SafetyCube – the European Road Safety Decision Support System

The webinar will start at 11:00 CET

www.roadsafety-dss.eu
#roadsafetydss
SafetyCube - the European Road Safety Decision Support System

Presenters: Pete Thomas, Loughborough University
Stijn Daniels, VIAS Institute
Eleonora Papadimitriou, NTUA
Wendy Weijermars, SWOV
George Yannis, NTUA
Susanne Kaiser, KFV
Delivering a long awaited 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, constantly improved and enhanced
SafetyCube concept and vision

• Problem
  – Evidence based road safety policies are becoming more usual and there is much better availability of national data and state of the art knowledge
  – Effective road safety policies need good information about accident risk factors and about measures

• SafetyCube will meet this need by generating new knowledge about accident risk factors and the effectiveness of measures relevant to Europe, to be integrated in a European Road Safety Decision Support System (DSS)
SafetyCube DSS Objectives

The SafetyCube DSS objective is to provide the European and Global road safety community 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.

The main contents of the SafetyCube DSS concern:
- road accident risk factors and problems
- road safety measures
- best estimate of effectiveness
- cost-benefit evaluation
- Serious injuries
- all related analytic background
Example questions addressed

- how important is my road safety problem?
- what is the nature of that problem?
- what solutions are usually proposed for my problem?
- how efficient are the solutions proposed?
- which is the most efficient solution?
- and if I have a combination of problems ...

... then use SafetyCube DSS to have the answers
SafetyCube DSS Users

- **Public Authorities**
  local, regional, national, European and international
- **Industry**
  Infrastructure, Vehicle, Insurance, Technology
- **Research Institutes, Experts**
- **Non Governmental Organisations**
- **Mass Media**
- **Everyone**

The SafetyCube DSS is intended to have **a life well beyond the end of the SafetyCube** research project.
Methodology

Stijn Daniels, VIAS Institute
SafetyCube Methodology

1. Consulting stakeholders to understand needs
2. Creating taxonomies of risk factors and measures
3. Exhaustive literature review and rigorous study selection criteria
4. Use of a template for coding studies, to be introduced in the DSS back-end database
5. Carrying out meta-analyses to estimate the effects of risk factors / measures.
6. Drafting Synopses summarising results of risk factors / measures.

- Systems approach: links between infrastructure, user and vehicle risks & measures
- Emphasis on risk factors and measures of priority issues (VRUs, ADAS, speed management, distraction, etc.)
- Rigorous assessment of the quality of the data / study methods
SafetyCube Taxonomy

Stijn Daniels, VIAS Institute
Taxonomy

• Risks & Measures
• main AREAS
  – Behaviour
  – Infrastructure
  – Vehicle
  – (Trauma care)
• Hierarchical
Taxonomy - DSS

- Backbone of DSS
- Finding risks & measures
- Linking risks to measures

- Additional entry points:
  - Road user groups
  - Accident categories
SafetyCube Repository

Stijn Daniels, VIAS Institute
Repository Evaluation of Studies

- Methodology
  - Design
  - Type of results
- Conditions
  - Country
  - Road user type
  - Road type
  - Traffic conditions
  - Crash severity
- Transferability
## Repository Coding template

### Core info

<table>
<thead>
<tr>
<th>Coder</th>
<th>Name</th>
<th>Institution</th>
<th>Email</th>
<th>Date/Available tool</th>
</tr>
</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Reference</th>
<th>Author</th>
<th>Title</th>
<th>Year</th>
<th>Source</th>
<th>URL</th>
</tr>
</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Risk factor of Driver\textsuperscript{a}</th>
<th>Vulnerability</th>
<th>Exposure</th>
<th>Accessibility</th>
<th>Expected number of crashes (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sampling frame</th>
<th>Country</th>
<th>Administrative level</th>
<th>Road user profile - Gender</th>
<th>Road user profile - Age</th>
<th>Road user profile - Mode</th>
<th>Road user profile - Environment</th>
<th>Road user profile - Location</th>
<th>Road user profile - Path</th>
<th>Road user profile - Time</th>
<th>Road user profile - Weather</th>
<th>Road user profile - Socio-demographic</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design</th>
<th>Features</th>
<th>Description</th>
<th>Exposure</th>
<th>Outcome</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limitations / Potential sources of bias</th>
<th>Error</th>
<th>Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

www.roadsafety-dss.EU
SafetyCube Synopses

Stijn Daniels, VIAS Institute
Synopsis

• Key conclusion
• Overview
• Scientific summary
• Supporting background
• For risk-factors and counter-measures
## Synopsis: colour code

