



ΣΥΛΛΟΓΟΣ ΕΛΛΗΝΩΝ
ΣΥΓΚΟΙΝΩΝΙΟΛΟΓΩΝ



7^o Panhellenic Road Safety Conference
Larissa, 11-12 October 2018

Overview of the SafetyCube project: Towards a European Road Safety Decision Support System

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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

1. Creating **taxonomies** of risk factors and measures
 2. Exhaustive **literature review** & 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**



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 SafetyCube DSS website. At the top is the header with the logo and title 'European Road Safety Decision Support System'. Below the header is a navigation bar with links: Search, Knowledge, Calculator, Methodology, and Support. Underneath is a row of five icons representing different categories: Keyword Search, Risk Factors, Measures, Road User Groups, and Accident Categories. Below this is a table with four columns: Road User, Infrastructure, Vehicle, and Post Impact Care. The table lists various risks and measures associated with each category.

Road User	Infrastructure	Vehicle	Post Impact Care
Law and enforcement	Traffic flow	Frontal impact	Amputation/lost limb
Education and voluntary training or programmes	Traffic composition	Side impact	Extracranial brain injury
Driver training and licensing	Formal tools to address road network infrastructure	Rear impact	Int hospital medical care
Methods to drive assessment and rehabilitation	Speed management & enforcement	Roll-over	Diagnosis and allocation to trauma facilities
Law enforcement and compliance	Road type	Reckless	First aid training drivers
	Road surface treatments	Crash	
	Marking / Lighting treatments	HyV	
	Workzones	Cyclist	
	Horizontal & vertical alignment treatments	Motor	
	Superelevation / cross-slopes treatment	Longitudinal	
	Barriers / noise treatments	Wheel 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 reporting 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

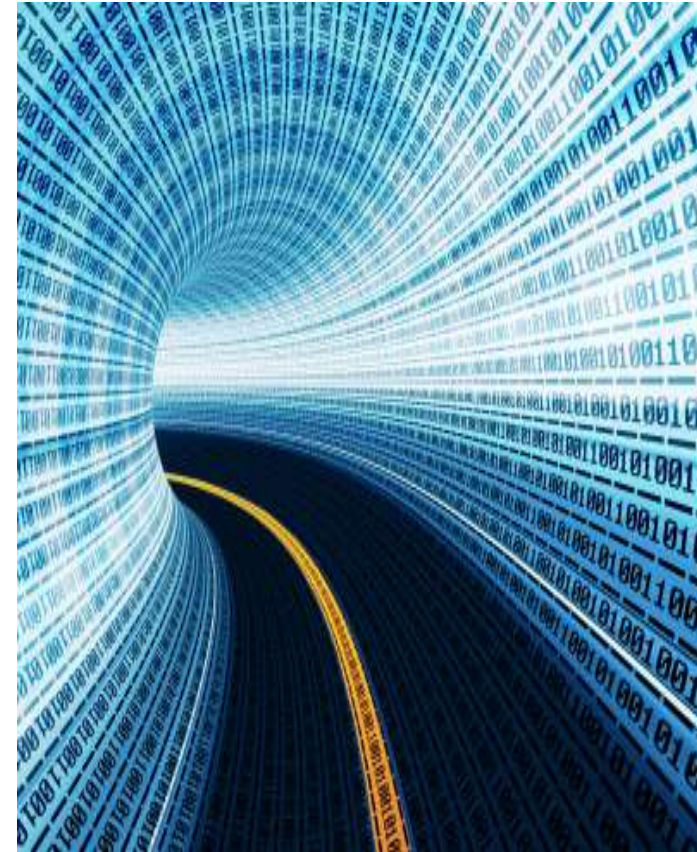
- search by any parameter in each data table in the database

