

9<sup>ο</sup> ΔΙΕΘΝΕΣ ΣΥΝΕΔΡΙΟ για την  
ΕΡΕΥΝΑ ΣΤΙΣ ΜΕΤΑΦΟΡΕΣ  
ΜΕΤΑΦΟΡΕΣ 4.0: Η Ευφυής Εξέλιξη



9<sup>th</sup> INTERNATIONAL CONGRESS on  
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# *Safe Road Design*

*Invited speech*

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# Contents

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This presentation briefly deals with:

- Safe Road Design fundamentals
- Safe Road Design framework
- Human error
- Latent conditions
- Proposed European Union initiatives
- Discussion / Conclusions



# Safe Road Design fundamentals (1/3)

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- Safe roads is one of the Safe System interacting pillars, along with safe speeds, safe vehicles and safe road users.
- People make mistakes that lead to road crashes. The central issue in designing safe roads is to reduce the probability of errors while driving. Human body tolerance against external forces is the basic parameter in safe road design.
- There is a need for road designers to understand road user demands, needs and capabilities in relation to the system and how to adapt the properties of the system to these characteristics; concern with the latent conditions that result in system failures.
- Causes of the road safety problem can be found in shortfalls in the design and function of the present road system. *The consequences of one single misjudgment or one single mistake in road traffic can be a matter of life and death.*



## Safe Road Design fundamentals (2/3)

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- Road designers should apprehend that road design upgrades and safety treatments to reduce accidents work through their influence on human behavior. Accordingly, road designers must be aware of human factors.
- To make an appropriate design choice affecting the future safety of a road, the designer has to use the best available information about how the choice might affect future safety.
- The speed limits within the road transport system should be determined by the technical standard of vehicles and roads so as not to exceed the level of violence that the human body can tolerate. The safer the roads and vehicles, the higher the speed that can be accepted. **Safety cannot be traded for mobility.**



## Safe Road Design fundamentals (3/3)

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- Self-explaining roads, which elicit safe speeds and safe user behavior simply by their design, are a key concept in safe road design. The urgent need for roads that fit the expectations of road users, i.e. “self-explaining roads” is widely accepted. A significant step in achieving self-explaining roads is the German “design class” approach introduced in the current road design guidelines for freeways and rural roads.
- The principles of the safe road design go far beyond the design of a road according to a set of recommended values. Such values, even if met in full, do not necessarily guarantee a safe road, while the absence of some of them does not necessarily mean a road is unsafe. **Sound engineering judgment and experience are critical for a safe road design in achieving safety by design.**



# A Safe Road Design Framework



# A Safe Road Design Framework (enlargement)

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## Achieving Political Commitment and Public Support

- Apply a targeted road safety strategy owned by the government with responsibilities and accountabilities
- Shift to a Safe System approach to road safety
- Undertake community engagement to raise awareness and gain support
- Seek a road safety culture upgrade
- Involve the public in the road design and road safety audit process
- Focus on results



# A Safe Road Design Framework (enlargement)

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## Safe Road Design Guides

- Incorporate Safe System principles, focus on safe roads and kinetic energy in crashes
- Adopt the concept of “design class” as the basis for self-explaining roads which elicit safe speeds and safe user behavior simply by their design
- Provide the best available information about how design choices might affect future safety
- Integrate a road safety audit perspective in the development of the design
- Include interventions to mitigate latent conditions





# A Safe Road Design Framework (enlargement)

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## Safe Road Designers

- Adapt road design to road user demands, needs, capabilities
- Have acquired a high level of road safety knowledge and culture
- Regard safe speed as the critical design parameter
- Are concerned about latent conditions resulting in road system failures
- Understand that road design upgrades and safety treatments work through their influence on human behavior
- Apprehend that appearance of the road to the user significantly influences user behavior and expectations



## Human error (1/2)

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“Every professional should know that you need to bring into your design the failing human. If that is not your starting point when you design something hazardous, then you will fail. There is no example in history of designing something based on the human doing the right thing” (Prof. Claes Tingvall).

Two approaches to the problem of human error exist:

- **The person approach** focuses on the errors of road users, blaming them for irresponsible behavior. It is dominant in traditional road design.
- **The Safe System approach** concentrates on the conditions under which road users act and tries to build defenses to avert errors or mitigate their effects. Weaknesses in the defenses arise from two reasons: *active failures and latent conditions*.



## Human error (2/2)

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- For road systems, **active failures** are the unsafe acts committed by road users who are in direct contact with the system.
- **Latent conditions** are the inevitable “resident pathogens” within the system. These conditions (potential causes of accidents) have been created in the past by decisions made by designers, operators and managers in responsible road organizations and institutions.
- **Latent conditions** have not attracted the necessary attention and treatment action, due to the lack of risk management and a road safety audit perspective.



