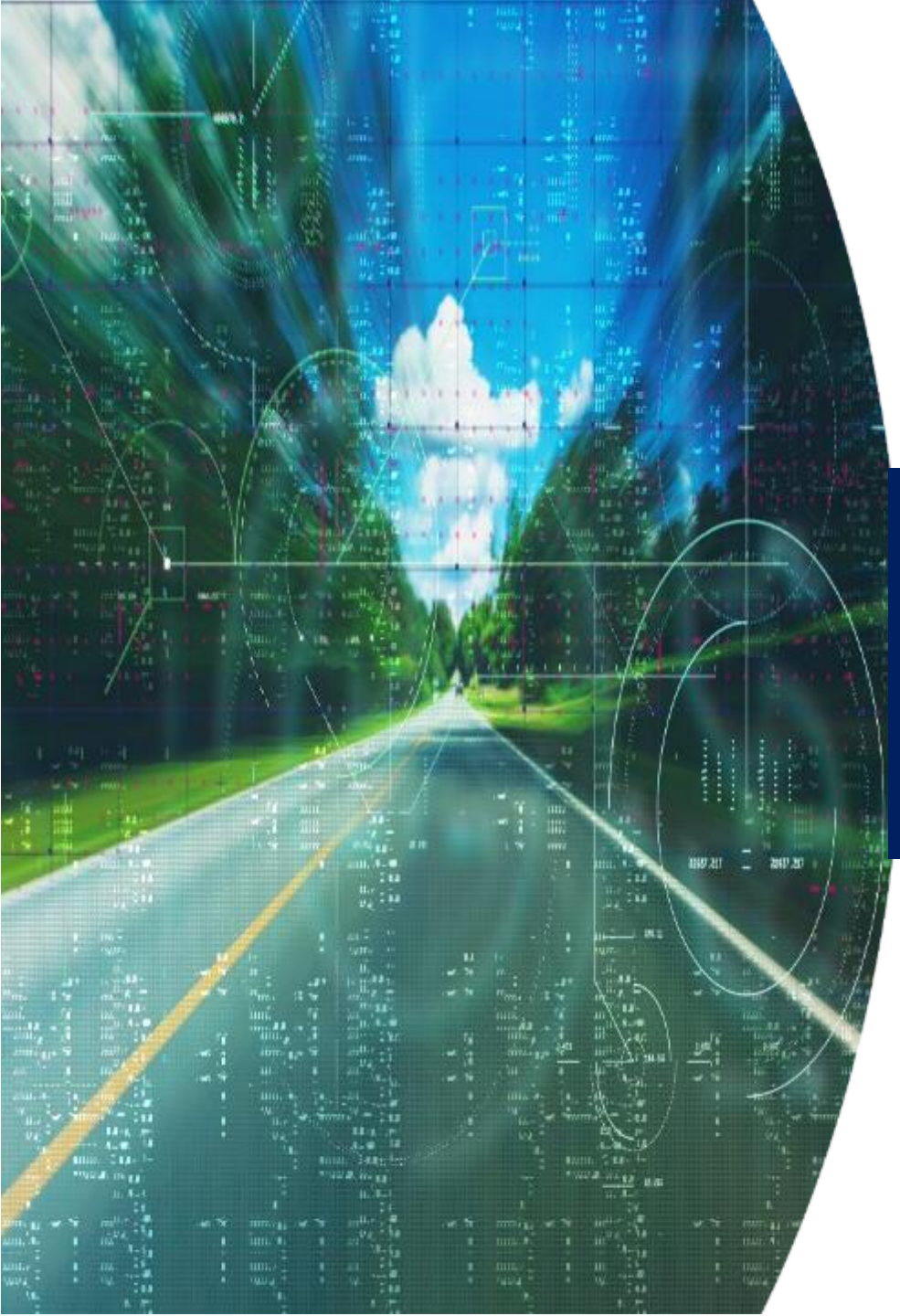

European Commission

Working Committee 3.9 "Road Safety Management" of the FGSV

October 12, 2022

Study on a Methodology for Network-wide Road Safety Assessment

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Outline

1. RISM Study
2. In-built safety assessment methodology
3. Accident occurrence methodology
4. Integrated methodology
5. Next steps