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red</strong></td>
<td><strong>Green</strong></td>
</tr>
<tr>
<td>Results consistently show an increased risk when exposed to the risk factor concerned.</td>
<td>Results consistently show that the countermeasure reduces road safety risk.</td>
</tr>
<tr>
<td><strong>Yellow</strong></td>
<td><strong>Light green</strong></td>
</tr>
<tr>
<td>There is some indication that exposure to the risk factor increases risk, but results are not consistent.</td>
<td>There is some indication that the countermeasure reduces road safety risk, but results are not consistent.</td>
</tr>
<tr>
<td><strong>Grey</strong></td>
<td><strong>Grey</strong></td>
</tr>
<tr>
<td>No conclusion possible because of few studies with inconsistent results, or few studies with weak indicators, or an equal amount of studies with no (or opposite) effect.</td>
<td>No conclusion possible because of few studies with inconsistent results, or few studies with weak indicators, or an equal amount of studies with no (or opposite) effect.</td>
</tr>
<tr>
<td><strong>Green</strong></td>
<td><strong>Red</strong></td>
</tr>
<tr>
<td>Results consistently show that exposure to the presumed risk factor does not increase risk.</td>
<td>Results consistently show that this measure does NOT reduce road safety risk and may even increase it.</td>
</tr>
</tbody>
</table>
SafetyCube Tools for Prioritisation

Stijn Daniels, VIAS Institute
Prioritisation
Economic Efficiency Evaluation (E³)

**User input**
- Info on measures

**Output E³-calculator**
- Cost Effectiveness Analysis
  - Costs per crash prevented (fatal, serious, slight, pdo)
- Cost Benefit Analysis
  - Net present value (benefits – costs)
  - Benefit-cost ratio (benefit / costs)

**SafetyCube input**
- Info per country

- Crash & casualty costs (fatal, serious, slight, pdo)
- Discount rate

**Effectiveness**
- Saved crashes per unit (fatal, serious, slight, pdo)

**Time horizon**

**Costs of measures**
E3-calculator
Economic efficiency evaluation

• SafetyCube examples
• User adapts SafetyCube example for own purposes
• Users’ analysis starts from scratch.

www.roadsafety-dss.EU
E3-calculator
Crash costs

• Based on SafetyCube crash-cost collection
  – *Countries’ own reported values*
  – *Common methodology estimates per country*
  – *EU standardized cost*
• Costs for counter-measures can be adjusted from one country to another, by means of *value transfer*.

- **Country**
- **Year**
- **Cost in source**
- **Inflation correction**
- **Cost 2015**
- **Price-level & currency correction**
- **Cost in target country, 2015**
SafetyCube E3 examples
Sensitivity analysis

- Low / high measure effect
  - Lower CI
  - Upper CI
- Low / high measure costs
  - -50%
  - +100%
- Combined scenarios
  - Worst case
  - Ideal case

Table 1: Input values and BCR for the 'best estimate' scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Input values</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best estimate</td>
<td>Crash reduction: 14%</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Implementation cost: €3,284,143 / 100,000 tests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual cost: €0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Affected nr. of casualties per year: Crashes: 304</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Sensitivity analyses

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Input values</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low measure effect</td>
<td>Crash reduction: 13%</td>
<td>5.7</td>
</tr>
<tr>
<td>High measure effect</td>
<td>Crash reduction: 18%</td>
<td>9.4</td>
</tr>
<tr>
<td>Low measure cost (-50%)</td>
<td>Implementation cost: €1,642,072 / 100,000 tests</td>
<td>14.6</td>
</tr>
<tr>
<td></td>
<td>Annual cost: €0.00</td>
<td></td>
</tr>
<tr>
<td>High measure cost (+100%)</td>
<td>Implementation cost: €6,568,287 / 100,000 tests</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Annual cost: €0.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: CBA for worst case and ideal case scenarios

