway – human body must be managed so that serious injury likelihood is minimized, if not eliminated: *towards zero*



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Two approaches to the human fallibility

- Person approach vs. System approach

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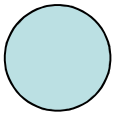
Person approach: 'Bad things happen to bad people'

- This approach focusses on unsafe acts by individuals: errors and (procedural) violations:
  - Forgetfulness, moral weakness, inattention, poor motivation, carelessness, negligence, recklessness

- Management response: campaigns that appeal to people's sense of fear, writing another procedure (or adding to existing ones), disciplinary measures, threat of litigation, retraining, naming, blaming, and shaming



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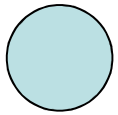
System approach: humans are fallible and errors are to be expected

- Errors are seen as consequences rather than causes, having their origins not so much in the perversity of human nature but in "upstream" systemic factors

- Countermeasures are based on the assumption that, though we cannot change the human condition, we can change the conditions under which humans work



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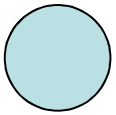
Person approach vs. System approach (James Reason, 1990)

- The human fallibility can be explained by using two approaches
- Person: errors of individuals because of forgetfullness, inattention, moral weakness, poor motivation, carelessness, recklessness, negligence, braking the law
- System: avert errors (or mitigate their effects) by defences, barriers, and safeguards
- Important understanding feeding the Safe System approach



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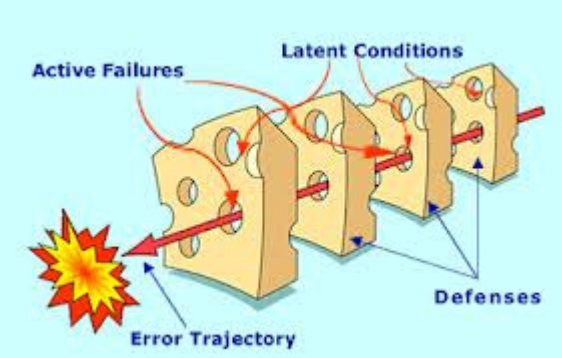
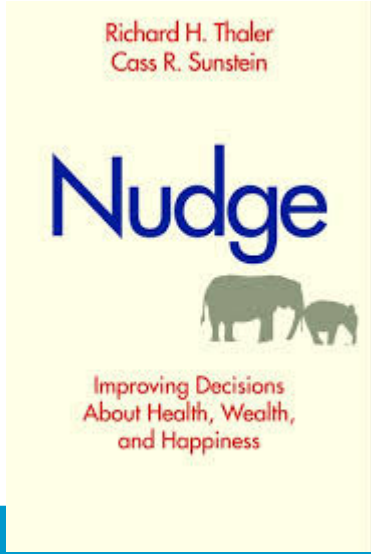
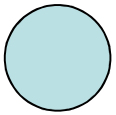
Understanding human choices, errors/violations and crash causation

- Swiss cheese model developed by James Reason (1990), used in aviation, engineering, healthcare, etc.



- 'Nudging behaviour' (Thaler & Sunstein, 2008)





