Economic Efficiency Evaluation (E³) of Road Safety Measures – Results from the SafetyCube project

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The SafetyCube Decision Support System (DSS)

Road Safety Decision Support System

- Risks
- Measures

Taxonomy
Repository
Synopsis
Prioritisation
How to prioritise road safety policy measures?
Methods for prioritisation

Effectiveness
- What will be the reduction in the number of accidents / injuries / fatalities?

Cost-effectiveness
- How many deaths will be avoided per unit cost of the measure?

Cost-utility
- What will be the cost per QALY when implementing the measure?

Cost-benefit
- Do the benefits exceed the costs of implementing the measure?

Multicriteria
- Which factors should be considered for deciding on a particular measure?
Focus on Cost Benefit Analysis (CBA)

- In a CBA, the benefits and drawbacks – both expressed in monetary terms – derived from the implementation of a road safety measure are compared.

- It is necessary to assign a monetary value to the impacts of measure. This can be controversial since a monetary value is given to human life.

- In a CBA analysis, it is possible to account for – positive and negative – side effects, eg environmental or mobility impacts

- Two indicators can be used for prioritisation
  - Benefit-Cost ratio
  - Net present value
Economic efficiency evaluation: what do you need?

**Info on measures**
- Effectiveness
  - saved crashes
  - per severity category
- Time horizon
- Costs of measures

**Economic assessment**
- Cost Benefit Analysis
  - Net present value  
  (benefits – costs)
  - Cost benefit ratio  
  (benefit / costs)

**Info per country**
- Crash costs
  - per severity category
- Discount rate
E³ method

Input
- Measures and measure costs
- Effectiveness of the measures
- Crash costs

Calculations
- Benefits
- Costs and benefits per year

Output
- Costs + benefits (present values)
- Prevented crashes
- Socio-economic return
- Costs per prevented crash

Extra analyses
- Sensitivity analyses
- Penetration rate
- Side impacts
- Long term trends
## COST-BENEFIT ANALYSIS

### Costs (present values)

<table>
<thead>
<tr>
<th>Cost Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-time investment costs</td>
<td>311 070 EUR</td>
</tr>
<tr>
<td>Recurrent costs</td>
<td>179 122 EUR</td>
</tr>
<tr>
<td>Total costs excluding side-effects</td>
<td>490 192 EUR</td>
</tr>
<tr>
<td>Side-effects</td>
<td>- EUR</td>
</tr>
<tr>
<td>Total costs including side-effects</td>
<td>490 192 EUR</td>
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</table>

### Benefits

<table>
<thead>
<tr>
<th>Benefit Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevented Casualties</td>
<td>521 739 EUR</td>
</tr>
</tbody>
</table>

### Socio-economic return excluding side-effects

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net present value</td>
<td>31 548 EUR</td>
</tr>
<tr>
<td>Cost-benefit ratio</td>
<td>1.1</td>
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</tbody>
</table>

### Socio-economic return including side-effects

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</table>

### Break-even cost for measure (per unit)

<table>
<thead>
<tr>
<th>Cost (per unit)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevented casualties</td>
<td>521 739 EUR</td>
</tr>
</tbody>
</table>

### COST-EFFECTIVENESS ANALYSIS

### Prevented casualties

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>0.1</td>
</tr>
</tbody>
</table>

|
Current status

- Documentation of the methodology, allowing a standardised methodology for CBA analyses for road safety measures
- Background data available
  - Standardised data on crash costs (per country, and for EU)
  - Conversion tools for costs (PPP and indexation)
  - Effectiveness measures available through SafetyCube DSS
- Concept version of E³ tool developed (in Excel), including user manual and reporting template available
- Cost-Benefits analyses are currently being undertaken using and documented for some 30 measures related to education, campaigns, enforcement, infrastructure and vehicle technology
Example 1: Section control systems

- Effect estimates from the meta-analysis by Høye (2014), supplemented by cost estimates in Owen et al. (2016) and target crash estimates in Montella et al. (2012).
- The resulting best estimate of the benefit-to-cost ratio is 19.5 which means that the benefits clearly outweigh the costs.
- The sensitivity analyses show that this measure remains cost-effective in all scenarios, even in the worst case scenario.

### Input values

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Reduction Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal injury crash</td>
<td>56%</td>
</tr>
<tr>
<td>Serious injury crash</td>
<td>56%</td>
</tr>
<tr>
<td>Slight injury crash</td>
<td>30%</td>
</tr>
<tr>
<td>PDO only crash</td>
<td>30%</td>
</tr>
</tbody>
</table>

- Implementation cost: 68323 €/km
- Annual cost: 6832 €/km

### Affected nr. of crashes per year:
- Fatal crashes: 0.08
- Serious injury crashes: 0.60
- Slight injury crashes: 0.45
- PDO crashes: 2.41
## Sensitivity analysis section control

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Input values</th>
<th>B/C ratio</th>
</tr>
</thead>
</table>
| **Low measure effect**          | Fatal injury crashes reduction: 42%  
                                | Serious injury crashes reduction: 42%                                       | 14.7      |
|                                 | Slight injury crashes reduction: 24%                                       |           |
|                                 | PDO only crashes reduction: 24%                                            |           |
| **High measure effect**         | Fatal injury crashes reduction: 66%                                       | 23.0      |
|                                 | Serious injury crashes reduction: 66%                                      |           |
|                                 | Slight injury crashes reduction: 36%                                       |           |
|                                 | PDO only crashes reduction: 36%                                            |           |
| **Low measure cost (-50%)**     | Impl. cost: 34162 €/km  
                                | Annual cost: 3416 €/km                                                       | 39.1      |
| **High measure cost (+100%)**   | Impl. cost: 136646 €/km  
                                | Annual cost: 13665 €/km                                                      | 9.8       |
Example 2: Alcohol interlock programme

- An existing cost-benefit analysis on the effect of an alcohol interlock program in the Netherlands (SWOV, 2009) was revisited.
- The resulting best estimate from the E³ calculator of the benefit-cost ratio (BCR) is 10.9 which means that the benefits substantially exceed the costs.
- The sensitivity analysis shows that while the BCR is sensitive to changes in the underlying assumptions, the ratio remains higher than 1, which means that the measure remains economically efficient.
Next steps

• E³ tool to be integrated in the final version of the SafetyCube DSS.

• Planned possibilities for the users
  – *Study the documented CBA analyses*
  – *Use such analyses as a basis for own analyses (overruling certain input values and run the calculations again)*
  – *Do a CBA analysis starting from a zero – i.e. providing all input values yourself (including values on side effects if relevant)*

• For more information
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