Study on a Methodology for Network-wide Road Assessment

In response to call for tenders: N° MOVE/C2/SER/2019-547

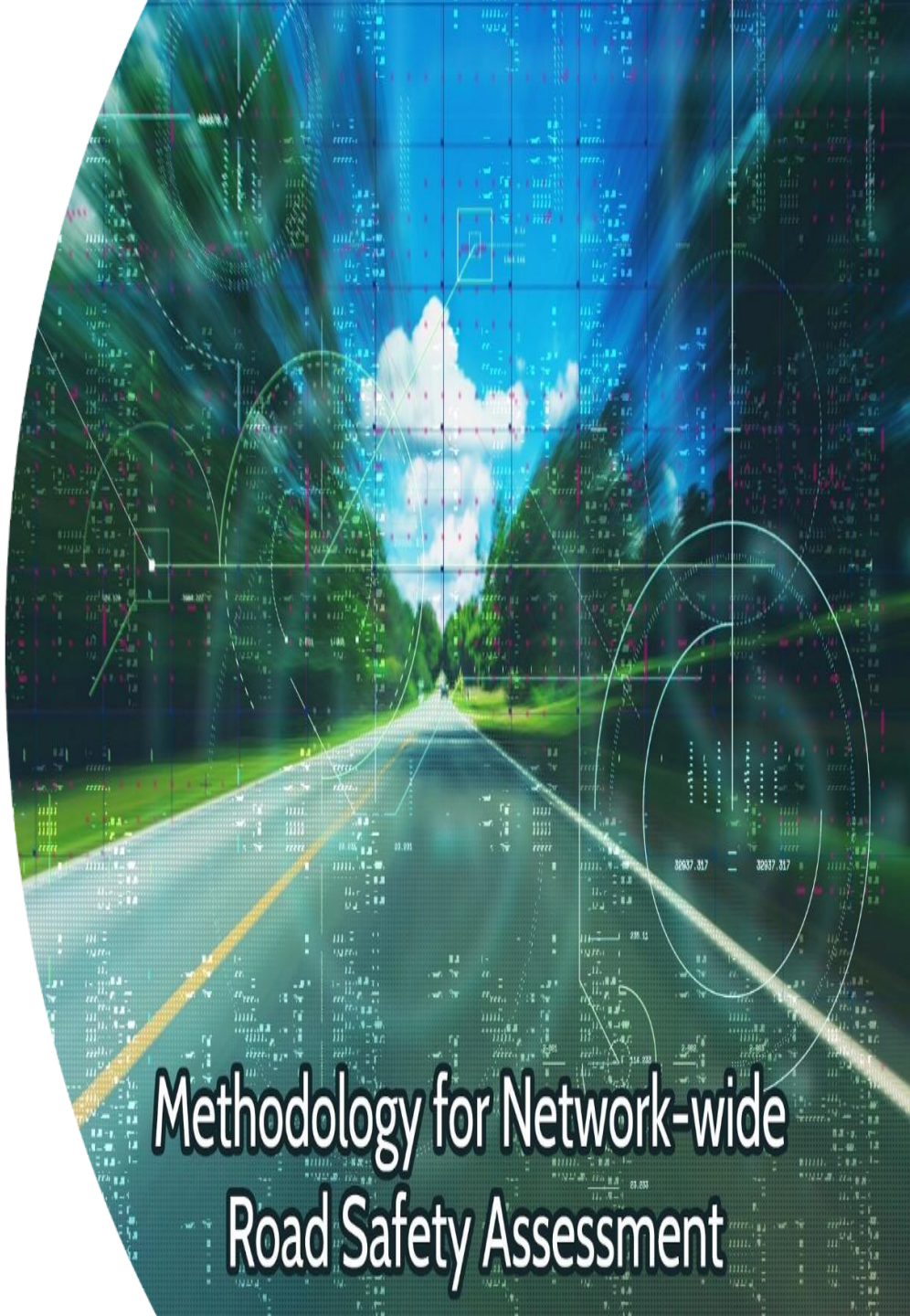
Project team

National Technical University of Athens (NTUA), Greece

University of Zagreb Faculty of Transport and Traffic Sciences (FPZ), Croatia

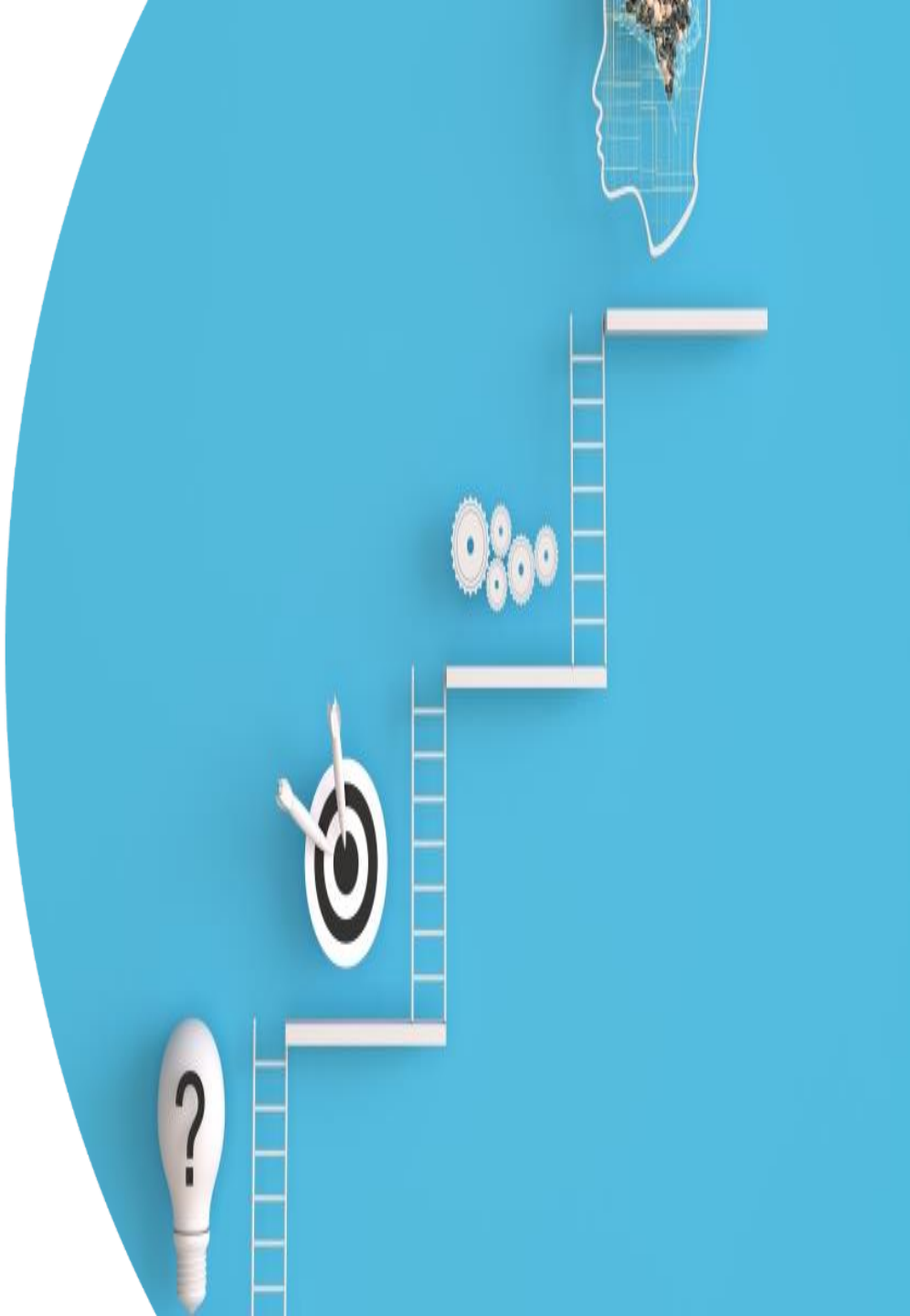
FRED Engineering s.r.l. (FRED), Italy

Project duration: September 2020-August 2023



Project status

- First steps:
  - Extensive review of relevant literature and applied practices in EU and internationally
  - Questionnaire survey to Member States and stakeholders.
- Development of a Network-Wide Assessment (NWA) methodology for motorways and primary roads, with distinct parts:
  - Assessment of "in-built"safety (proactive approach)
  - Assessment of crash occurance (reactive approach)
  - Integration of results
- Several rounds of methodology review and revision to achieve consensus of Member States (through EGRIS - Expert Group on Road Infrastructure Safety).
- Currently, the methodology is pilot tested in all Member States, in order to assess it in realistic conditions and finalize it.



2. In-built safety assessment methodology

Developing a methodology for the in-built safety assessment of roads

- Identification of appropriate road characteristics, i.e., a set of parameters, that affect network-level safety, according to relevant scientific literature and applied practices but also considering data availability.
- Identification of a scientifically sound relationships between the set of parameters and expected safety outcomes.
- Achieve a balance between accuracy and level of detail, without being overly data-intensive and costly to use.
- Consider the needs of Member States (e.g., data availability, design standards).

Proposed framework (1/2)

- Using a set of design and operational characteristics each one corresponding to a parameter, a road section is assessed. A perfectly safe road section is rated with a maximum score of 100 points. Reductions are applied for each identified unsafe condition.
- A CMF value lower than 1, or "Reduction Factor" (RF), is estimated per parameter to represent identified unsafe conditions. For safe conditions RF=1.
- The score for the road section i is estimated based on the formula:

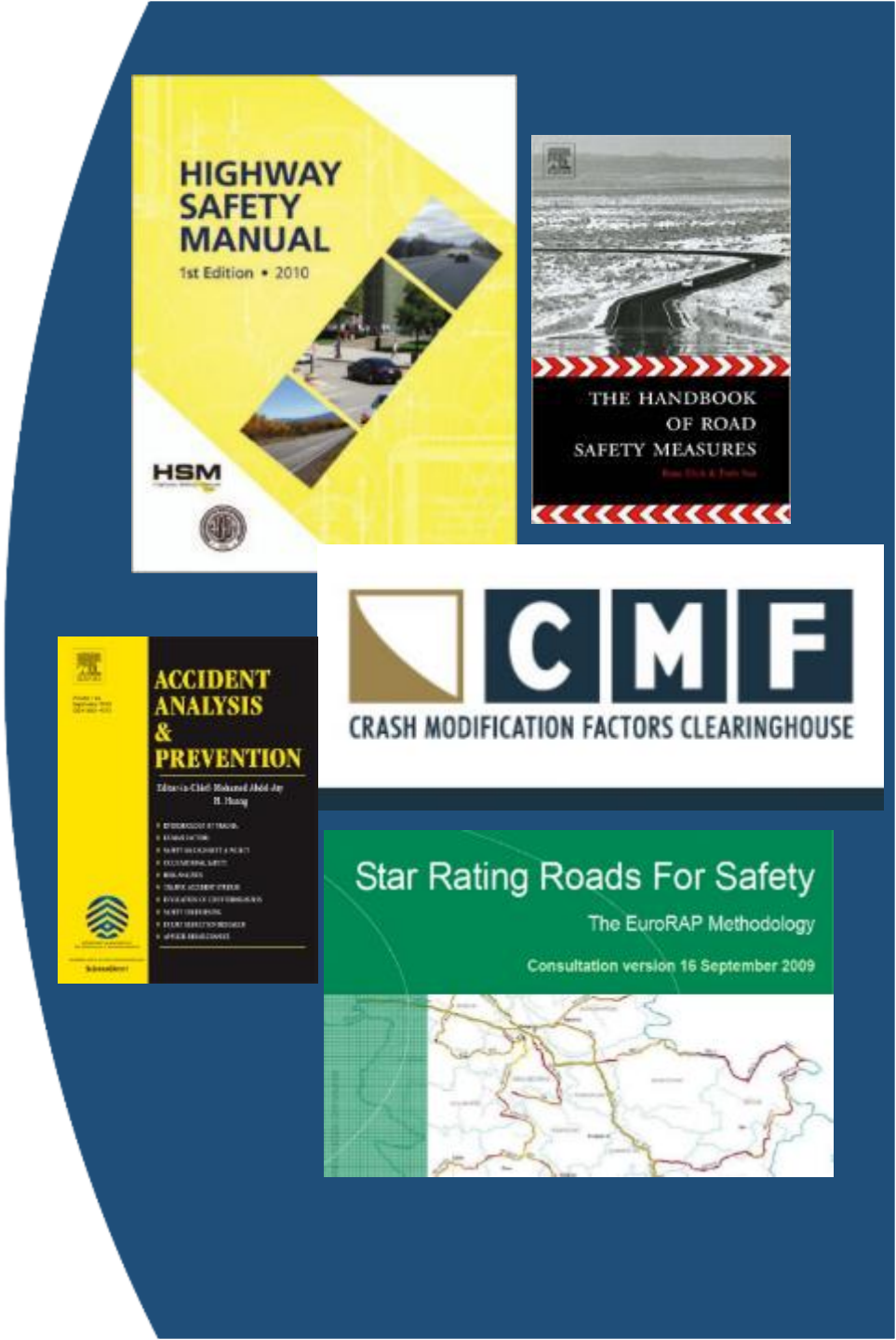
$$Score_i = 100 \times RF_{1i} \times RF_{2i} \times \cdots \times RF_{ni}$$

Proposed framework (2/2)

- Each road section is classified in one out of 3 classes based on the scoring:
  - High Risk (class 3)
  - Intermediate (class 2)
  - Low Risk (class 1)
- A section is defined as a road stretch consisting of road segments and junctions.
- Four distinct road types considered:
  - Rural motorways
  - Urban motorways
  - Primary divided roads (rural by definition)
  - Primary undivided roads (rural by definition)
- Scoring and classification between road types is not comparable.

Quantification of parameters' safety impact

- Identification of appropriate Crash Modification Factors (CMFs) based on international literature:
  - AASHTO Highway Safety Manual 2010, 2014
  - CMF Clearing House (individual studies)
  - PRACT Repository (individual studies)
  - The Handbook of Road Safety Measures, Elvik et al. (2009)
  - iRAP Factsheets (Star Rating Protocol)
- Reviewed studies include CMFs for all injury accidents at motorways and primary rural roads.
- Subsequent adjustments made, where appropriate, according to feedback from EGRIS.



Parameters used for the in-built safety assessment of roads

Based on the feedback from EGRIS Members as well the existing safety literature, the proactive methodology considers the following parameters for the assessment of motorways and primary roads:

#	Parameter
	MOTORWAYS
1	Lane width *
2	Roadside (clear zone width, obstacles, presence of barriers)
3	Curvature *
4	Interchanges *
5	Conflicts between pedestrians/ bicyclists and motorized traffic
6	Traffic operation centers and / or mechanisms to inform users for incidents
7	Lighting *(TBD)*
	PRIMARY ROADS
1	Lane width **
2	Roadside (clear zone width, obstacles, presence of barriers) **
3	Curvature
4	Density of property access points **
5	Junctions
6	Conflicts between pedestrians/ bicyclists and motorized traffic
7	Shoulder type and width **
8	Passing lanes **
9	Signs and markings
10	Lighting *(TBD)*