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**
215 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. To the left of the main content area, a list of keywords is shown, grouped by a bracket under the "PEDESTRIAN" category. The keywords include: CHILD PEDESTRIANS, PEDESTRIAN CROSSING, PEDESTRIAN CROSSING, PEDESTRIAN SIGNAL, PEDESTRIAN CRASHES, PEDESTRIAN AIRBAGS, and PEDESTRIAN DETECTION. The main content area shows a detailed taxonomy for "PEDESTRIAN". It is divided into two main sections: "Risk Factors" (red background) and "Measures" (blue background). The "Risk Factors" section is further divided into three columns: Behavior, Infrastructure, and Vehicle. The "Measures" section is divided into three columns: Behavior, Infrastructure, and Vehicle. The "Post Impact Care" column is also present. The "Risk Factors" section includes sub-headers: Functional Impairment, Detection and Identification, and Traffic Rule Violations. The "Measures" section includes sub-headers: Education and voluntary training/programs, Traffic signals treatments, Road markings and junctions, Speed management & enforcement, Speed management, Rail road crossings, and Traffic signs treatments.

Risk Factors			Measures			Post Impact Care
Behavior	Infrastructure	Vehicle	Behavior	Infrastructure	Vehicle	Post Impact Care
Functional Impairment	Adverse weather	Pedestrian	Education and voluntary training/programs	Traffic signals treatments	Pedestrian	Not Applicable
Detection and Identification	Poor junction visibility	Visibility / Congestion		Road markings and junctions	Vulnerable Road User Protection	
Traffic Rule Violations	All-grade junction deficiencies	PKW / ATV		Speed management & enforcement	Infrastructure	
	Median / barrier deficiencies (risk of crash with oncoming traffic)	LDV		Speed management		
	Horizontal/vertical alignment deficiencies	Passenger Cars		Rail road crossings		
	Traffic flow			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



215 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)

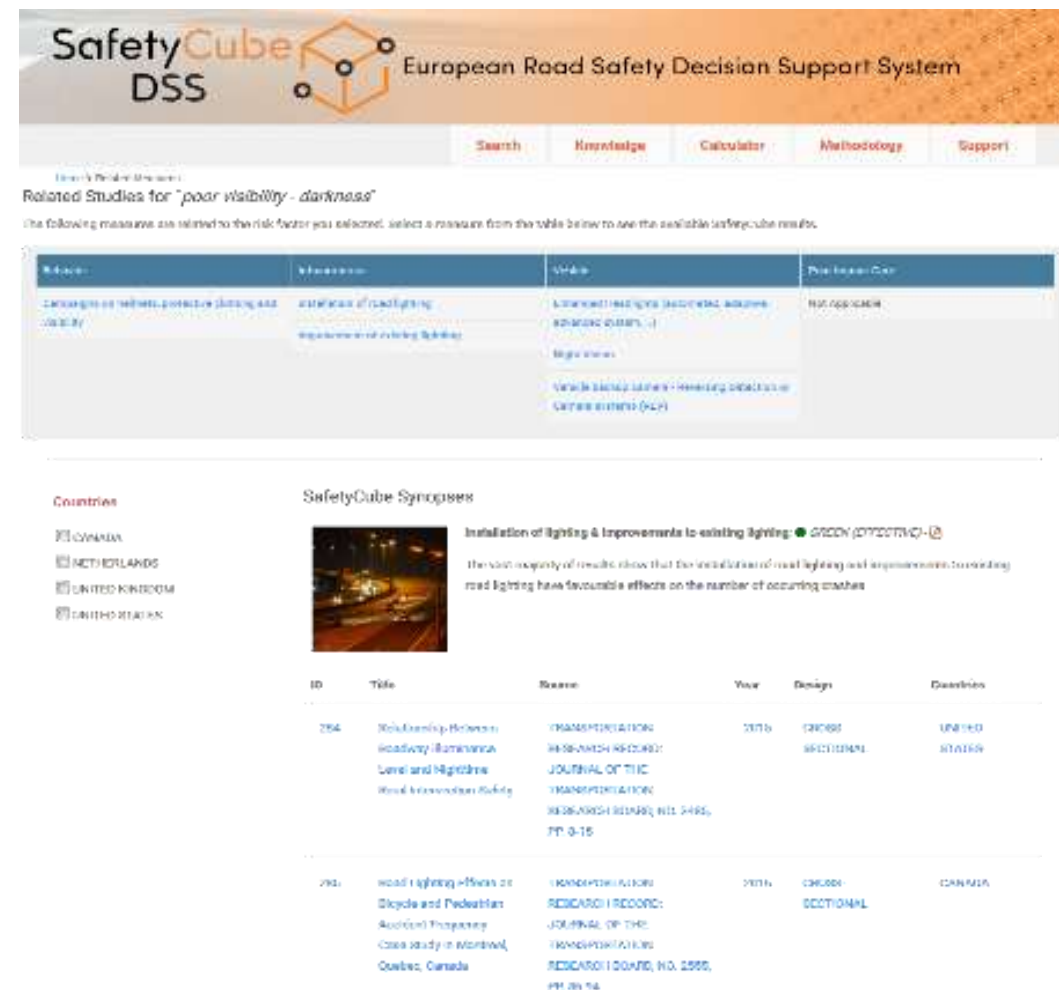
- Literature search strategy & study selection criteria
- Detailed analyses



