How the European Road Safety Decision Support System can help to improve urban traffic safety

Wendy Weijermars (SWOV), SafetyCube project
www.roadsafety-dss.eu
The SafetyCube project

Funded by the European Commission under the Horizon 2020 research framework programme

Coordinator: Pete Thomas, Loughborough University

Start: May 2015
Finish: April 2018

17 partners from 12 EU countries
The SafetyCube Dream

To provide the European and Global road safety community with a **user friendly, web-based, interactive Decision Support Tool** to properly substantiate their road safety decisions for the actions, measures, programmes, policies and strategies to be implemented at local, regional, national, European and international level.
European Road Safety DSS

• **User friendly** and **web-based** decision support system

• One-stop shop for **evidence** on **risks and measures** regarding **all aspects of road safety**
Intended users

- Public Authorities/policy makers
  local, regional, national, European and international
- Industry
  Infrastructure, Vehicle, Insurance, Technology
- Research Institutes, Experts
- Non Governmental Organizations
- Mass Media
- Everyone
This presentation

• SafetyCube methodology
• DSS design
• Live demonstration
• Questions that can be answered using the DSS
• Added value of the European road safety DSS
SafetyCube methodology
Risk factors and measures

1. Creating **taxonomies** of risk factors and measures
2. Exhaustive literature review and selection of studies
3. **Coding studies**, using a dedicated coding template
4. Carrying out meta-analyses, vote-count analysis or descriptive analysis to estimate the effects of risk factors / measures
5. Drafting **Synopses** summarising results
SafetyCube Taxonomies

- Three-level taxonomies, separately for risks and measures

- **4 Categories**: road user, infrastructure, vehicle, post impact care
- **88 Topics** e.g. distraction, roadside, crashworthiness
- **175 Specific topics** e.g. mobile phone use, no clear-zone, low pedestrian rating (NCAP)
Selecting and Coding Studies

Study search in key databases
(Scopus, TRID, Elsevier, Taylor & Francis, Springer etc.)

Study selection and prioritization criteria
• Studies with quantitative results
• Meta-analyses, or other high quality studies (peer-reviewed journals)
• Recent studies
• European studies

Coding of studies in a dedicated template
• Study design and methodology
• Results and their confidence intervals
• Study limitations
# Coding template

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Source</th>
<th>URL</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Risk factor or Countermeasure?</th>
<th>Risk factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WPS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trucks / Bus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crashworthiness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compatibility (self protection / partner protection)</td>
<td></td>
</tr>
</tbody>
</table>

| Abstract | Crash aggressivity (CA), along with conventional crash worthiness (CW), has been recently proposed. Crash-comparing, Crash aggressivity, Bayesian Hierarchical model, Ordinal regression model, Study area: Florida, USA. |

<table>
<thead>
<tr>
<th>Keywords</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash aggressivity</td>
<td>Crash-comparing</td>
</tr>
</tbody>
</table>

| Sampling frame | Countries | United States | Regional | |
|----------------|-----------|---------------|----------|
|                | Administrative Level |             |           | |
|                | Road user profile - Modes | Driver |           | |
|                | Road user profile - Type |           |           | |
|                | Road user profile - Subgroup |         |           | |
|                | Road user profile - Age | 12-65 | 65+ |  |
|                | Road user profile - Gender | Male | Female | |
|                | Road network profile - Area |             |           | |
|                | Road network profile - Segments |             |           | |
|                | Accident severities |             |           | |
|                | Study area | Florida, USA |           | |

| Design | Features | Observational | | |
|--------|-----------|---------------|---|
|        | Direction | Exposure > Outcome | Crashworthiness index |