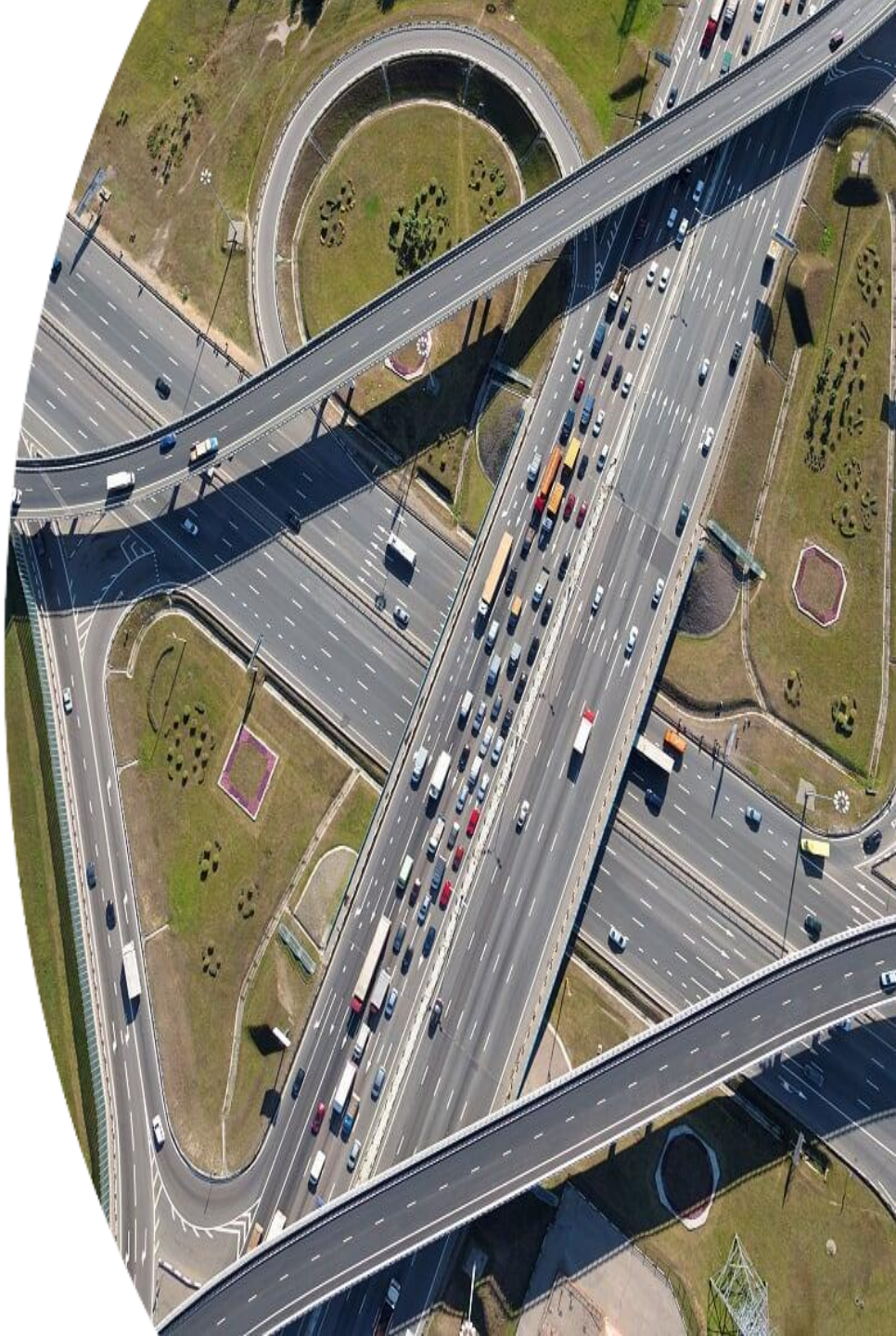
* *Different assessment between urban and rural motorways*

** *Different assessment between (primary) divided and undivided roads*

3. Accident occurrence analysis methodology

Developing a methodology for accident occurrence analysis

- Across Member States, it was found that different accident occurrence methods are used.
- They vary in terms of safety performance metric (e.g., accident rate), safety ranking, type of accidents used for the analysis, etc.
- Modular approach: combination of possible methods for each step allowing flexibility to Member States to implement the method that is more compatible to
  - existing data
  - available budget
  - previous experience



Proposed framework (1/4)

1. Network segmentation

- Section lengths have been proposed per road type.
- The sections are homogeneous.
- Three approaches are proposed to deal with junctions:
  - 1st approach: midpoint of the junction as the section limit
  - 2nd and 3rd approaches: boundary of the area of influence of the junction as limit of the section

Proposed framework (2/4)