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. At the top, there's a header with the SafetyCube logo and navigation tabs: Search, Knowledge, Calculator, Methodology, and Support. Below the header, a search bar shows the query "poor visibility - darkness". A message states: "The following measures are related to the risk factor you selected. select a measure from the table below to see the available SafetyCube results." A table lists related measures with columns: Measure, Information, Value, and Priority/Order. The table shows two measures: "improvement of road lighting" and "improvement of existing lighting". Below the table, there's a section for "SafetyCube Synopses" featuring a thumbnail image of a road at night and a summary of the installation of lighting and improvements to existing road lighting. A table below this section lists specific studies with columns: ID, Title, Research, Year, Design, and Countries. The table contains two entries, one for the UK and one for Canada.

Measure	Information	Value	Priority/Order
improvement of road lighting	improvement of road lighting	improvement of road lighting	Not applicable
improvement of existing lighting	improvement of existing lighting	improvement of existing lighting	Not applicable

SafetyCube Synopses

Installation of lighting & improvements to existing lighting (GREEN (EFFECTIVE) - 1)

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	Research	Year	Design	Countries
264	Relationship between Roadway Illuminance Level and Nighttime Road Intersection Safety	TRANSPORTATION RESEARCH RECORD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2485, PP. 9-15	2010	CONTROLLED	UNITED STATES
294	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. 2555, PP. 29-34	2010	CONTROLLED	CANADA

