

SafetyCube - the European Road Safety Decision Support System



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Annual Polis Conference, December 6-7, 2017



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)
by NHTSA (USA) - **5.151 CMF** on infrastructure only - on going
- 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 (toolkit.irap.org/)
by iRAP - **58 treatments** (43 on infrastructure)
- Safety Performance Factors Clearinghouse (spfclearinghouse.org)
by Tatum Group LLC, Dr. Andrew Kwasniak (USA) - **few SPF** – subscribers only

SafetyCube DSS Users



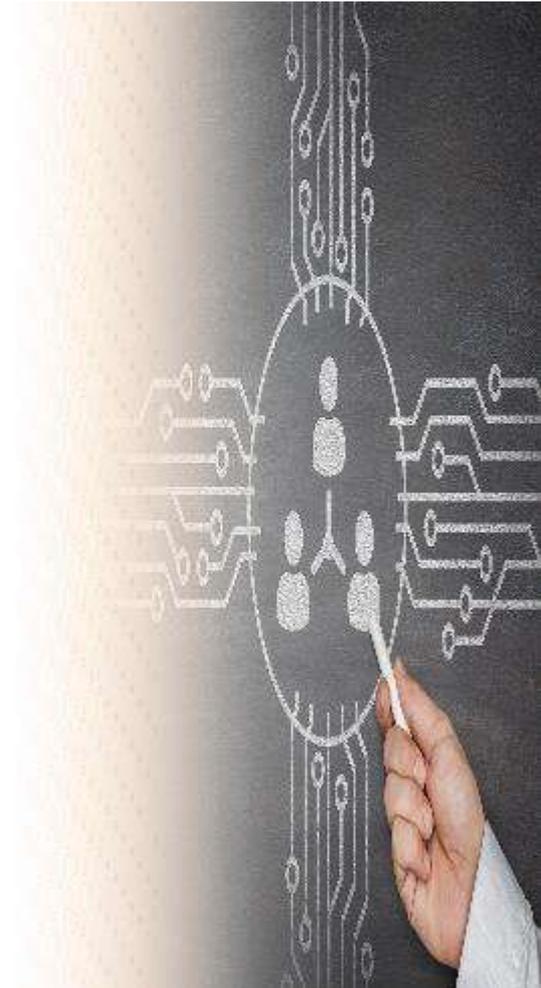
- **Public Authorities**
local, regional, national, European and international
- **Industry**
Infrastructure, Vehicle, Insurance, Technology
- **Research Institutes, Experts**
- **Non Governmental Organisations**
- **Mass Media**
- **Everyone**

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.
- **Systems approach:** links between infrastructure, user and vehicle risks
 - Emphasis on risk factors and measures of **priority issues** (VRUs, ADAS, speed management, distraction, etc.)
 - 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)

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 network 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	
		Longitudinal	

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 journals)
- Recent studies
- European studies

Coding of studies in a dedicated template

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



SafetyCube Synopses



150 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

Synopsis 11: Presence of workzones Workzone length



Illustration: Presence of workzones length (1)

1 Summary

Thalwitzer A., Perakowski J., Danegren A., Vaino O., Samerakoski J., Juntti C.
September 2016

1.1.1 Introduction

The presence of long workzones is frequently considered as a risk factor, since more crashes are likely to occur in extensive work areas (increased crash risk). This work was reported by all coded studies, which have shown a consistent negative effect on the number of crashes (increased crash risk) and was also confirmed by the meta-analysis carried out. This study also indicates that increased length of work zones increases the probability of crash occurrence.

1.1.2 Workzone length studies

1.1.2.1 Introduction

It can be assumed that long work zones may increase risk of crashes, because work zones are artificial road environments for road users, due to special arrangements (lane closures, traffic disruptions, changes in road delineation and signage, presence of barriers, obstacles, workers etc.). In general, work zone length was found to significantly increase the number of crashes. The most majority of international literature investigated crash happening, following that longer work zone lengths in road networks are associated with an increased number of crashes at a 95% confidence level. This result is confirmed by the meta-analysis that was carried out, which revealed a significant overall estimate of work zone length. However, only one study that investigated crash risk probability of crash occurrence in non-road environments was found, suggesting that work zone length significantly increases crash risk.

1.1.2.2 Introduction

The data factor has a straightforward definition in international literature. It is defined as 'work zone length' and examined as nominal variable measured in miles or kilometers. However, a number of studies measure it as the ratio (proportion) of length, for roadwork purposes.