<table>
<thead>
<tr>
<th>Measure of effect/association</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log odds of higher severity</td>
<td>0.1200</td>
<td>0.3900</td>
<td>0.4600</td>
<td>0.6000</td>
<td>0.3100</td>
</tr>
<tr>
<td>Log odds of higher severity</td>
<td>0.3400</td>
<td>0.8300</td>
<td>0.9400</td>
<td>0.9900</td>
<td>0.9700</td>
</tr>
<tr>
<td>p-value</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Confidence level</td>
<td>44472</td>
<td>44472</td>
<td>44472</td>
<td>44572</td>
<td>44752</td>
</tr>
<tr>
<td>Lower limit</td>
<td>0.2900</td>
<td>0.3400</td>
<td>0.3100</td>
<td>0.3400</td>
<td>0.2900</td>
</tr>
<tr>
<td>Upper limit</td>
<td>0.4000</td>
<td>0.6000</td>
<td>0.7000</td>
<td>0.8000</td>
<td>0.9000</td>
</tr>
</tbody>
</table>

| Adjustment variables/Covariates | Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; Driver age; Driver gender; |

| Conclusion | Significant negative effect or significant negative effect (significant negative effect on significant negative effect) |

| Comments | Estimation sample mean; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; Standard error of estimate; |

<table>
<thead>
<tr>
<th>Effect 1</th>
<th>Effect 2</th>
<th>Effect 3</th>
<th>Effect 4</th>
<th>Effect 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van</td>
<td>Light truck</td>
<td>Medium truck</td>
<td>Heavy truck</td>
<td>Truck tractor</td>
</tr>
<tr>
<td>Car</td>
<td>Car</td>
<td>Car</td>
<td>Car</td>
<td>Car</td>
</tr>
</tbody>
</table>
Synopses

> **210 Syntheses** on risk factors / measures

- **Summary (2 pages) including colour code**
- **Scientific overview (4-5 pages):**
  - *Comparative analysis of available studies:*
    - **Meta-analysis**
    - **Vote-count analysis**
    - **Qualitative analysis**
- **Supporting document (3-10 pages)**
  - *Literature search strategy and study selection criteria*
  - *Detailed analysis*
Quality Assurance

Four step process to QA:

1. **Guidelines**, supported by workshops, webinars, Q&A sessions assisted the expert SafetyCube researchers.

2. **Internal peer review**. The selection and coding of studies, and synopses of the findings, were peer reviewed within each work package.

3. **Independent expert review**. Independent experts reviewed the synopses and coding sheets, applying a set of predefined quality criteria. One expert specifically looked at consistency within and between synopses.

4. **Proof reading**. All synopses went through a language check by a native English speaker.
Linking between risks and measures

- A theoretical framework for linking risk factors and measures
  - based on a crash chain model
  - applied through existing expert knowledge
- Links are integrated in the DSS to explore and identify a range of potential measures
- The DSS contents “validate” or “conditionalize” the links, assist to understand the conditions of measures effectiveness and flag the sources of uncertainty.
Accident scenarios

Accident categories / Scenarios
The accident categories available in SafetyCube are an example of accident configurations that are currently used to identify road safety issues (see below). For each scenario, a detailed synopsis was built, using in-depth French data.

Example: Pedestrian-related scenarios
Cost Benefit analysis

• Allows socio-economic evaluation of measures:
  – Benefits: costs of crashes prevented by measure (+ side effects)
  – Costs: costs of measure (+ side effects)

• Collection and standardisation of crash costs in all European countries
• 37 cost-benefit analyses (including sensitivity analysis)
  – 2 page PDF, summarizing input information, Benefit/Costs ratio and results of sensitivity analysis
Information on costs of crashes

- Guidelines: which cost components to include and how to calculate costs
- Costs of crashes in different EU countries
- (Standardized) Crash cost estimates for EU
Serious road injuries (MAIS3+)

- Assessment of current practices concerning estimation of MAIS3+ casualty numbers and consequences of methodological differences
- Physical, psychological and socio-economic impacts and burden of injury of non-fatal injuries
- Assessment of costs related to serious road injuries
- Selection of groups of casualties with relatively many MAIS3+ casualties and determination of relevant risk factors
Serious road injuries (MAIS3+)
DSS design
DSS Design Principles