SafetyCube DSS Individual Study Pages

Title, author, source, abstract

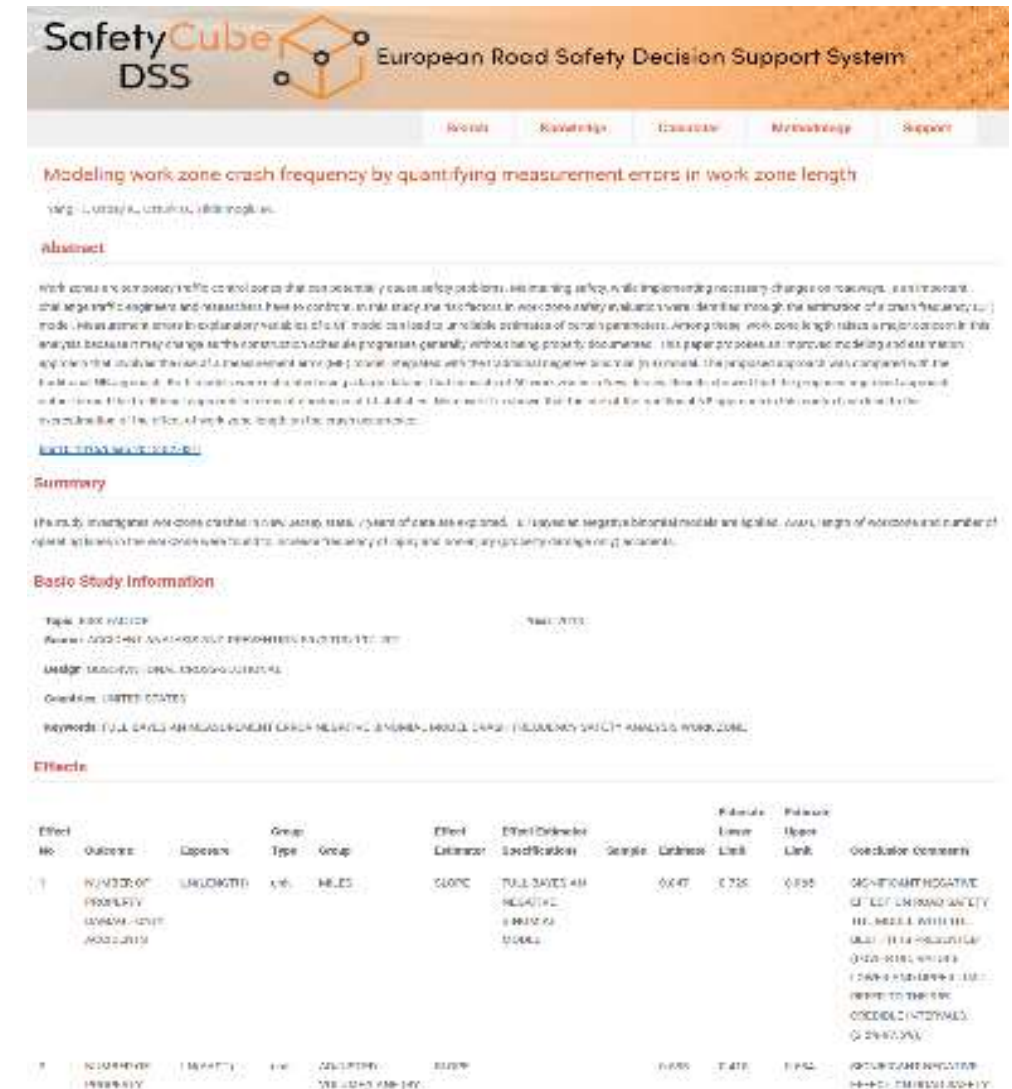
- Link to URL for full-text download (depending on Institute permissions)

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



The screenshot displays the SafetyCube DSS web interface. At the top, the header includes the SafetyCube DSS logo and the text 'European Road Safety Decision Support System'. Below the header, there are navigation tabs: 'Home', 'Knowledge', 'Database', 'Methodology', and 'Support'. The main content area is titled 'Modeling work zone crash frequency by quantifying measurement errors in work zone length'. It includes an abstract, a summary, and a table of study information. The table of study information lists the topic, research question, design, location, and keywords. Below this, there is a table of effects, which is partially visible in the screenshot.

Effect No.	Outcome	Exposure	Group Type	Group	Effect Estimator	Effect Definition Specifications	Geography	Language	Lower Limit	Upper Limit	Conclusion Comments
1	NUMBER OF PROBABLY WORK ZONE ACCIDENTS	UNLIMITED	YES	NO	COX	FULL-SIZE AND REGULAR SIZES	USA	ENG	0.75	0.95	SIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY (11.1% REDUCTION IN ACCIDENTS WITH THE FULL-SIZE AND REGULAR SIZES) COMPARED TO THE REGULAR SIZES (CONTROLLED INTERVENTION).
2	NUMBER OF PROBABLY WORK ZONE ACCIDENTS	UNLIMITED	YES	NO	COX	FULL-SIZE AND REGULAR SIZES	USA	ENG	0.75	0.95	SIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY (11.1% REDUCTION IN ACCIDENTS WITH THE FULL-SIZE AND REGULAR SIZES) COMPARED TO THE REGULAR SIZES (CONTROLLED INTERVENTION).

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 Calculator interface. The top navigation bar includes links for Search, Knowledge, Calculator, Methodology, and Support. The main content area is titled 'Calculator' and features a balance scale icon. Below the title, there is a brief description of the tool's purpose: to calculate the Economic Efficiency Evaluation (E3) of road safety measures. The interface is divided into two main sections: 'Input' and 'Cost-Benefit Analysis'.