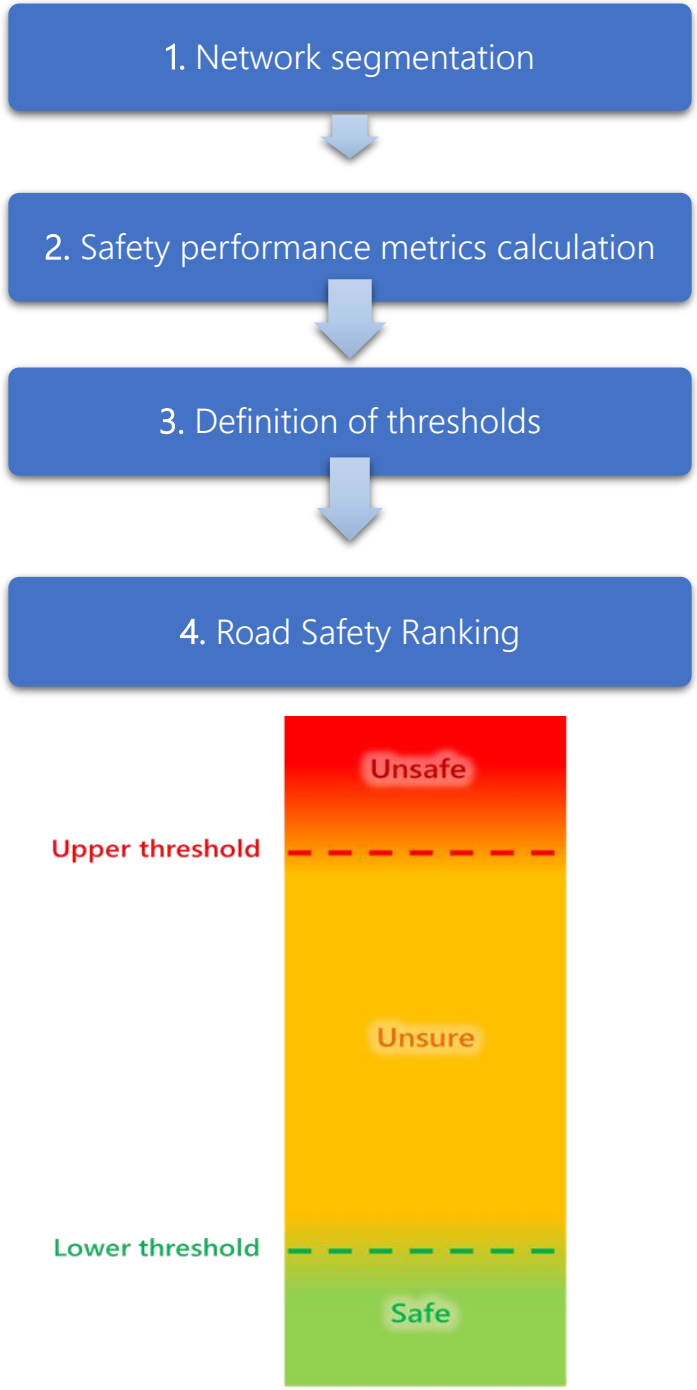
2. Safety performance metric calculation

- **Accident data** should be available for at least three years to implement the methodology.
- The number of accidents with **fatalities and injuries** are considered.
- Accident density is estimated for each section. Additionally, depending on traffic volume data availability, it is proposed to use **accident rates** (accidents per million vehicle km).
- Future:
  - common definition AIS → accidents with serious injuries (MAIS 3+) and fatalities
  - Use of accident rates

Proposed framework (3/4)

3. Definition of critical thresholds

- Accident density thresholds are defined for each reference population (e.g., rural motorways)
- They are defined using the Poisson method
- Based on the confidence level (e.g., 5% and 95%), two thresholds are defined:
  - Upper
  - Lower
- If traffic data are available, using the accident density thresholds, thresholds are defined for **accident rate**.



Proposed framework (4/4)

