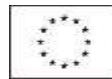




SafetyCube

SafetyCube - the European Road Safety Decision Support System

Professor George Yannis,
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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, - **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
- **38 risks, 50 measures (88 in total)**
e.g. distraction, roadside, crashworthiness
- **120 specific risks, 193 specific measures (313 in total)**
e.g. mobile phone use, no clear-zone, low pedestrian rating (NCAP)

The screenshot shows the homepage of the SafetyCube DSS (European Road Safety Decision Support System). The header includes the logo and navigation links: Search, Knowledge, Calculator, Methodology, and Support. Below the header, there are five main categories represented by icons: Keyword Search, Risk Factors, Measures, Road User Groups, and Accident Categories. At the bottom, there is a detailed table of taxonomies.

Risk factor	Infrastructure	Vehicle	Post impact Care
Law and enforcement	Traffic flow	Frontal impact	Advanced Care/Teleoperators
Education and voluntary training or programmes	Traffic composition	Side impact	Extracare heavy vehicle
Driver training and licensing	Formal tools to address road safety deficiencies	Rear impact	Pre-hospital medical care
Flows to other assessment and rehabilitation	Speed management & enforcement	Bulldozer	First aid and education for trauma facilities
Assessment rating and comparison	Road type	Crash	Post-aid training drivers
	Road surface treatments	ITW	
	Visibility / Lighting treatments	ITW	
	Work zones	ITW	
	Horizontal / vertical alignment treatments	Longitudinal	
	Superelevation / cross-slopes treatment	Lateral control	
	Lanes / design treatments		

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**
211 Synopses, Serious Injuries, Accident Scenarios
- **Calculator**
Economic Efficiency Evaluation
- **Methodology**
System documentation
- **Support**
Contact, help, feedback



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 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)

The screenshot displays the SafetyCube DSS interface. At the top, the header reads "SafetyCube DSS" and "European Road Safety Decision Support System". Below the header, there are navigation tabs: "Search", "Knowledge", "Calculator", "Methodology", and "Support". The "Search" tab is active, showing a "Keyword Search" entry point. A sidebar on the left lists various categories: PEDESTRIANS, CHILD PEDESTRIANS, PEDESTRIAN CROSSING, PEDESTRIAN CROSSINGS, PEDESTRIAN SIGNAL, PEDESTRIAN CRASHES, PEDESTRIAN AIRBAGS, and PEDESTRIAN DETECTION. A large orange bracket groups the first six categories under the "PEDESTRIANS" heading. The main content area shows a table with two main sections: "Risk Factors" and "Measures". The "Risk Factors" section is further divided into "Behavior", "Infrastructure", and "Vehicle". The "Measures" section is divided into "Behavior", "Infrastructure", and "Vehicle". The table lists various factors and measures related to pedestrian safety.

Risk Factors			Measures			
Behavior	Infrastructure	Vehicle	Behavior	Infrastructure	Vehicle	Post Impact Care
Functional impairment	Adverse weather	Pedestrian	Educational and voluntary trainings/programs	Traffic signs, treatments	Pedestrian	Not Applicable
Distraction and inattention	Poor junction visibility	Visibility / Complexity			Vulnerable Road User Protection	
Traffic rule violations	At grade junctions, intersections	PCN / ATV		Road markings at junctions		
	Median / barrier deficiencies (risk of crash with oncoming traffic)	LDV		Speed management & enforcement		
	Horizontal/vertical alignment deficiencies	Passenger Cars		Speed management		
	Traffic flow			Rail-road crossings		
				Traffic signs, treatments		

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

[illegible]

SafetyCube Related Risks / Measures

- Linking based on a **dedicated model** categorizing risks
- Risk Factors (118) are **linked** to one or more Road Safety Measure(s) (167)*
- A total of **762 links** between risk factors and measures

*A few risk factors or measures (e.g. post-impact care) were not "linkable".

The screenshot displays the SafetyCube DSS (European Road Safety Decision Support System) interface. The top navigation bar includes links for Search, Knowledge, Calculator, Methodology, and Support. The main content area is titled 'Related Studies for "poor visibility - darkness"' and provides a table of measures related to the selected risk factor. Below the table, there is a section for 'SafetyCube Synopses' featuring a thumbnail image of a road at night and a summary of findings. A table at the bottom lists specific studies with their IDs, titles, sources, years, designs, and countries.

Behavior	Substance	Vehicle	Post Impact Care
Consequences on behavior, protective clothing and visibility	Installation of road lighting Improvement of existing lighting	Advanced headlights (autonomous, adaptive, sensorized systems, ...) Night vision Vehicle backup camera - following detection of camera systems (360°)	Not Applicable

Countries

- ☐ CANADA
- ☐ NETHERLANDS
- ☐ UNITED KINGDOM
- ☐ UNITED STATES

SafetyCube Synopses

Installation of lighting & improvements to existing lighting: **GREEN (EFFECTIVE)** -

The vast majority of results show that the installation of road lighting and improvements to existing road lighting have favourable effects on the number of occurring crashes.

ID	Title	Source	Year	Design	Countries
234	Relationship Between Roadway Illuminance Level and Nighttime Rural Intersection Safety	TRANSPORTATION RESEARCH BOARD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2485, PP. 5-15	2015	CROSS-SECTIONAL	UNITED STATES
295	Road Lighting Effects on Bicycle and Pedestrian Accident Frequency: Case Study in Montreal, Quebec, Canada	TRANSPORTATION RESEARCH BOARD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2555, PP. 56-64	2016	CROSS-SECTIONAL	CANADA

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., Ouyang P., Choudhry G., Mahalingam A.

Abstract

Work zones are temporary traffic control zones that can potentially cause safety problems. Assessing 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 the 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 66 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.