• A Modern web-based tool
• Highly Ergonomic interface
• Simple structure
• Powerful Search Engines
• Fully Documented information
• Easily Updated
DSS Search Engine

• Fully linked search
  – search a road safety problem alone or through the measures
  – search a measure alone or through the road safety problems
  – search for risks and measures related to specific road user groups or crash types (accident categories)
• Fully detailed search
  – search by any parameter in each data table in the database
• Fully flexible search
  – adjust and customize search according to results
• Fully documented search
  – access background information at any stage (supporting documentation, links, etc.)
The SafetyCube DSS is the European Road Safety Decision Support System, which has been produced within the European research project SafetyCube, funded within the Horizons 2020 Programme of the European Commission, aiming to support evidence-based policy making. The SafetyCube Decision Support System provides detailed interactive information on a large list of road accident risk factors and related road safety countermeasures. A Quick Guide on using the SafetyCube DSS, with instructions on how to browse the system, make a search and further refine the results, is available for download here.

SafetyCube (Safety CaUsation, Benefits and Efficiency) is a research project funded by the European Commission under the Horizons 2020, the EU Framework Programme for Research and Innovation, in the domain of Road Safety. The project started on May 1st, 2015 and will run for a period of three years.

The primary objective of the SafetyCube project is to develop an innovative road safety Decision Support System (DSS) that will enable policy-makers and stakeholders
DSS main menu

- **Search**
  Risk Factors & Measures

- **Knowledge**
  Synopses, Serious Injuries, Accident Scenarios

- **Calculator**
  Economic Efficiency Evaluation

- **Methodology**
  System documentation

- **Support**
  Contact, help, feedback
Entry points for DSS search

- Keyword search
  (all database keywords)
- Risk factor search
  (taxonomy)
- Measures search
  (taxonomy)
- Road User Groups
  (database keywords related to each group)
- Accident Categories
  (links between accident categories and risk factors and measures)
Three level Structure

1. **Search** (5 entry points)
2. **Results** pages (colour codes, synopses, overview of coded studies, link to related risk factors or measures)
3. **Individual Studies** pages
Live demonstration – part I

https://www.roadsafety-dss.eu/#/
DSS Calculator

Main Functions

• Perform cost-benefit analysis with own input data.

• Select (and adapt) one of the SafetyCube examples
Live demonstration – part II

https://www.roadsafety-dss.eu/#/
Questions that can be answered using the DSS
Q1) Which countermeasure is not effective and might even increase risk?

- a) licence suspension
- b) pedestrian skills training for children
- c) graduated driver licencing
- d) age based screening of elderly drivers
Let’s look in the DSS

https://www.roadsafety-dss.eu/#/
Q1) Which countermeasure is not effective and might even increase risk?

- a) licence suspension
- b) pedestrian skills training for children
- c) graduated driver licencing
- d) age based screening of elderly drivers
Q2) For which road users could roundabouts - under certain conditions - induce risks?

a) Pedestrians
b) Cyclists
c) Foreign drivers
d) All of the above
Let’s look in the DSS

https://www.roadsafety-dss.eu/#/
Roundabouts effectiveness

• Overall, the conversion of junctions to roundabouts seems to reduce fatal and injury accident frequency (with some rare exceptions)

• However, for accidents involving cyclists, the safety effects of roundabouts varies according to the type of cyclist facility: worst safety effects for roundabouts with cycle lanes close to the roadway, but reductions in accident frequency for roundabouts with cycle paths.