<table>
<thead>
<tr>
<th>Combined Scenario</th>
<th>Input values</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst case</td>
<td>Crash reduction: 13%</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>PDO only crashes reduction: 13%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation cost: €6,568,287 / 100,000 tests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual cost: €0.00</td>
<td></td>
</tr>
<tr>
<td>Ideal case</td>
<td>Crash reduction: 18%</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>Implementation cost: €1,642,072 / 100,000 tests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual cost: €0.00</td>
<td></td>
</tr>
</tbody>
</table>
Linking between risks and measures

Eleonora Papadimitriou, NTUA
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 solutions with potential of addressing road safety problems

• The DSS contents (individual studies, synopses and meta-analyses) “validate” or “conditionalize” the links, assist to understand the conditions of measures effectiveness and flag the sources of uncertainty.
Chains of risk factors and outcomes

- Each crash type is caused by a (combination of) circumstantial risk(s), which are due to or strengthened by pre-existing generic risks.
- The combination of risk factors then may result to specific crash types and related crash consequences.

<table>
<thead>
<tr>
<th>Generic risks</th>
<th>Circumstantial risks</th>
<th>Crash types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal/vertical alignment deficiencies</td>
<td>Road surface deficiencies</td>
<td>Single vehicle accident - Run off road</td>
</tr>
<tr>
<td>Superelevation / cross-slopes</td>
<td>Adverse weather</td>
<td>Single vehicle - on roadway</td>
</tr>
<tr>
<td>Vehicle design and crashworthiness</td>
<td></td>
<td>Rear end collisions / same direction traffic</td>
</tr>
<tr>
<td>Insufficient skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor road readability</td>
<td>Poor visibility and lighting</td>
<td>Pedestrian accident</td>
</tr>
<tr>
<td>Poor junction readability</td>
<td></td>
<td>Bicycle accident</td>
</tr>
<tr>
<td>Visibility &amp; conspicuity by design</td>
<td></td>
<td>Rear end collisions / same direction traffic</td>
</tr>
<tr>
<td>Functional Impairment</td>
<td>Adverse weather</td>
<td>Junction accident – no turning</td>
</tr>
<tr>
<td></td>
<td>Misjudgement &amp; Observation Errors</td>
<td>Junction accident – turning</td>
</tr>
</tbody>
</table>
Proposed SafetyCube model

Risk Factors
- Generic / Pre-crash
- Circumstantial / Crash-specific

Outcomes
- Crash scenario
- Crash severity

Measures

“side effects”
- uncertainty
- behavioural adaptation
DSS links from risks to related measures

- Measures for “Fatigue - not enough sleep”

The following measures are related to the risk factor you selected. Select a measure from the table below to see the available SafetyCube results.

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Infrastructure</th>
<th>Vehicle</th>
<th>Post Impact Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness to drive, medical referrals</td>
<td>Installation of median</td>
<td>Electronic Stability Control (ESC)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Campaign on fatigue</td>
<td>Increase median width</td>
<td>Lane Departure Warning (LDW), Lane Keeping Assist (LKA) &amp; Lane Centering System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change median type</td>
<td>Overtaking and Distraction Recognition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation of rumble strips at centerline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shoulder implementation (shoulder type)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase shoulder width</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change shoulder type</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety barriers Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change type of safety barriers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Create clearzone / remove obstacles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase width of clearzone</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation of edge of advisory rumble strips</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

safetycube synopses

Effectiveness of Road Safety Campaigns: ❑ LIGHT GREEN (PROBABLE EFFECTIVE)❑

There is some indication that campaigns are beneficial for road safety on various levels. Meta-analyses show an association with accident reduction, increased safe behaviours and risk awareness. However, for other outcome variables such as drink-driving or safety relevant attitudes, no such effect was found. Furthermore, meta-analyzed studies vary strongly, mainly regarding the design of the evaluated campaigns.

<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Source</th>
<th>Year</th>
<th>Design</th>
<th>Countries</th>
</tr>
</thead>
</table>
DSS links from measures to related risks

- Risks addressed by “Emergency Braking Assistance Systems”
Serious injuries

Wendy Weijermars, SWOV
Serious injuries

- Serious road injuries are increasingly being adopted as an additional road safety performance indicator
- EU definition (2013): non-fatal road traffic casualty with an injury severity level of **MAIS3+**
- All EU member states are asked to provide data from 2014 on, by:
  1. Applying correction factors to police data
  2. Using hospital data
  3. Using linked police and hospital data
Serious injuries in SafetyCube

- Estimation of the number of MAIS3+ casualties
- Consequences of serious road injuries
- Costs related to serious road injuries
- Risk factors associated with serious road injuries
Serious injuries in the DSS

Estimating the number of serious road injuries

Serious road traffic injuries have recently been adopted as an additional road safety indicator. The EU High Level Group on Road Safety defined serious traffic injuries as road casualties with an injury level of MAIS3+. Within SafetyCube, practical guidelines have been developed to help countries in determining the number of MAIS3+ road casualties. A summary of these guidelines can be found here.