[Go to the full-text document](#)

Summary

The study investigated work zone crashes in New Jersey state. 7 years of data are exploited. Full Bayesian negative binomial models are applied. (A) Length of workzone and number of opening lanes in the workzone were found to increase frequency of injury and non-injury (property damage only) accidents.

Basic Study Information

Topic: ROAD SAFETY

Year: 2015

Review: ACCIDENT ANALYSIS AND PREVENTION 95 (2015) 180-200

Design: OBSERVATIONAL, CROSS-SECTIONAL

Country: 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 Specifications	Sample	Estimate	Estimate Lower Limit	Estimate Upper Limit	Conclusion Comments
1	NUMBER OF PROPERTY DAMAGE ONLY ACCIDENTS	LENGTH (FT)	CONT	BELES	GLMER	FULL BAYESIAN NEGATIVE BINOMIAL MODEL	0.047	0.705	0.340		INSIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY. THE MODEL WITH THE BEST FIT IS PRESENTED (LOWER AND UPPER LIMIT REFER TO THE 95% CREDIBLE INTERVALS (0.02% AT 95%)).
2	NUMBER OF PROPERTY DAMAGE ONLY	LENGTH	REF	ADJUSTED VOLUME/LANE/FT	GLMER		0.000	0.470	0.430		INSIGNIFICANT 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)
 - Post-impact care (1 example)

The screenshot displays the 'SafetyCube DSS' interface, specifically the 'Calculator' section. The header includes the logo and the text 'European Road Safety Decision Support System'. Below the header are navigation tabs: 'Home', 'Calculator', 'Knowledge', 'Methodology', and 'Support'. The 'Calculator' section features a 'Calculator' title, a 'First version: under development' note, and a brief description of the tool's purpose. The 'Input' section includes a 'My Measure' button and a 'SELECT A SAFETYCUBE EXAMPLE' button. Below these are input fields for 'Description' (Infrastructure safety management - Speed management & enforcement), 'Country' (UK), 'Measure' (Reduction in terms of casualties or crashes), 'Number of years implemented' (1), and 'Costs' (Cost breakdown Per Unit). The 'Cost-Benefit Analysis' section shows a table with 'Costs (present values)' and 'Benefits'. The table includes columns for 'Description', 'Value', and 'Unit'.

Description	Value	Unit
One-time investment costs	82041.00	EUR
Recurrent costs	17964.89	EUR
Total costs including side-effects	100005.89	EUR
Side-effects	0.00	EUR
Total costs including side-effects	100005.89	EUR

Description	Value	Unit
Prevented Crashes	1.000000	Crashes

Description	Value	Unit
Net present value	40276.42	EUR
Cost-benefit ratio	1.0	

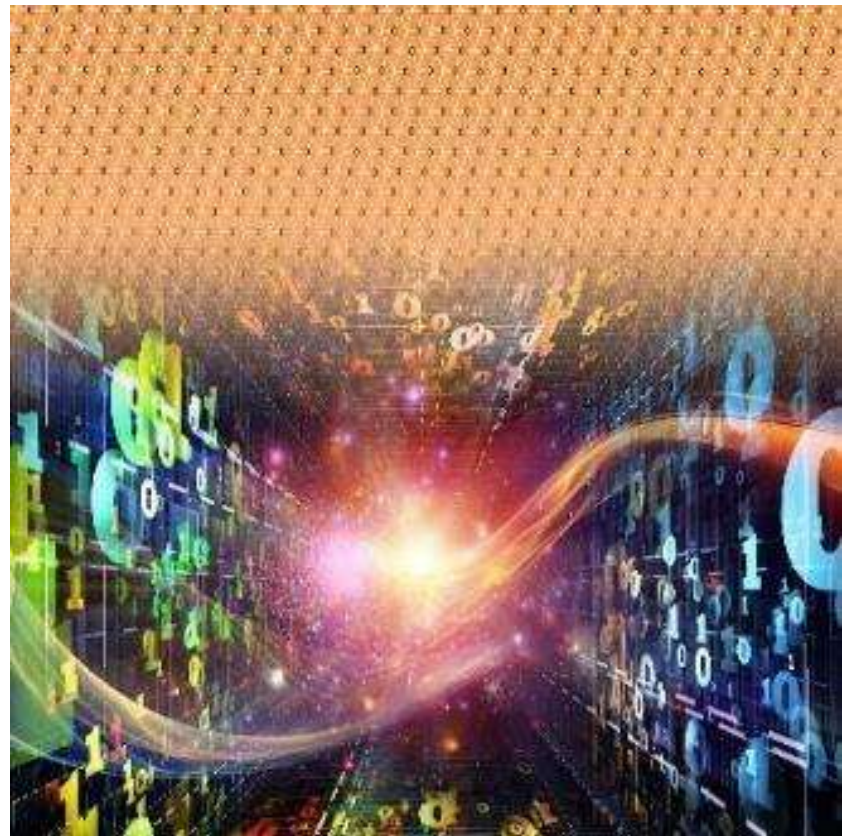
Description	Value	Unit
Net present value	40276.42	EUR
Cost-benefit ratio	1.0	

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
- **211 Synopses**
- **36 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



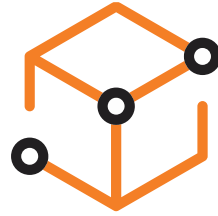
- SafetyCube DSS **Opening** (October 2017)
- The **future operation** of the SafetyCube DSS concerns:
 1. the uninterrupted operation of the current SafetyCube DSS
 2. updates of the risk factors, measures and cost-benefit analyses (recent studies but also older ones)
 3. addition of studies in more 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

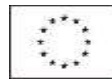




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