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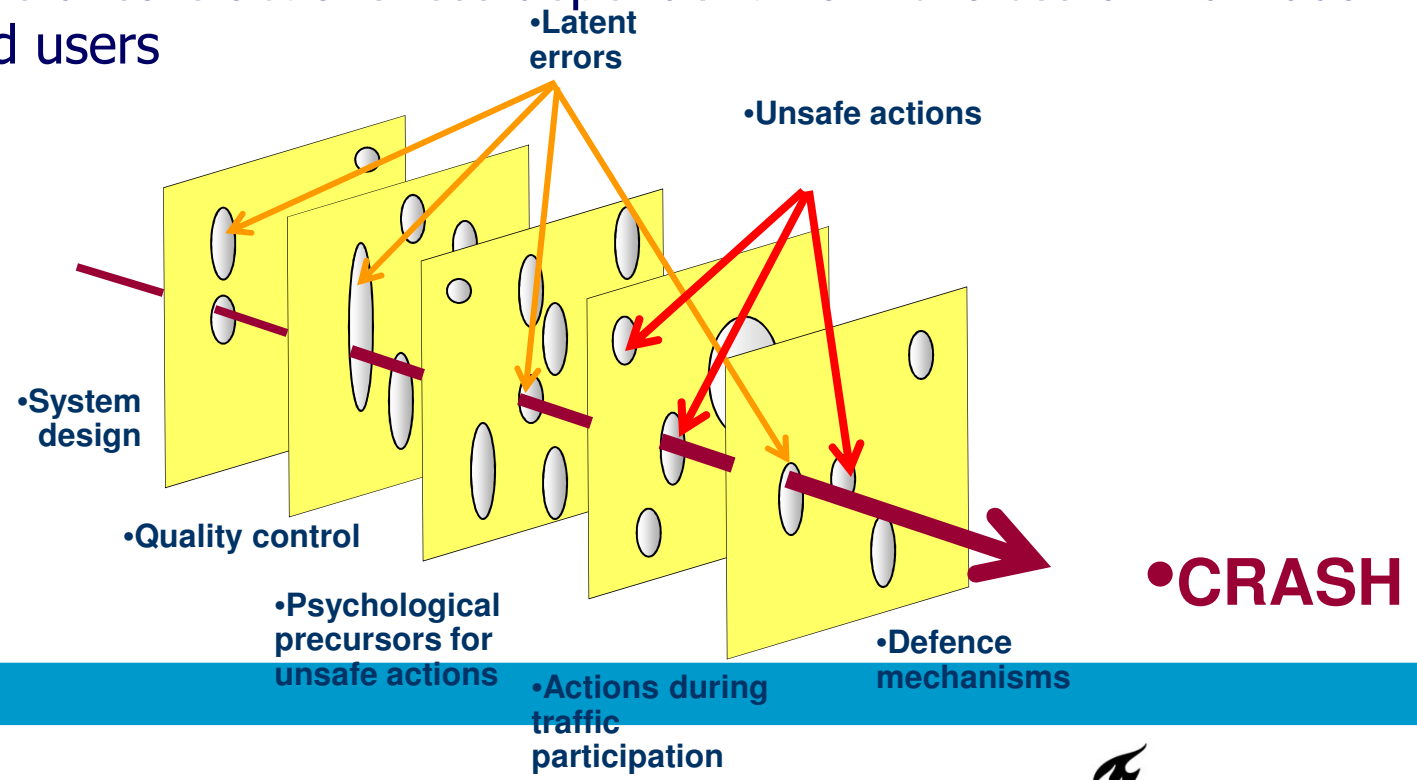
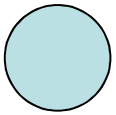
Safe System: a proactive approach

- System approach: prevention of latent errors (system gaps)
  - Intervene as early in chain as possible
  - Make unsafe actions less dependent from choices of individual road users





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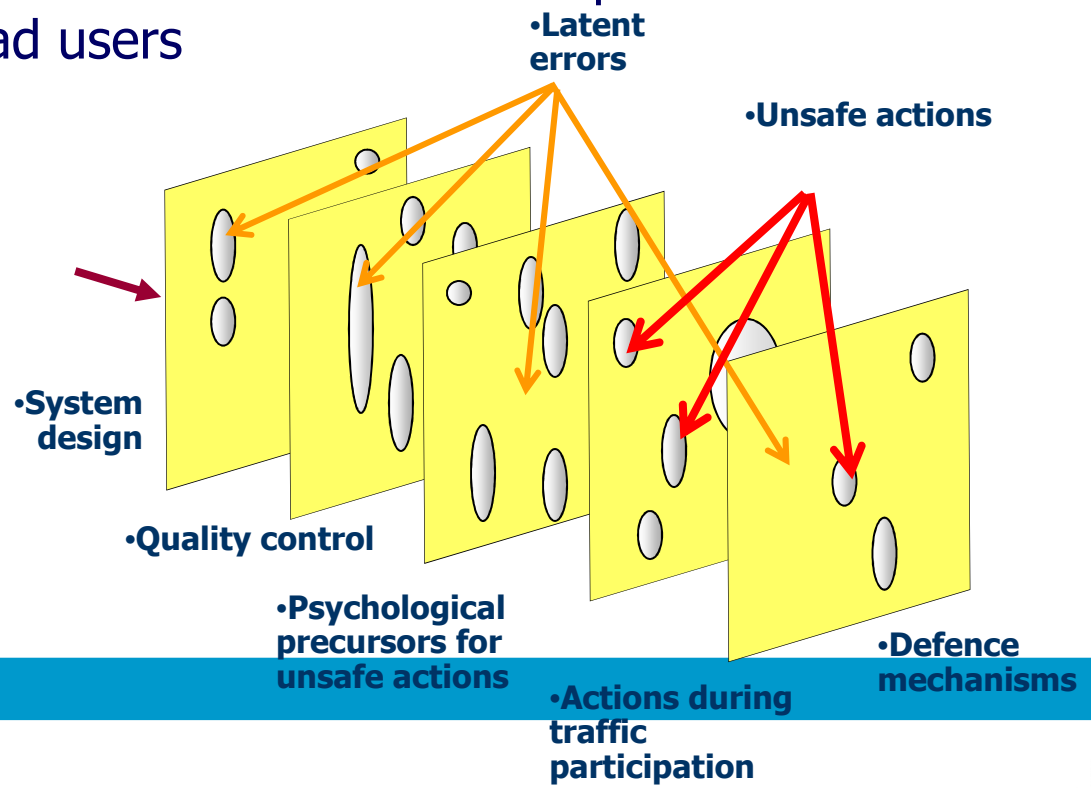