Impacts and costs of serious road injuries
Presenting the DSS
SafetyCube DSS Design Principles

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

SafetyCube DSS will eventually include by April 2018:

- more than **1,250 studies**,

- with more than **7,500 estimates** of risks/measures effects on:
  - behaviour,
  - infrastructure,
  - vehicle, and
  - post impact care

- **211 Synopses**

- **36 cost-benefit analyses**
SafetyCube DSS Menu

- **Search**
  Risk Factors & Measures

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

- **Calculator**
  Economic Efficiency Evaluation

- **Methodology**
  System documentation

- **Support**
  Contact, help, feedback
SafetyCube DSS Search Pages

DSS Search through five entry points:

• **Keyword** search  
  (all database keywords)

• **Risk factor** search  
  (taxonomy)

• **Measures** search  
  (taxonomy)

• **Road User Groups**  
  (database keywords related to each group)

• **Accident Categories**  
  (under development)
The Search Structure

- **Search**
  (5 entry points)
- **Results pages**
  (Introduction, Colour codes, Synopses, Coded studies)
- **Individual Studies pages**
  (Disaggregate level, detailed effects listed, some studies not in synopses)
- **Links** between Risk Factors
  Information about which risks can be remedied by which types of measures
SafetyCube DSS Results Pages

- Refine risk factor
- Level of risk
- Synopsis pdf
- Link to measures
- Individual studies
SafetyCube Synopses

211 Syntheses on risk factors / measures
Summary (2 pages)
– Effect of risk factor / measure and ranking (colour code)
– Risk / safety effect mechanisms
– Risk / safety effects size, transferability of effects

Scientific overview (4-5 pages)
– Comparative analysis of available studies
– Analysis results:
  Meta-analysis/Vote-count analysis/Qualitative analysis

Supporting document (3-10 pages)
– Literature search strategy and study selection criteria
– Detailed analyses
SafetyCube Related Risks / Measures

- Linking based on a dedicated model categorizing risks

- Every Risk Factor (88) is linked to one or more Road Safety Measure(s) (175)

- Every Road Safety Measure (175) is linked to one or more Risk Factor(s) (88)

- A total of 762 links between risk factors and measures
Title, author, source, abstract
- Link to URL for full-text download (depending on Institute permissions)

Study design info:
- Country
- Research Method, Design, Sample
- Exposure/Control group
- Risk/Outcome Group
- Modifying Conditions
- Potential limitations

Study results:
- Table listing the detailed effects reported in the study
SafetyCube DSS Calculator

- Combines information about the **effectiveness of a measure** (i.e. the percentage of crashes or casualties prevented) with the **costs** of this measure
- Integrates updated information of **crash costs in the European countries**
- Allows to express all costs and benefits of a measure in monetary values and conduct **cost benefit analysis**

**Main Functions**
- Perform cost-benefit analysis with **own input data**.
- Select one of the **SafetyCube examples** of cost benefit analyses
  - Measures with high effectiveness
  - For which reliable cost information could be found
... hands-on examples for querying the DSS
The next steps ...
SafetyCube Next Steps

The **future operation** of the SafetyCube DSS concerns:

1. the uninterrupted operation of the current SafetyCube DSS
2. updates of the risk factors, measures and cost-benefit analyses (recent studies but also older ones)
3. addition of studies in more languages
4. translation of the contents in other languages
5. possibility to receive, check and incorporate studies submitted by external experts and organizations and the respective quality control
6. incorporation of additional data and knowledge sections
7. A partnership of public and private organisations is being assembled to enable the DSS to continue
SafetyCube - the European Road Safety Decision Support System

A recording of this webinar and all deliverables of the project will be available at
www.Safetycube-project.eu

You are welcome to use the DSS at
www.roadsafety-dss.eu