SafetyCube - the European Road Safety Decision Support System

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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
- all related analytic background

Special focus on linking road safety problems with related measures.

Current Road Safety DSS Worldwide

- Crash Modification Factors Clearinghouse (www.cmfclearinghouse.org) by NHTSA (USA) - **6.251 CMF** on infrastructure only – ongoing

- 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 (http://toolkit.irap.org/) by iRAP - **58 treatments** (42 on infrastructure)

- Safety Performance Factors Clearinghouse (http://spftool.com/) by Tatum Group LLC, Dr. Andrew Kwasniak (USA) - **few SPF** – subscribers only

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**. It is developed in a form that can readily be incorporated within the existing European Road Safety Observatory of the European Commission DG-MOVE.

SafetyCube Methodology

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

- **Systems approach:** links between infrastructure, user and vehicle risks
- Rigorous assessment of the **quality of the data / study methods**

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)

SafetyCube DSS — European Road Safety Decision Support System

Search | Knowledge | Calculator | Methodology | Support

Home > Measures Search

Keyword Search | Risk Factors | Measures | Road User Groups | Accident Categories

Behavior	Infrastructure	Vehicle	Post Impact Care
Law and enforcement	Traffic flow	Frontal impact	Ambulances/helicopters
Education and voluntary training or programmes	Traffic composition	Side impact	Extraction from vehicle
Driver training and licensing	Formal tools to address road nettwork deficiencies	Rear impact	Pre-hospital medical care
Fitness to drive assessment and rehabilitation	Speed management & enforcement	Rollover	Triage and allocation to trauma facilities
Awareness raising and campaigns	Road type	Pedestrian	First aid training drivers
	Road surface treatments	Child	
	Visibility / Lighting treatments	PTW	
	Workzones	Cyclist	
	Horizontal & vertical alignment treatments	HGV	
	Superelevation / cross-slopes treatment	Longitudinal	
	Lanes / ramps treatments	Lateral control	

SafetyCube DSS Design Principles

- A **Modern** web-based tool

- Highly **Ergonomic** interface

- **Simple** structure

- Powerful **Search** Engines

- Fully **Documented** information

- Easily **Updated**

SafetyCube 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.)

SafetyCube DSS Menu

- **Search**
  Risk Factors & Measures

- **Knowledge**
  >210 Synopses, Serious Injuries,
  Accident Scenarios

- **Calculator**
  Economic Efficiency Evaluation

- **Methodology**
  System documentation

- **Support**
  Contact, help, feedback

www.roadsafety-dss.eu
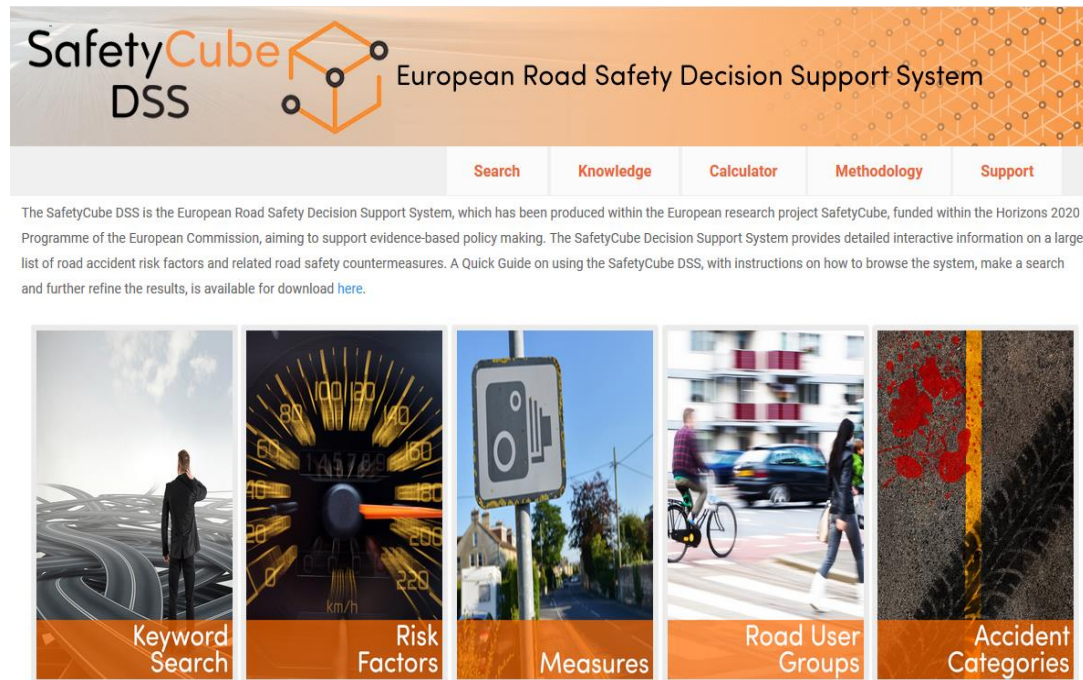
The Search Structure