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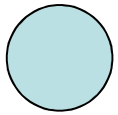
My building blocks of a Safe System (I)

- An ethical approach
  - We don't want to hand over a road traffic system to the next generation with current casualty levels, but considerably less: *Towards zero*
- A proactive approach
  - Don't wait for crashes before to act, but use available knowledge before crashes occur; use crash data for priority setting



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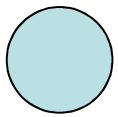
My building blocks of a Safe System (II)

- An integral/holistic approach
  - Integrate man, vehicle and road into a Safe System
  - Covers the whole network, all vehicles, all road users
  - Align with other policy areas: infrastructure, planning, health, etc.
- 'People are the measure of all things'
  - Human capacities and limitations are the guiding factors



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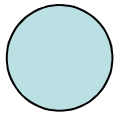
My building blocks of a Safe System (III)

- Reducing latent errors (system gaps) of the system
  - Which means we will not be fully dependent on whether a road user makes a mistake or an error in preventing a crash
- Improving road safety is a shared responsibility between road users and system designers/operators, and between different stakeholders
- Use *criterion of preventable injuries* (prevent avoidable crashes by cost effective interventions)



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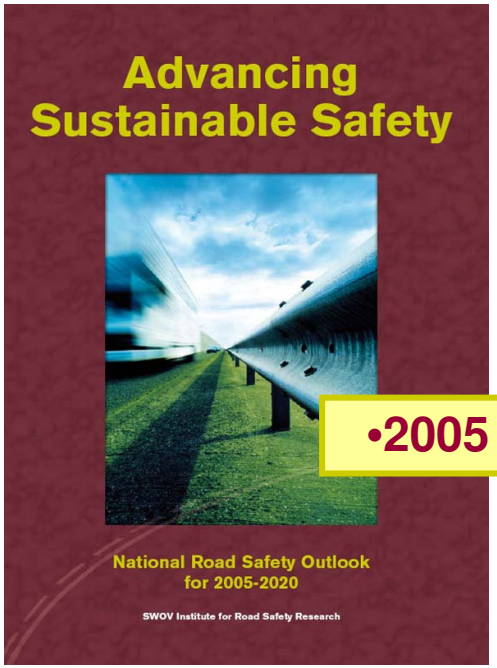
Sustainable Safety: the first example of a Safe System approach



•2005

•1992

- Aims
  - Prevention of serious crashes by eliminating conditions/circumstances where serious crashes *can* occur
  - Reduction/elimination of probability of serious injury when a crash occurs

