CEDR WG Road Safety
Network-wide Road Safety Assessment (Article 5) of RISM II
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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
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, for example:
  - barrier presence and safe roadside are important.
  - the presence of an uncovered barrier end does not affect network-level safety, although it’s important for the specific site.

- Identification of a **scientifically sound relationship** between the set of parameters and 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 1)
  - **Medium Risk** (class 2)
  - **Low Risk** (class 3)

- **Scoring and classification** between motorways and primary roads is **not comparable**.

- Differentiation between **rural and urban motorways** is considered.

- A section is defined as a road stretch consisting of road segments and junctions.
Quantification of parameters’ safety impact

- Identification of appropriate Crash Modification Factors (CMFs) based on international literature:
  - 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

<table>
<thead>
<tr>
<th>Number</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOTORWAYS</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Lane width *</td>
</tr>
<tr>
<td>2</td>
<td>Roadside (clear zone width, obstacles, presence of barriers)</td>
</tr>
<tr>
<td>3</td>
<td>Curvature *</td>
</tr>
<tr>
<td>4</td>
<td>Interchanges *</td>
</tr>
<tr>
<td>5</td>
<td>Conflicts between pedestrians/ bicyclists and motorized traffic</td>
</tr>
<tr>
<td>6</td>
<td>Quality of signs and markings</td>
</tr>
<tr>
<td>7</td>
<td>Presence of traffic operation center and mechanisms to inform users for incidents</td>
</tr>
<tr>
<td>8</td>
<td>Lighting (TBD)</td>
</tr>
<tr>
<td><strong>PRIMARY ROADS</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Median separation</td>
</tr>
<tr>
<td>2</td>
<td>Lane width</td>
</tr>
<tr>
<td>3</td>
<td>Roadside (clear zone width, obstacles, presence of barriers)</td>
</tr>
<tr>
<td>4</td>
<td>Curvature</td>
</tr>
<tr>
<td>5</td>
<td>Density of property access points</td>
</tr>
<tr>
<td>6</td>
<td>Junctions</td>
</tr>
<tr>
<td>7</td>
<td>Conflicts between pedestrians/ bicyclists and motorized traffic</td>
</tr>
<tr>
<td>8</td>
<td>Shoulder type and width</td>
</tr>
<tr>
<td>9</td>
<td>Passing lanes</td>
</tr>
<tr>
<td>10</td>
<td>Shoulder type and width</td>
</tr>
<tr>
<td>11</td>
<td>Lighting (TBD)</td>
</tr>
</tbody>
</table>
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)

**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

1. Network segmentation
2. Safety performance metrics calculation
3. Definition of thresholds
4. Road Safety Ranking
Proposed framework (2/4)

Safety performance metric calculation

- **Accident data** should be available for at least three years to implement the methodology.
- The number of **fatalities and injuries** are considered.
- Depending on traffic volume data availability, it is proposed to use **accident rates** (accidents per million vehicle km).
- Alternatively, the proposed safety performance metric is the **accident density** (accidents per km).
- **Future:**
  - common definition AIS → accidents with serious injuries (MAIS 3+) and fatalities
  - Use of accident rates
Proposed framework (3/4)

Definition of critical thresholds

1. If traffic data are available:
   - **Threshold:** Critical accident rate (Quality Control method)
   - Specific threshold for each section/junction

2. If traffic data are not available (i.e., use of accident density):
   - **Threshold:** Critical value (Poisson method)
   - Specific threshold for each reference population (e.g., divided rural roads)
   - Based on the confidence level, two thresholds are defined:
     - Upper
     - Lower
Proposed framework (4/4)

- Based on the two upper and lower threshold values, the **accident rate** and **accident density thresholds** are determined:
  
  **Unsafe section**: value of the metric exceeding the upper threshold
  
  **Unsure section**: value of the metric between the two thresholds. It is not clear if a section is “safe”/“unsafe”.
  
  **Safe section**: value of the metric below the lower threshold
  
- **Output**: a classification for accident density and a classification for accident rate
4. Integration of the proactive and reactive methodologies
Integrated methodology - 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 (1/2)

The integrated approach is proposed to apply a 3-class ranking system similarly to the number of ranking classes in the proactive and reactive methodologies.

**A. Roads with no accident data** (i.e., roads with no/low accident data availability or low accident data quality)
- Rely on the proactive score

**B. Roads with sufficient accident data**:
- Reactive score = Unsafe $\rightarrow$ Road Safety Inspection
- Reactive score = Safe $\rightarrow$ Use proactive score to prioritize Road Safety Inspection
- Reactive score = Unsure $\rightarrow$ Rely on the proactive score

<table>
<thead>
<tr>
<th>Proactive methodology</th>
<th>Reactive methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe (class 3)</td>
<td>Safe (class 3)</td>
</tr>
<tr>
<td>Intermediate (class 2)</td>
<td>Intermediate (class 2)</td>
</tr>
<tr>
<td>Unsafe (class 1)</td>
<td>Unsafe (class 1)</td>
</tr>
<tr>
<td>Not applicable (e.g. no/ unreliable accident data)</td>
<td>Not applicable (e.g. no/ unreliable accident data)</td>
</tr>
</tbody>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
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<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Integration of proactive and reactive methodologies (2/2)

- The **right column** describes cases with **no accident data**, where the use of **proactive methodology** is the only way to assess safety.

- **Consensus** between the two methodologies: when a section is “Safe” or “Unsafe” based on both methodologies, then it corresponds to Classes 3 and 1, respectively.

- A **prioritization rule** is needed when the two methodologies produce different results:
  - Sections found “Unsafe” based on the reactive methodology, belong in Class 1 regardless of the proactive assessment score.
  - Sections found “Safe” based on the reactive methodology, yet the proactive approach indicates safety deficiencies (Unsafe/intermediate), then they are classified in Class 2 and are in second priority for detailed inspection.

- When the reactive approach is “unsure”, the proactive is used.

<table>
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<th>Safe (class 3)</th>
<th>Unsure (class 2)</th>
<th>Unsafe (class 1)</th>
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<tbody>
<tr>
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<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate (class 2)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Unsafe (class 1)</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Flow chart presenting the steps for conducting NWA in motorways and primary rural roads.

A document with guidelines will be developed to guide authorities step-by-step.
5. Next steps
Ongoing Study Activities

- Currently, a revised version of the NWA methodology is being developed, to address comments from EGRIS.

- Guidance document and assessment excel tool are developed in parallel.

- The developed methodology will be pilot tested in all Member States.

- The pilot studies are expected to result in technical improvements of the methodology but also assist in better shaping the guidelines for its implementation.

- The methodology will be finalized after the completion of the pilot studies (summer of 2023).
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