4. Road Safety Ranking

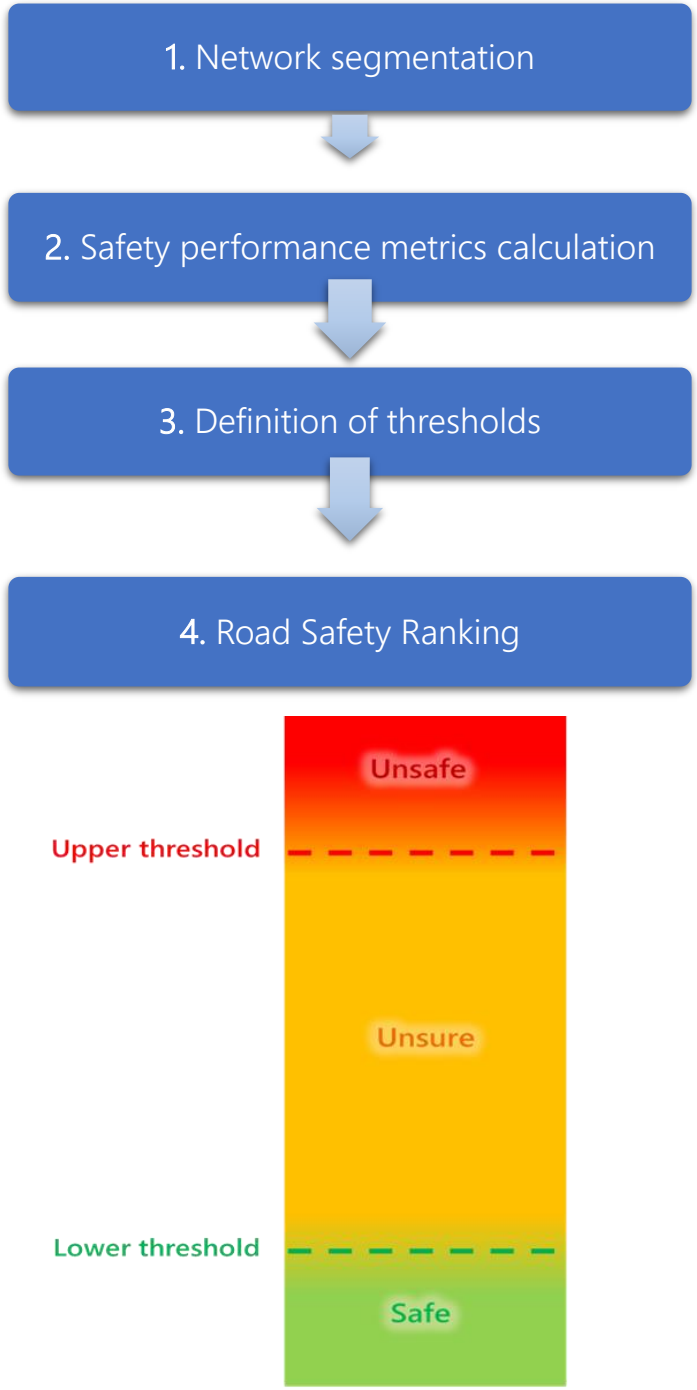
- Based on the two upper and lower threshold values, the accident rate and accident density thresholds are determined:

  Class 3: High Risk section: value of the metric exceeding the upper threshold

  Class 2: Unsure section: value of the metric between the two thresholds. It is not clear if a section is safe/unsafe.

  Class 1: Low Risk section: value of the metric below the lower threshold

- **Output**: the sections is classified based on the most conservative outcome.



4. Integration of the proactive and reactive methodologies

Overview

- The objective of the integrated methodology is to combine the proactive and reactive methodologies.
- The integrated methodology will determine the final safety ranking of a road section, and in turn, of the network.
- Two main things needed to be determined:
  - The number of safety classes to be considered
    - *According to the RISM Directive they have to be at least three classes*
  - A rule to determine whether the proactive or the reactive methodology should be prioritized over the other.

Integration of proactive and reactive methodologies

- It has been proposed to apply a 5-class ranking system for combining the results of the proactive (3 classes) and reactive (2 classes + unsure + no data) methodologies.

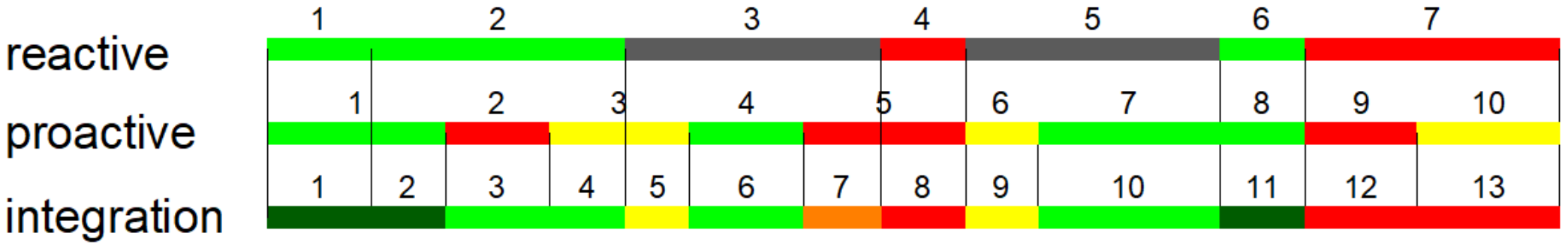
Very High Priority (class 5)	High Priority (class 4)	Intermediate Priority (class 3)	Low Priority (class 2)	Very Low Priority (class 1)

- The Reactive Assessment (when data is available and it can be completed) is prioritized over the Proactive:

PROACTIVE ASSESSMENT RESULTS \ REACTIVE ASSESSMENT RESULTS	High Risk (class r3)	Unsure (class r2)	No Data	Low Risk (class r1)
High Risk (class p3)	Very High Priority (class 5)	High Priority (class 4)	High Priority (class 4)	Low Priority (class 2)
Intermediate Risk (class p2)	Very High Priority (class 5)	Intermediate Priority (class 3)	Intermediate Priority (class 3)	Low Priority (class 2)
Low Risk (class p1)	Very High Priority (class 5)	Low Priority (class 2)	Very Low Priority (class 1)	Very Low Priority (class 1)

Visual combination of findings

- The Proactive and Reactive methodologies may use different segmentation approach.