•Copies are downloadable from

• www.sustainablesafety.nl

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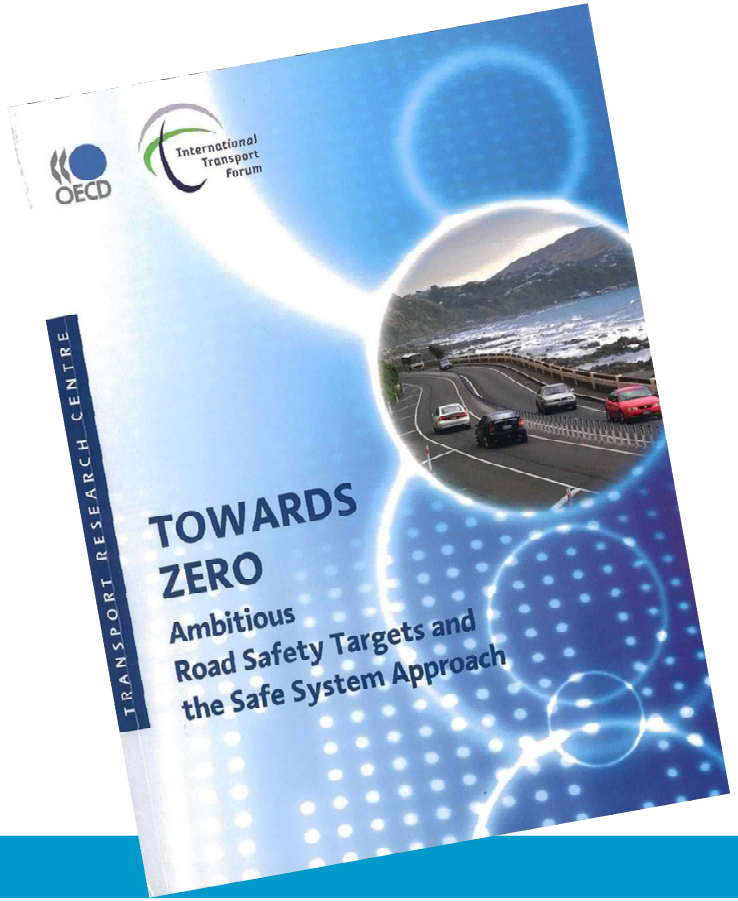
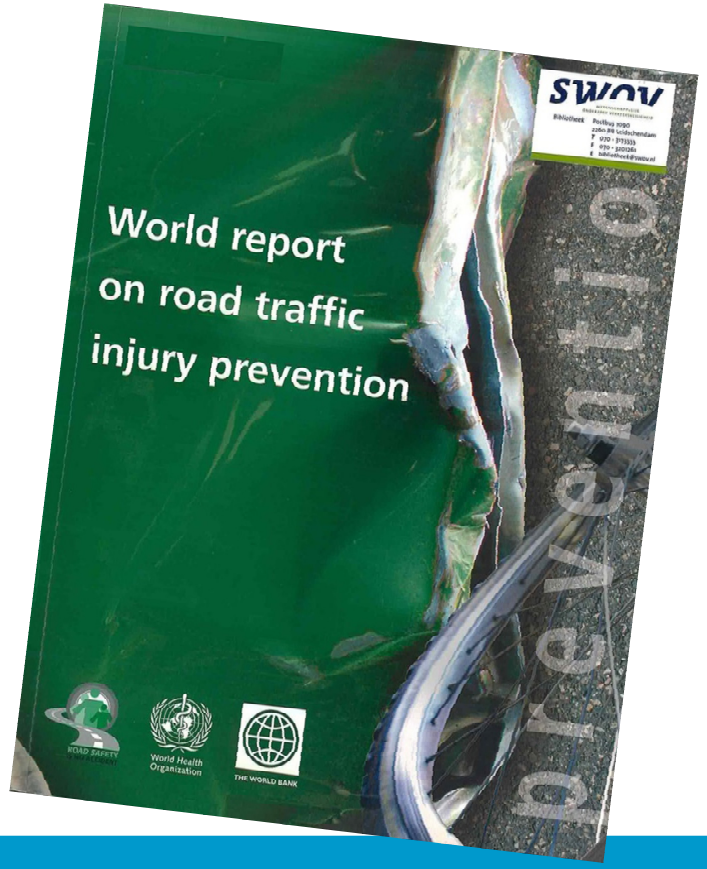
Safe system approach: an example in NL Sustainable Safety





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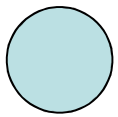
Five principles of Sustainable Safety

	Sustainable safety principles
SAFETY CONSCIOUS PLANNING	**Functionality** of roads
HUMAN CENTRED ROAD DESIGN	**Homogeneity** of masses and/or speed and direction
	Predictability of road course and road user behaviour by a recognisable road design
	Forgivingness of the environment and of road users
	State awareness by the road user



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Functional road categorization & homogeneity

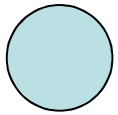
- Through roads
  - Traffic should flow

Flow = high speed: separation of mass + speed differences

- Distributor roads
  - Flow function on road sections
  - Exchange of traffic at intersections

Exchange = mixing of vulnerables: reduce speed!