• When designing roundabouts, don’t forget cyclists!!
Q2) For which road users could roundabouts - under certain conditions - induce risks?

a) Pedestrians
b) Cyclists
c) Foreign drivers
d) All of the above
Q3) Which of the following 4 measures in road safety has the highest benefit-to-cost ratio?

a) DUI checkpoints  
b) Alcohol interlock program  
c) Road lighting  
d) Autonomous Emergency Breaking
Let’s look in the DSS

https://www.roadsafety-dss.eu/#!/
## Benefit Cost ratios

<table>
<thead>
<tr>
<th>Feature</th>
<th>B/C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUI checkpoints</td>
<td>7.3</td>
</tr>
<tr>
<td>Alcohol interlock program</td>
<td>10.8</td>
</tr>
<tr>
<td>Road lighting</td>
<td>0.7</td>
</tr>
<tr>
<td>Autonomous Emergency Breaking</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Q3) Which of the following 4 measures in road safety has the highest benefit-to-cost ratio?

- a) DUI checkpoints
- b) Alcohol interlock program
- c) Road lighting
- d) Autonomous Emergency Breaking
Q4) Which percentage of MAIS3+ casualties indicates not to be fully recovered three years post-crash?

- a) 25%
- b) 33%
- c) 50%
- d) 75%
Consequences of (serious) injuries

- Literature review + analysis additional data/studies
- ESPARR cohort study: follow-up study among 1168 road traffic casualties in Rhône area (16+), including 320 MAIS3+
## ESPARR cohort study

<table>
<thead>
<tr>
<th>Follow up</th>
<th>% fully recovered</th>
<th>% with pain</th>
<th>% with sequelae (excl pain)</th>
<th>% with PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year (n=276)</td>
<td>20%</td>
<td>85%</td>
<td>75%</td>
<td>20%</td>
</tr>
<tr>
<td>3 years (n=266)</td>
<td>26%</td>
<td>75%</td>
<td>64%</td>
<td>NA</td>
</tr>
<tr>
<td>5 years (n=254)</td>
<td>35%</td>
<td>66%</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Q4) Which percentage of MAIS3+ casualties indicates not to be fully recovered three years post-crash?

- a) 25%
- b) 33%
- c) 50%
- d) 75%
You can also find this information in the DSS

- https://www.roadsafety-dss.eu/##/
Q5) For which of these measures did we not include Canadian studies

- a) Law and enforcement
- b) Road safety audits and inspections
- c) Child restraint systems
- d) None of the above
Let’s look in the DSS

https://www.roadsafety-dss.eu/#!/
Q5) For which of these measures did we not include Canadian studies

a) Law and enforcement
b) Road safety audits and inspections
c) Child restraint systems
d) None of the above 😊
Added value of European road safety DSS
Other Road Safety DSS Worldwide

- Crash Modification Factors Clearinghouse (www.cmfclearinghouse.org) by NHTSA (USA) - 5,151 CMF on infrastructure only - on going
- Road Safety Engineering Kit (www.engtoolkit.com.au) by Austroads (Australia) - 67 treatments on infrastructure only
- PRACT Repository (www.pract-repository.eu) by CEDR (Europe) - 889 CMF and 273 APM on infrastructure only – high quality
- iRAP toolkit (toolkit.irap.org/) by iRAP - 58 treatments (43 on infrastructure)
- Safety Performance Factors Clearinghouse (spfclearinghouse.org) by Tatum Group LLC, Dr. Andrew Kwasniak (USA) - few SPF – subscribers only
SafetyCube DSS Knowledge Wealth

- More than 1500 studies,
- With more than 7000 estimates of risks/measure effects
- More than 210 Synopses
- More than 30 cost-benefit analyses
Delivering a long waited powerful tool

- SafetyCube DSS is the first integrated road safety support system *developed in Europe*

- SafetyCube DSS *offers for the first time* scientific evidence on:
  - risks and not only measures
  - risks and measures not only on infrastructure
  - a very large number of estimates of risks and measures effects
  - links between risks factors and measures

- SafetyCube DSS aims to be a *reference system* for road safety in Europe and beyond, constantly improved and enhanced
Thank you!

Any questions?

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