- **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

Keyword Search

Accident Categories Search

Measures Search

Risk Factors Search

Road User Groups Search

The Results Page

Related Risk Factors / Measures

Individual Synopsis

Individual Study Page

SafetyCube DSS 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**
  (inquiries about specific scenarios)

SafetyCube DSS Results Pages

Search results
- Synopses, and their short summaries & colour codes
- Table listing the available studies

Refine search
- Specific Risk factor / Measure
- Other **search filters:**
  - Road user groups: All, car occupants, drivers, passengers, PTW riders, pedestrians, cyclists, HGVs.
  - Road types: All, motorways, rural roads, urban roads
  - Country: EU, EU countries, US and Canada, Australia, Asia.

Links to related measures
- Select a specific risk factor / measure
- Get the list of related measures

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)

- **Exploration** of more than 270 relationships

SafetyCube DSS Individual Study Pages

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 — European Road Safety Decision Support System

Search | Knowledge | Calculator | Methodology | Support

Modeling work zone crash frequency by quantifying measurement errors in work zone length

Yang H., Ozbay K., Ozturk O., Yildirimoglu M.

Abstract

Work zones are temporary traffic control zones that can potentially cause safety problems. Maintaining safety, while implementing necessary changes on roadways, is an important challenge traffic engineers and researchers have to confront. In this study, the risk factors in work zone safety evaluation were identified through the estimation of a crash frequency (CF) model. Measurement errors in explanatory variables of a CF model can lead to unreliable estimates of certain parameters. Among these, work zone length raises a major concern in this analysis because it may change as the construction schedule progresses generally without being properly documented. This paper proposes an improved modeling and estimation approach that involves the use of a measurement error (ME) model integrated with the traditional negative binomial (NB) model. The proposed approach was compared with the traditional NB approach. Both models were estimated using a large dataset that consists of 60 work zones in New Jersey. Results showed that the proposed improved approach outperformed the traditional approach in terms of goodness-of-fit statistics. Moreover it is shown that the use of the traditional NB approach in this context can lead to the overestimation of the effect of work zone length on the crash occurrence.

doi.10.1016/j.aap.2013.02.031

Summary

The study investigates workzone crashes in New Jersey state. 7 years of data are exploited. Full Bayesian Negative binomial models are applied. AADT, length of workzone and number of operating lanes in the workzone were found to increase frequency of injury and non-injury (property damage only) accidents.

Basic Study Information

Topic: RISK FACTOR   **Year:** 2013
Source: ACCIDENT ANALYSIS AND PREVENTION 55 (2013) 192- 201
Design: OBSERVATIONAL CROSS-SECTIONAL
Countries: UNITED STATES
Keywords: FULL BAYESIAN MEASUREMENT ERROR NEGATIVE BINOMIAL MODEL CRASH FREQUENCY SAFETY ANALYSIS WORK ZONE

Effects

Effect No	Outcome	Exposure	Group Type	Group	Effect Estimator	Effect Estimator Specifications	Sample	Estimate	Estimate Lower Limit	Estimate Upper Limit	Conclusion Comments
1	NUMBER OF PROPERTY DAMAGE ONLY ACCIDENTS	LN(LENGTH)	unit	MILES	SLOPE	FULL BAYESIAN NEGATIVE BINOMIAL MODEL		0.847	0.729	0.965	SIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY THE MODEL WITH THE BEST FIT IS PRESENTED (LOWER DIC VALUE). LOWER AND UPPER LIMIT REFER TO THE 95% CREDIBLE INTERVALS (2.5%-97.5%).
2	NUMBER OF PROPERTY	LN(AADT)	unit	ADJUSTED VOLUME/LANE (BY	SLOPE			0.538	0.415	0.634	SIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY

SafetyCube DSS Calculator (1/2)

- 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

SafetyCube DSS Calculator (2/2)

Economic Efficiency Evaluation Tool (E3)

- Fully integrated in the DSS

- Enables users to create their custom CBA "My Measure" function with free input on:
  - Country, years of analyses
  - Basis: Crashes or Casualties
  - Costs (implementation and annual)
  - Measure effectiveness (per severity category)
  - Penetration rate and side effects