- Access roads
  - Residence and exchange of traffic is central



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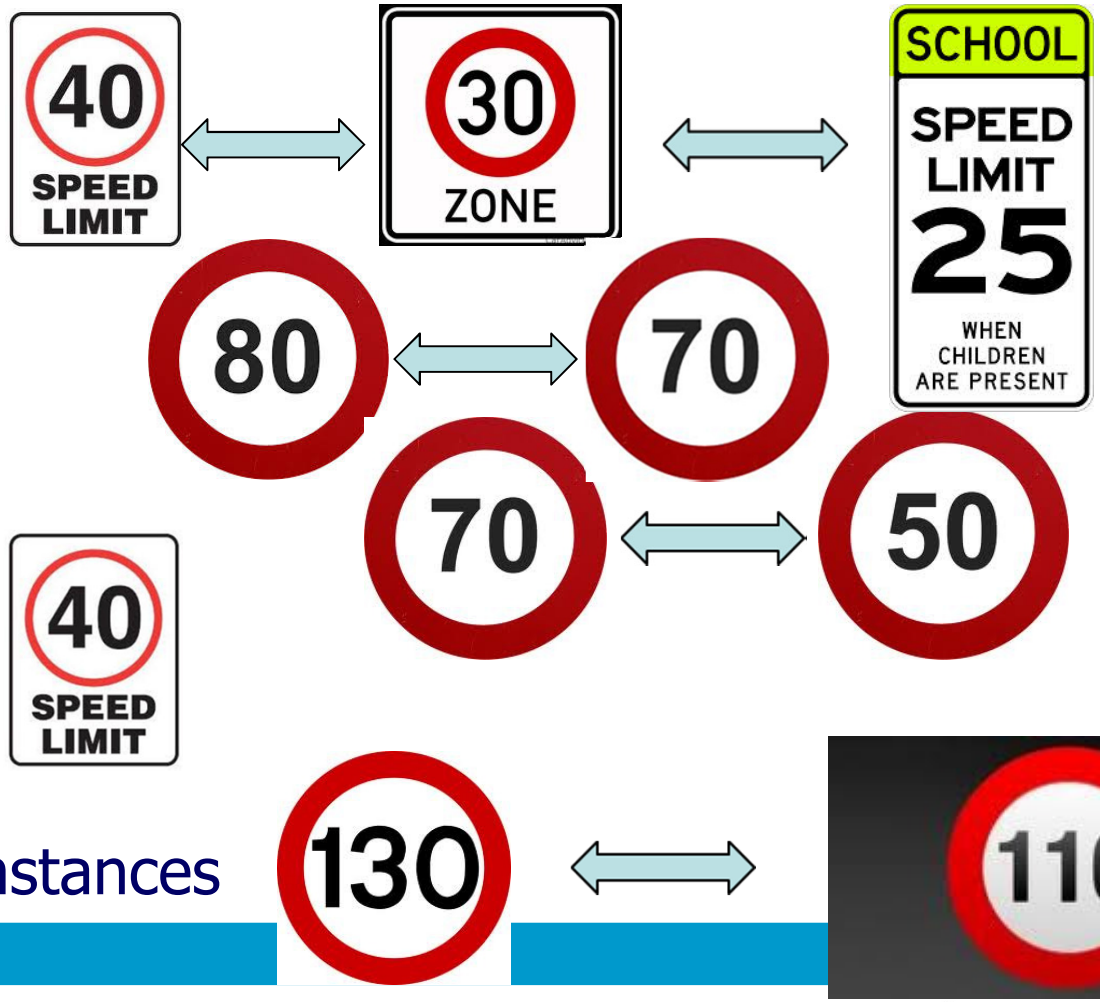
Safe speeds: coordination between vehicle manufacturers and road auth.

- Pedestrians
- Head-on
- Side
- Rear-end
- Other circumstances



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Prevent kinetic energy leading to serious injuries in a crash

- Prevention of conflicts, if speed is too high
  - Separate driving lanes for different types of traffic (speed or mass)
    - Cycle paths and sidewalks
  - Opposite driving directions with high speed: physical separation

- Conflicts unavoidable? Reduce speed!
  - Concept of safe speeds and credible speed limits
  - Lower speed limit + enforcement
  - Speed reduction at intersections
    - Roundabouts
    - Plateaus/raised intersections

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Predictable roads and traffic behaviour as basis for safe traffic

- Preventing errors by:
  - Recognizable situations: consistency in road design
  - Predictable road course: continuity in road design

- Anticipated result:
  - More routine traffic behaviour → fewer errors
  - More predictable behaviour of other road users