Input

Measure:

Description:

Country:

Measure:

Behavioural measure of road safety:

Number of years of implementation:

Costs

☐ Cost breakdown per user

☐ Total Cost For UK

Cost-Benefit Analysis

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

Revised costs

Costs (present values)	
One-time investment costs	12241 EUR
Recurrence costs	175000 EUR
Total costs including side-effects	187241 EUR
Side-effects	0 EUR
Total costs including side-effects	187241 EUR

Benefits

Investment costs	12241 EUR
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Socio-economic return excluding side-effects

Net present value	60075.42 EUR
Cost-benefit ratio	1.9

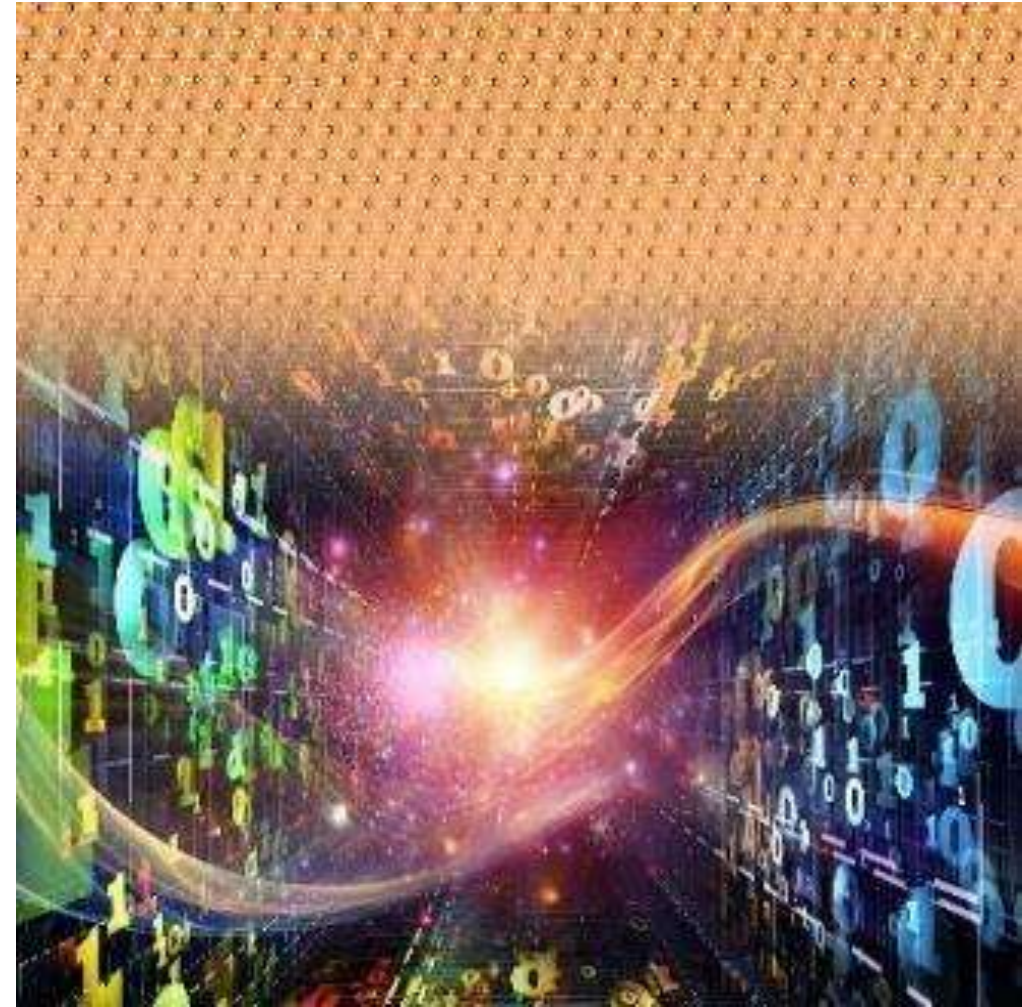
Socio-economic return including side-effects

Net present value	60075.42 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
- **215 Synopses**
- **37 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 **is open** (October 2017):
<https://www.roadsafety-dss.eu>
- 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 & 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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