1.1.2.3 How does work zone length affect road safety?

It is expected that long work zones may increase risk of crashes, because work zones are artificial road environments for road users, due to special arrangements (lane closures, traffic disruptions, changes in road delineation and signage, presence of barriers, obstacles, workers etc.). Therefore, those exposures to work zones increase. Consequently, it is likely that they pose a greater threat to the safety of road users than regular road segments. Therefore, presence of such arrangements for long road segments can deteriorate road safety levels.

1.1.2.4 Which safety outcomes are affected by work zone length?

In international literature, the effect of work zone length on road safety has been measured mainly on the basis of crash frequency (number of crashes occurred). Less frequently, it was found to be

Illustration: Presence of workzones length (2)

measured as crash risk (probability of crash occurrence versus probability of non-crash occurrence). It is noted that to studies concerning crash or injury severity were identified through the literature search.

1.1.2.5 How is the effect of work zone length studied?

In general, when the impact of work zone length is examined, crash data from police records are usually utilized. Regarding the methods of analysis, the effect of workzone length is usually examined by applying multivariate linear statistical models. When crash frequency is examined, the relationship between work zone length and number of crashes is investigated by applying negative binomial models. Probability of crash occurrence was investigated by applying rare events logistic regression models.

1.1.2.6 Mechanism of exposure

The entire examination of relevant studies suggests that the effect of work zone length on road safety is generally consistent, meaning that when work zone length increased length the number of crashes is increased. The same direction of the effect is obtained when crash risk is examined (probability of crash occurrence in non-road environments), where there is also a negative effect of work zone length on safety.

on the frequency of crashes is considered to be the same for all observations (all work zone segments). Consequently, the resulting estimate indicates that is biased.

Overall, this risk factor would be considered to be adequately studied. However, there was no detailed focusing on the effect of work zone length on crash or injury severity. However, this is an essential part of the data and this is a specific focus of other studies. In conclusion, data concerning more outcomes and differential crash risk would be needed.

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 Design Principles



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



SafetyCube DSS Menu



- **Search**

Risk Factors & Measures

- **Knowledge**

135 synopses

- **Calculator**

Econ. Efficiency Evaluation
(under development)

- **Methodology**

System documentation

- **Support**

Contact, help, feedback



This is the European Road Safety Decision Support System, which has been produced within the European research project SafetyCube, funded by the European Commission, aiming to support evidence-based policy making. The SafetyCube Decision Support System provides detailed interactive information on risk factors and related road safety countermeasures. A Quick Guide on using the SafetyCube DSS, with instructions on how to browse the results, is available for download [here](#).



SafetyCube DSS Search Pages

○ — ○
DSS Search through five 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**
 (under development)

The screenshot shows the SafetyCube DSS interface. At the top, there is a header with the logo and the text "European Road Safety Decision Support System". Below the header are navigation tabs: Search, Knowledge, Calculator, Methodology, and Support. The main content area features five large tiles for "Keyword Search", "Risk Factors", "Measures", "Road User Groups", and "Accident Categories". A sidebar on the left lists search categories: CHILD PEDESTRIANS, PEDESTRIANS, PEDESTRIAN CROSSING, PEDELEC, MOPEDS, PEDESTRIAN CRASHES, PEDESTRIAN DETECTION, and PEDESTRIAN SIGNAL. The "PEDESTRIANS" category is selected, leading to a table with two main sections: "Risk Factors" and "Measures".

Risk Factors			Measures			
Behavior	Infrastructure	Vehicle	Behavior	Infrastructure	Vehicle	Post Impact Care
Functional Impairment	Adverse weather	LDV	Education and voluntary trainings/programs	Traffic signs treatments	Not Applicable	Not Applicable
Traffic Rule Violations	Poor junction readability	Passenger Cars		Road markings at junctions		
	At-grade junction deficiencies	Pedestrian		Speed management & enforcement		
	Median / barrier deficiencies (risk of crash with oncoming traffic)	PTW / ATV		Speed management		
	Traffic flow		Traffic signs treatments			
			Rail-road crossings			

