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# SafetyCube - the European Road Safety Decision Support System

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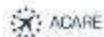


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# The SafetyCube project



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



# 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](http://www.cmfclearinghouse.org)) by NHTSA (USA) - **6.251 CMF** on infrastructure only – ongoing
- Road Safety Engineering Kit ([www.engtoolkit.com.au](http://www.engtoolkit.com.au)) by Austroads (Australia) - **67 treatments** on infrastructure only
- PRACT Repository ([www.pract-repository.eu](http://www.pract-repository.eu)) by CEDR (Europe) - **889 CMF and 273 APM** on infrastructure only – high quality
- iRAP toolkit ([toolkit.irap.org](http://toolkit.irap.org)) by iRAP - **58 treatments** (42 on infrastructure)
- Safety Performance Factors Clearinghouse ([spfclearinghouse.org](http://spfclearinghouse.org)) by Tatum Group LLC, Dr. Andrew Kwasniak (USA) - **few SPF** – subscribers only

# SafetyCube DSS Users

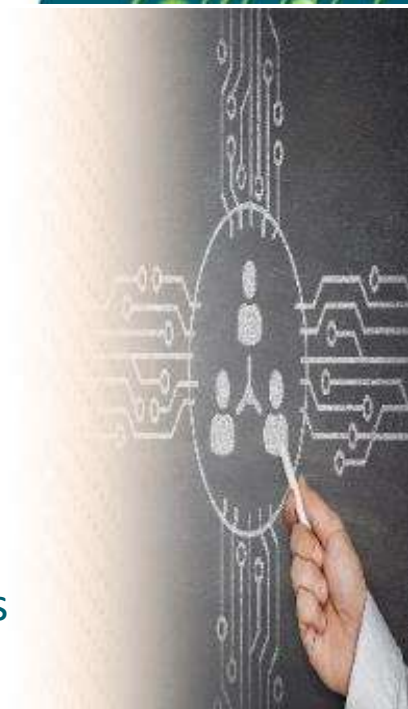
- **Public authorities** - local, regional, national, European and international
- **Industry** - Infrastructure, Vehicle, Insurance, Technology
- **Research Institutes, Experts**
- **Non Governmental Organisations**
- **Mass Media**
- **Everyone**

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
- **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)



Behaviour	Infrastructure	Vehicle	Post Impact Care
Law and enforcement	Traffic flow	Frontal impact	Amputations/limblosses
Education and voluntary training or programmes	Traffic composition	Side impact	Extraction from vehicle
Driver training and licensing	Portals links to address road network deficiencies	Rear impact	Pre-hospital medical care
Fitness to drive assessment and rehabilitation	Speed management & enforcement	Roll-over	Triage and allocation to trauma facilities
Awareness raising and campaigns	Road type	Pedestrian	First aid training drivers
	Road surface treatments	Child	
	Visibility / Lighting treatments	ITW	
	Workzones	Cyclist	
	Horizontal & vertical alignment treatments	HSV	
	Super-elevation / cross-slopes treatment	Longitudinal	
	Lines / lane treatments	Lateral control	

# Selection and Coding of 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)
- Recent studies
- European studies

## Study selection and prioritization criteria

- Study design and methodology
- Results and their confidence intervals
- Study limitations





# SafetyCube DSS Design Principles

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



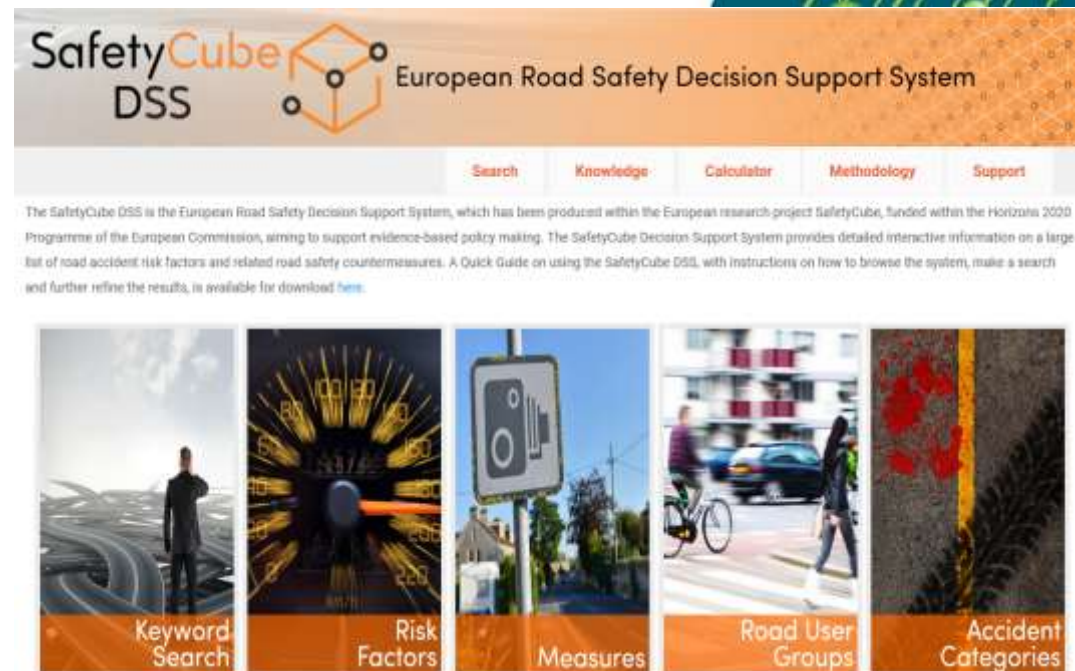
# SafetyCube DSS Search Engine

- 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** pages  
(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)