- **Contains SafetyCube example CBAs on:**
  - Behaviour (12 examples)
  - Infrastructure (19 examples)
  - Vehicle systems (4 examples)

SafetyCube DSS — European Road Safety Decision Support System

Search   Knowledge   Calculator   Methodology   Support

Home > Calculator

Calculator

Pilot version, under development

The calculator for Economic Efficiency Evaluation (E3) of road safety counter measures allows to combine information about the effectiveness of a measure (i.e. the percentage of crashes or casualties prevented) with the costs of this measure. The calculator also integrates updated information of crash-costs in the European countries, allowing to express all costs and benefits of a measure in monetary values and conducting cost benefit analysis. Select one of the SafetyCube cost benefit analyses examples, or perform a cost benefit analysis with your own input data.

All figures and estimates refer to euros for year 2015.

Input

| MY MEASURE | SELECT A SAFETYCUBE EXAMPLE |

Infrastructure safety management - Speed management & enforceme ▾

| Description | Roundabout |
| Country | UK ▾ |

Measure

Horizon (period of analysis)	25
Reduction in terms of casualties or crashes	◉ Casualties ○ Crashes
Number of units implemented	1

Costs

◉ Cost Breakdown Per Unit
○ Total Costs Per Unit

Cost-Benefit Analysis

Infrastructure safety management - Speed management & enforcement - 30-zones implementation

Roundabout

Costs (present values)

One-time investment costs	82241 EUR
Recurrent costs	17964.84 EUR
Total costs excluding side-effects	100205 EUR
Side-effects	0 EUR
Total costs including side-effects	100205 EUR

Benefits

| Prevented Crashes | 190481.42 EUR |

Socio-economic return excluding side-effects

| Net present value | 90276.42 EUR |
| Cost-benefit ratio | 1.9 |

**Socio-economic return including side-effects**

| Net present value | 90276.42 EUR |
| Cost-benefit ratio | 1.9 |

SafetyCube DSS Knowledge Wealth

SafetyCube DSS contains:

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

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

- more than **210 Synopses**

- more than **35 cost-benefit analyses** (adjustable)
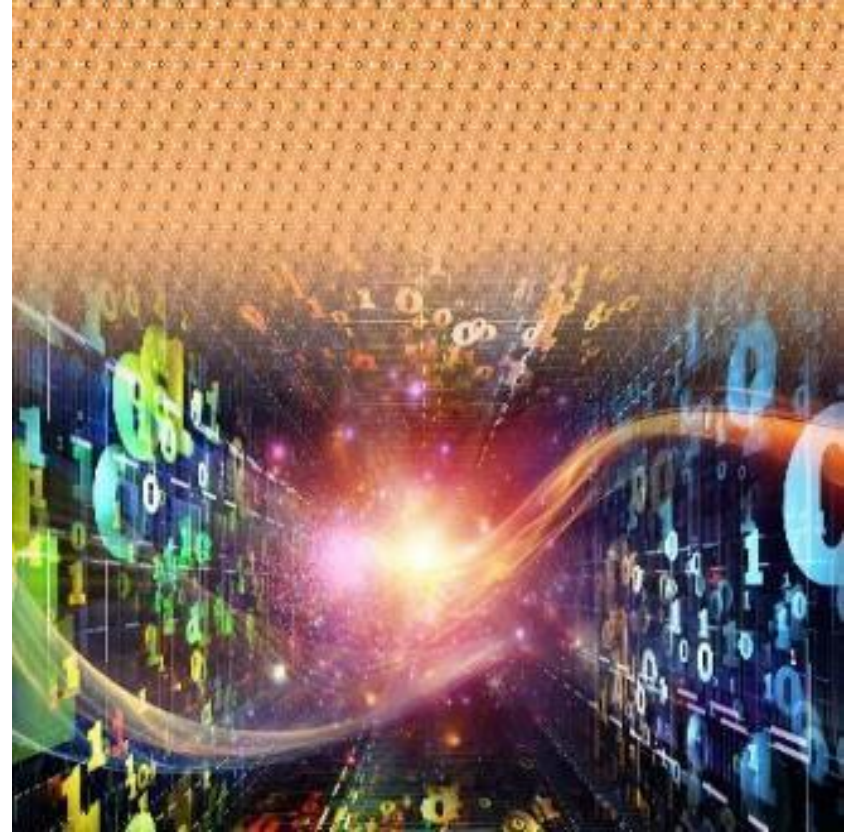
Example questions addressed

- how important is my road safety problem?
- who else is having similar problems?
- 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 Next Steps

- SafetyCube DSS **Opening** (October 2017)
- 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

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, constantly improved and enhanced

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