SafetyCube DSS Results Pages

Search results

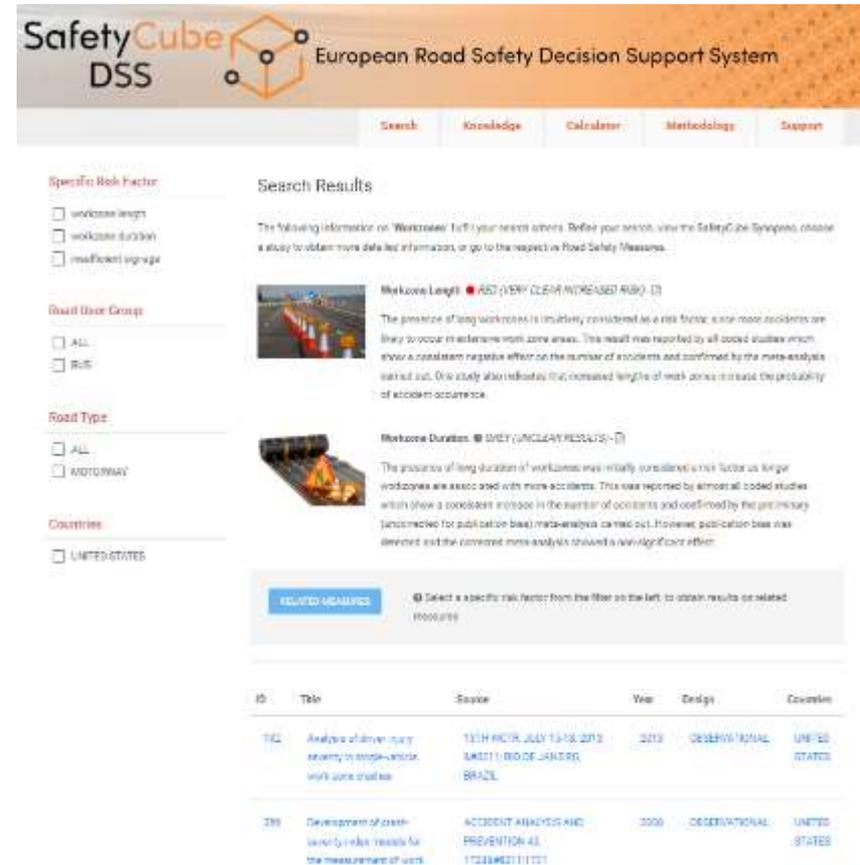
- Synopses, and their short summaries & colour codes
- Table listing the available studies

Refine search

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

Links to related measures

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



The screenshot displays the SafetyCube DSS interface. The header includes the logo and the text 'European Road Safety Decision Support System'. Below the header are navigation tabs: Search, Knowledge, Calculator, Methodology, and Support. The main content area is divided into a left sidebar with filters and a right main panel with search results.

Specific Risk Factor:

- workzone length
- workzone duration
- insufficient signage

Road User Group:

- ALL
- RUC

Road Type:

- ALL
- MOTORWAY

Country:

- UNITED STATES

Search Results

The following information on 'Workzone Length' will be shown to you. Refine your search, view the SafetyCube Synopses, choose a study to obtain more detailed information, or go to the respective Road Safety Measures.

Workzone Length (ASD) (NEW) (CLEAR) (NOISE) (RUP) (1)

The presence of long workzones is relatively considered as a risk factor, since road accidents are likely to occur in extension work zone areas. This result was reported by all coded studies which show a consistent negative effect on the number of accidents and confirmed by the meta-analysis carried out. One study also indicates that, consistent lengths of work zones increase the probability of accident occurrence.

Workzone Duration (NEW) (UNCLEAR) (RESULTS) (-)

The presence of long duration of workzones was initially considered as a risk factor as longer workzones are associated with more accidents. This was reported by almost all coded studies which show a consistent increase in the number of accidents and confirmed by the preliminary (unconnected for publication base) meta-analysis carried out. However, publication base was derived and the connected meta-analysis showed a non-significant effect.

RELATED MEASURES (Select a specific risk factor from the filter on the left, to obtain results on related measures)

ID	Title	Source	Year	Design	Country
142	Analysis of driver safety by type-vehicle work zone studies	13TH FACTOR JULY 13-18, 2013 (44221) (RUC) (LANDING) BRAZIL	2013	OBSERVATIONAL	UNITED STATES
139	Development of crash severity index results for the measurement of work	ACCIDENT PREVENTION AND PREVENTION 43 (12334221) (1) (1)	2000	OBSERVATIONAL	UNITED STATES

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



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

Heng H., Orbay K., Ozark G., Yilmazoglu M.

Abstract

Work zones are temporary traffic control zones that can potentially cause safety problems. Minimizing 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.2013.02.001

Summary

The study investigates workzone crashes in New Jersey state. 7 years of data are analyzed. 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 noninjury (property damage only) accidents.

Study Design

Topic: RISK FACTOR Year: 2013

Source: ACCIDENT ANALYSIS AND PREVENTION 33 (2013) 1928-1931, 2013

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	Effect Group	Effect Estimator	Estimator Specifications	Sample	Estimate	Estimate		Credible Intervals
									Lower Limit	Upper Limit	
1	NUMBER OF PROPERTY DAMAGE ONLY ACCIDENTS				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 DAMAGE				SLOPE			0.836	0.413	0.856	SIGNIFICANT NEGATIVE EFFECT ON ROAD SAFETY.