## Latent conditions (1/2)

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- There is not any specific reference to latent conditions for road infrastructure safety. A proposed relevant list (indicative and not exhaustive) follows:
  - Lack of road safety strategy and action plan.
  - Inadequately qualified professionals in committees for road design guidelines.
  - Outdated or inadequate road design, construction and operation guidelines.
  - Inadequate implementation of road infrastructure safety management guidelines.
  - Differing guidelines along a road corridor.

## Latent conditions (2/2)

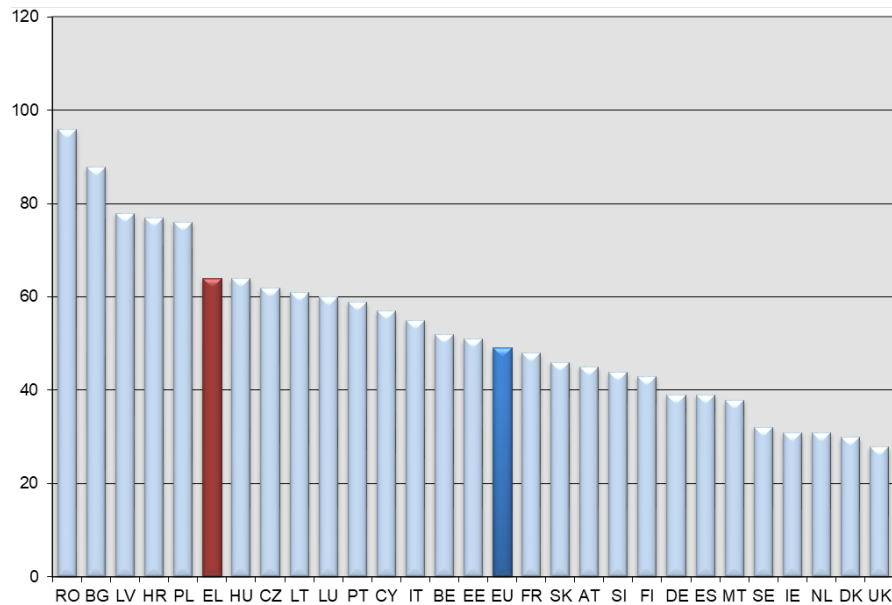
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Cont.

- Differentiation of road operation conditions from the road design assumptions
- Low-level road safety culture and commitment to road safety programs in responsible organizations
- Ineffective safety education and training of road engineers
- Joint responsibilities and uncertainties in roles
- Inadequate supervision of road design, construction and operation.



# Proposed European Union initiatives (1/3)



Road fatalities per million inhabitants, EU 28, 2018, Source: CARE

The European Union has the potential to lead the way internationally in Safe System implementation. Sweden and the Netherlands are pioneering Vision Zero / Safe System countries. Yet the situation with regard to road safety varies widely across Member States in terms of deaths in road traffic accidents per million inhabitants.

- According to the Valletta ministerial declaration on road safety (Council of the European Union, 2017), “A special effort should be made in those cases where road safety is below the European Union average, supported by close cooperation and knowledge-exchange among member states”.



## Proposed European Union initiatives (2/3)

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- **Adoption of the Safe System approach as an EU road safety strategy from now on.** The Safe System / Vision Zero approach has already been embraced in EU aviation and rail transport systems.
- A sustained commitment to the strategy at the highest EU level (European Council).
- Building a road safety culture in the EU in which safety is an inherent part of all decisions affecting the design, construction and operation of the road system; starting from **primary school** with road safety education and from transportation curricula in **Technical Universities** underpinning Safe System / safe road design courses.



## Proposed European Union initiatives (3/3)

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- Establishment of an EU Road Safety Agency similar to the EU Aviation and Rail Agencies.
- Establishment of an EU Association like AASHTO, FHWA (USA) and Austroads (Australia), preferably called “**EUroads**”.
  - ✓ Development of a **framework of EU guides** to a safe-by-design road system, integrating safety and human factor issues into road design guides.
  - ✓ Publication of **EUroads design and road safety audit guides** adopting a Safe System perspective and providing adequate guidance to road designers and practitioners.





## Discussion / Conclusions (1/2)

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- A road safety strategy based on the Safe System approach is a necessary prerequisite for safe road design.
- There is an urgent need to guide road-design engineers so that they assimilate safe road design principles and become familiar with recent human factor developments and research regarding relationships between crash frequency / severity and road design choices.
- The relevant information should be **integrated** in a concise and comprehensive way **into road design guides**. Road designers and road-safety auditors should be involved in the integration process. Further research is needed.
- The litmus test of a safe road design is how well it works for vulnerable users.



## Discussion / Conclusions (2/2)

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- Public acceptance of speed limit reduction remains a challenge and there is a need to engage more effectively with the community on the link between speed and road deaths / serious injuries.
- A community discourse must be created on speed, road risk, traffic and human tolerance to impact.
- Cities are the starting place for safe road design.
- Safe-route-to-school development is an opportunity to create a concise safe system. “Zero deaths cities” have already been achieved in some urban areas worldwide.