**SafetyCube DSS** European Road Safety Decision Support System

Search Knowledge Calculator Methodology Support

Keyword Search Risk Factors Measures Road User Groups Accident Categories

PEDESTRIANS

Behavior	Infrastructure	Vehicle	Behavior	Infrastructure	Vehicle	Post Impact Care
Horizontal alignment	Adverse weather	Pedestrian	Location and visibility	Traffic signals	Pedestrian	Not applicable
Intersection and intersection	Poor junction visibility	Visibility / Consciousness	Emergency programs	Speed limits	Non-motorized Road	Emergency Response
Truck / Heavy Vehicle	Designated pedestrian crossings	PTW / ATV		Road markings of pavement	Emergency Response	Emergency Response
	Median / barrier deficiencies (risk of crash with oncoming traffic)	Car		Speed management & enforcement		
	Horizontal/vertical alignment deficiencies	Passenger cars		Speed management		
	Traffic flow			Defined crossings		
				Traffic signs		
				Traffic signs		



# 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

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# 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".

**SafetyCube DSS** European Road Safety Decision Support System

Home > Search > Knowledge > Consult > Methodology > Support

Items > Search > Measure: Related Studies for "poor visibility - darkness"

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

Measure	Infrastructure	Vehicle	Post-impact Care
Changes to vehicle, pedestrian clothing and visibility	Installation of road lighting Improvement of existing lighting	Driver's headlight (automatic, manual, driver's choice, ...) Night vision Vehicle Adaptive Systems (steering, braking or engine control) (ADAS)	First Aid Kits

## Countries

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

## SafetyCube Synopses



Installation of lighting & improvements to existing lighting ● 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
254	Relationship between Roadway Illuminance Level and Nighttime Rural Intersection Safety	TRANSPORTATION RESEARCH RECORD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2480, PP. 8-15	2015	CROSS-SECTIONAL	UNITED STATES
295	Road Lighting Effects on Bicycle and Pedestrian Accident Frequency: Case Study in Montreal, Quebec, Canada	TRANSPORTATION RESEARCH RECORD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2588, PP. 80-94	2016	CROSS-SECTIONAL	CANADA

## Title, author, source, abstract

- ### 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

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[illegible]

# 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)

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The screenshot displays the 'Calculator' section of the SafetyCube DSS. It includes an 'Input' section with dropdown menus for 'Country' (set to 'Austria'), 'Measure' (set to 'Infrastructure safety management - Speed management & enforcement - 3D zones implementation'), 'Years' (set to '2018'), 'Basis' (set to 'Crashes'), 'Penetration rate' (set to '0.1'), and 'Side effects' (set to 'Excluded'). Below this is a 'Costs' section with checkboxes for 'Costs: Implementation' and 'Costs: Annual' (both checked). To the right, a 'Cost-Benefit Analysis' table is shown, detailing costs and benefits in EUR.

Costs (present values)	
Infrastructure safety management - Speed management & enforcement - 3D zones implementation	171000000 EUR
Costs: Implementation	171000000 EUR
Costs: Annual	0 EUR
Costs: Side effects	0 EUR
Costs: Total	171000000 EUR

Benefits	
Infrastructure safety management - Speed management & enforcement - 3D zones implementation	171000000 EUR
Benefits: Implementation	171000000 EUR
Benefits: Annual	0 EUR
Benefits: Side effects	0 EUR
Benefits: Total	171000000 EUR

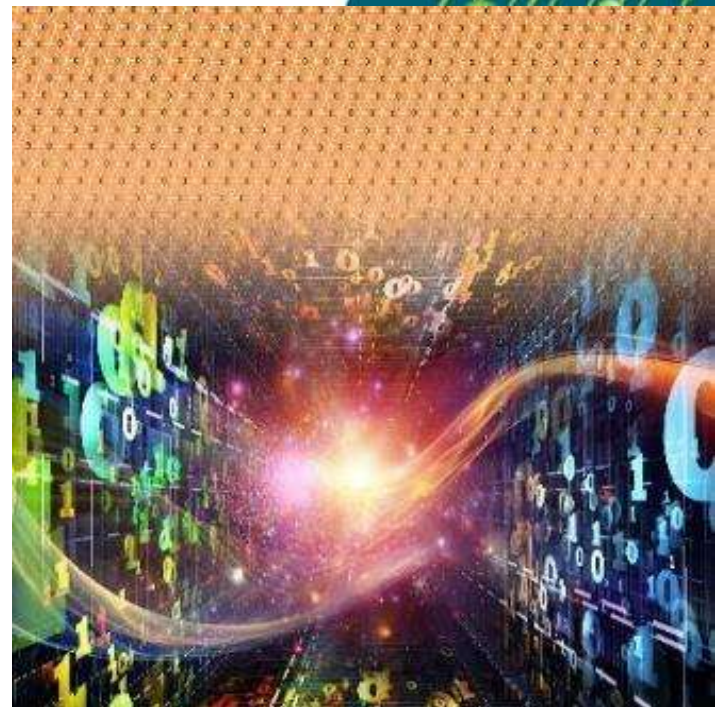
Socio-economic return excluding side effects	
Net present value	171000000 EUR
Cost-benefit ratio	1.0

Socio-economic return including side effects	
Net present value	171000000 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







## Contact

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