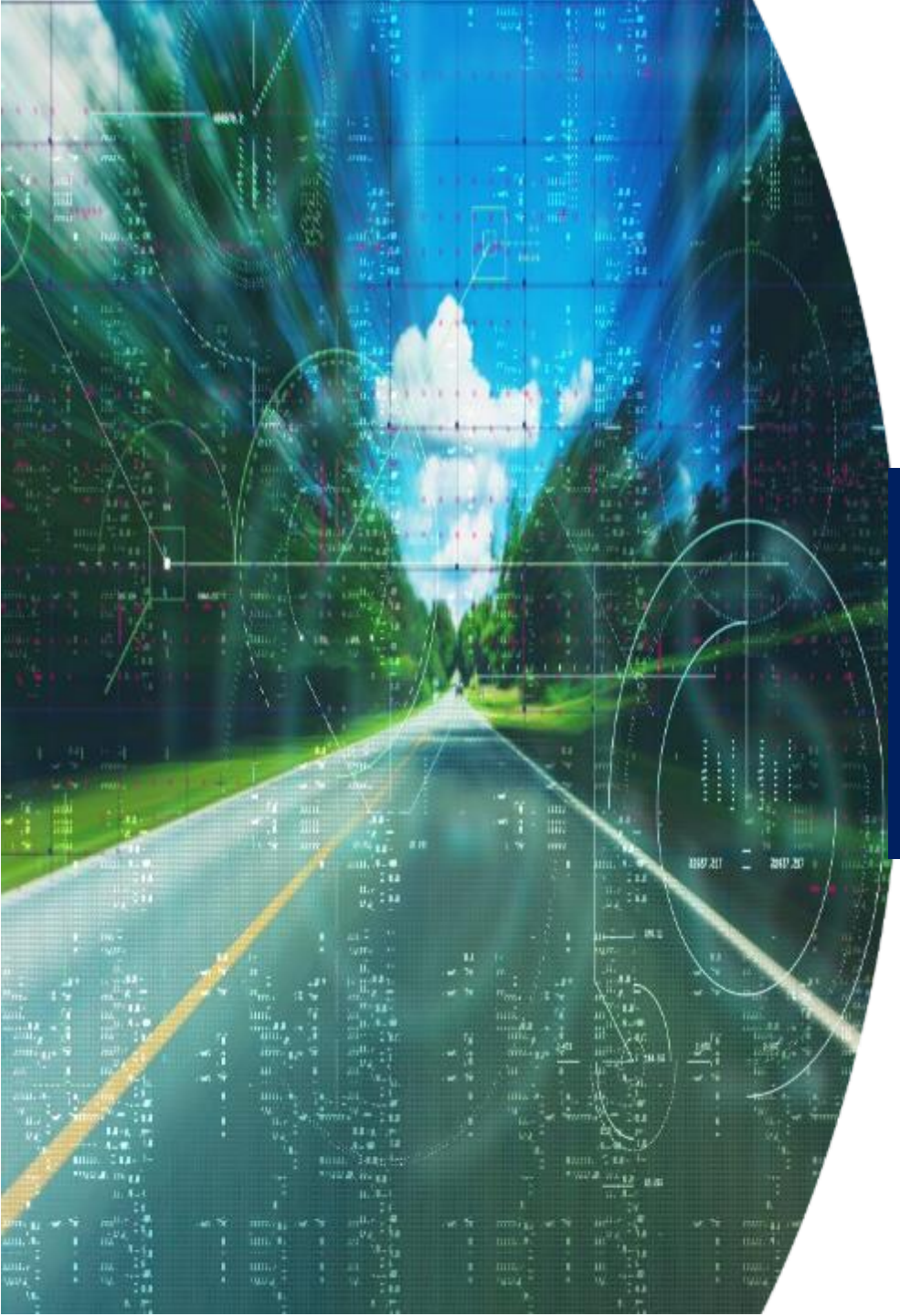
5. Pilot Implementation & Next Steps

Pilot Implementation - Next Steps

- The developed methodology is currently pilot tested in Member States.
- Up to now (October 2022), assessment results are available for:
  - 28 kms of urban motorways *
  - 481 kms of rural motorways *
  - 124 kms of primary divided roads *
  - 291 kms of primary undivided roads

  spreading over 8 European Countries
- The methodology will be finalized after the completion of the pilot studies.

** assessment length refers to single direction of travel*



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