SafetyCube Related Risks / Measures



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.

Behavior	Infrastructure	Vehicle	Post Impact Care
Helmet, protective clothing and visibility	installation of road lighting improvement of existing lighting	Enhanced Headlights (automated, adaptive, advanced system, ...) Night Vision Vehicle backup camera - Reversing Detection or Camera systems (REV)	Not Applicable

Countries

- CANADA
- NETHERLANDS
- UNITED KINGDOM
- UNITED STATES

ID	Title	Source	Year	Design	Countries
327	Relationship Between Roadway Illuminance Level and Nighttime Rural Intersection Safety	TRANSPORTATION RESEARCH RECORD: JOURNAL OF THE TRANSPORTATION RESEARCH BOARD, NO. 2485, PP. Bಋ15	2015	CROSS-SECTIONAL	UNITED STATES
328	Road Lighting Effects on Bicycle and Pedestrian Accident Frequency Case	TRANSPORTATION RESEARCH RECORD: JOURNAL OF THE	2016	CROSS-SECTIONAL	CANADA

SafetyCube DSS Calculator



Economic Efficiency Evaluation Tool (E₃)

- 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**.
- 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*
- Under development and coming soon ...

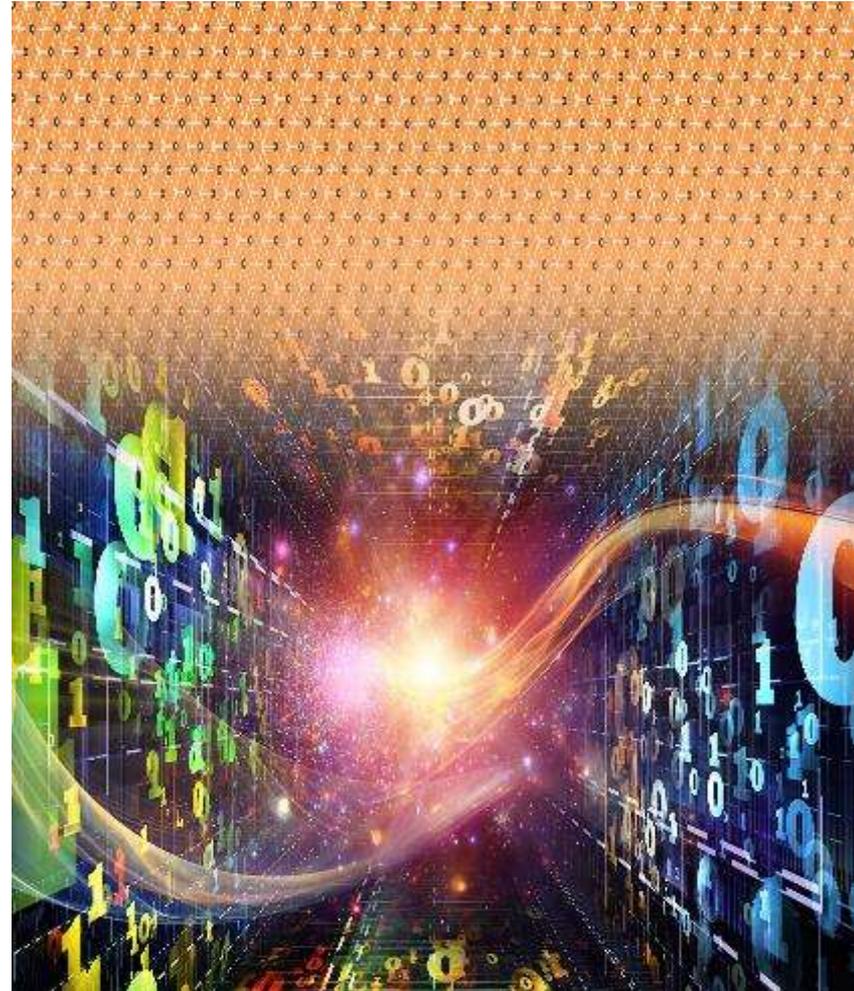


SafetyCube DSS Knowledge Wealth



SafetyCube DSS will eventually include by April 2018:

- more than **1,200 studies**,
- with more than **7,500 estimates** of risks/measures effects on:
 - behaviour,
 - infrastructure,
 - vehicle, and
 - post impact care
- more than **150 Synopses**
- more than **50 cost-benefit analyses** (adjustable)



Development and Operation Phases



- **SafetyCube DSS Pilot Operation**
 - *Started early 2017*
 - *User feedback exploited*
- **SafetyCube DSS Opening**
 - *October 2017*
- **Continuous Enhancement and Update**
 - *Until April 2018 (end of SafetyCube project)*
 - *And beyond...*



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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