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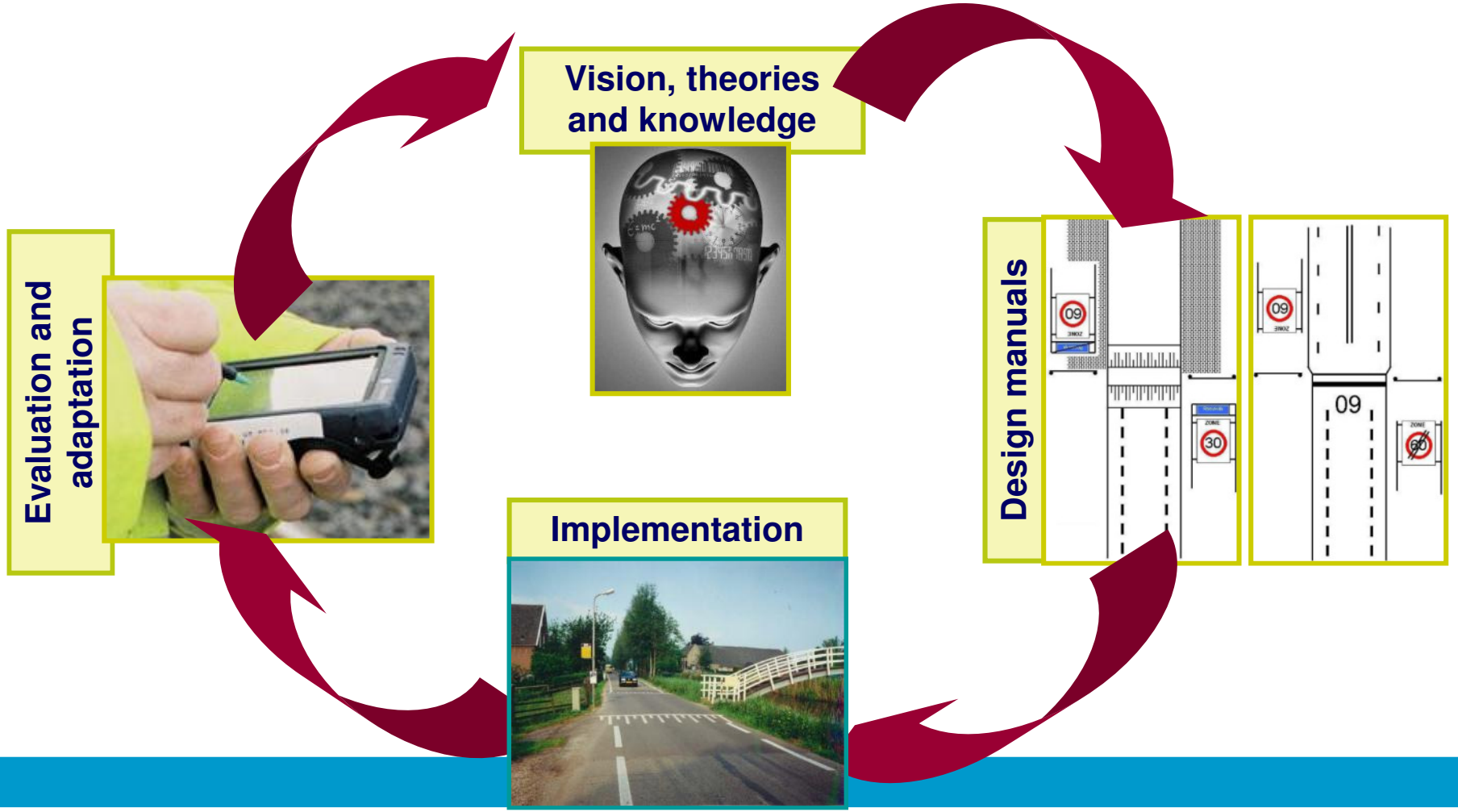
The way from vision to effective implementation



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Dutch design manuals (revised in November 2013)

- An update of the 2002-version

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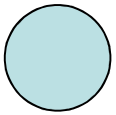
Saving lives through safer roads; a few conclusions

- A paradigm shift is needed and recommended to further improve road safety: from reactive to proactive, from 'blaming the driver' to reducing latent errors, from an ad-hoc to an integral approach, don't compromise safety: *Towards a Safe System approach*
- Define a 'minimum safety standard' for road design and include and detail this in design guidelines
- Implement a *Safe System* is a step by step approach; use demonstration projects to showcase and to learn; integrate this approach in asset management



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'Road crashes are to a large extent predictable and preventable'

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