Developing the European Road Safety Decision Support System

within the *SafetyCube* project



Pete Thomas¹, Eleonora Papadimitriou² & George Yannis² ¹ Loughborough University, ² National Technical University of Athens



The SafetyCube project

1/18/2017

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 concept and vision

- Problem
 - Evidence based road safety policies are becoming more usual and there is much better availability of national data and state of the art knowledge
 - Effective road safety policies need good information about accident risk factors and about measures
- SafetyCube will meet this need by generating new knowledge about accident risk factors and the effectiveness of measures relevant to Europe, to be integrated in a European Road Safety Decision Support System (DSS)



Challenges of the evidence based approach

- Do we have a comprehensive method to identify risks?
 - Road, road users and vehicles
- Do we have a comparable method to evaluate measures?
 - Road, road users and vehicles
- How do we estimate the likely casualty reduction of a measure that has not been introduced to the realworld?
- Do we have a comprehensive method to evaluate costeffectiveness?
- How do we handle the situation where there are many measures of effectiveness but they disagree?



Accessing the evidence base

- Much of the evidence on risks and measures is in the research literature – how can it be brought together?
- How can we assess transferability of measures from one country to another?
- How can the available information and data be synthesised?
- How can it be made accessible to stakeholders?



SafetyCube will meet these challenges

SafetyCube will:

- Provide new information about the effects of risk factors and related measures by bringing together published information
- Produce a comprehensive method to evaluate the costs and benefits of measures
- Produce new information about seriously injured casualties
- Produce a new **Decision Support System** that will enable easy access to information on risks and measures



SafetyCube methodology

- Creating taxonomies of risk factors and measures
- 2. Exhaustive literature review and rigorous study selection criteria
- 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
- Hot topics & additional risk factors and measures
- Assessment of the quality of the data / study methods

What have we already achieved?

- Mid-point of SafetyCube
- Consulted many different stakeholders
- Already reviewed and summarised hundreds of studies on crash risks
- Developed an outline of the SafetyCube DSS and its functionality
- Progressed well with work on serious injuries
- Preparing for the second half of the project
- Preparing for final project conference 22-23 March 2018 Vienna





Development of the DSS

1/18/2017

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 Too 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 casualty reduction effectiveness
- cost-benefit evaluation
- all related analytic background

Special focus is given to linking road safety problems with related countermeasures. Framework for Assessing and Transferring Highway Safety Performance Measurement to Both Developing and Developed Countries

TRB Annual Meeting, January 8th, 2017



Current Road Safety DSS Worldwide

- Crash Modification Factors Clearinghouse (<u>www.cmfclearinghouse.org</u>) by NHTSA (USA) - **5.151 CMF** on infrastructure only - on going
- Road Safety Engineering Kit (<u>www.engtoolkit.com.au</u>)
 by Austroads (Australia) 67 treatments on infrastructure only
- PRACT Repository (<u>www.pract-repository.eu</u>)
 by CEDR (Europe) 889 CMF and 273 APM on infrastructure only high quality
- iRAP toolkit (<u>toolkit.irap.org/</u>)
 by iRAP **58 treatments** (43 on infrastructure)
- Safety Performance Factors Clearinghouse (<u>spfclearinghouse.org</u>)
 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
- Non Governmental Organisations
- Mass media

The SafetyCube DSS is intended to have a life well beyond the end of the SafetyCube research project. Furthermore, it will be developed in a form that can readily be incorporated within the existing European Road Safety Observatory of the European Commission DG-MOVE.



SafetyCube DSS Design Principles

- A **Modern** web-based tool
- High **Ergonomy** interface
- Simple structure
- Powerfull **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 scenaria)

Fully **detailed** search

- search by any parameter in each data table (road safety problems, measures)
- Fully **flexible** search
 - adjust and customize search according to results
- Fully documented search
 - access background information at any stage (links, etc.)



Relational Data Base

- The templates of coded studies undergo a thorough checking and debugging process
- The templates are eventually stored in a relational database, which serves as the back-end of the DSS
- Front-end DSS results are retrieved through queries on the back-end database (DSS search engine).



SafetyCube DSS Structure

0							
T. Keyword search Level 0 (search field)		A. Risk Factors	B. Measures	C. Road User Groups	D. Accident Scenarios	E. Methodology	
Level 1 Search pages	Page T1. Keyword search form - Type keyword Deleted Biels (behaviour	Page A1. Risk factor search form Search from full taxonomy All Diale (helpsion		Page C1. Road user group search form - Select Road User group - Related Risks (behaviour,	Page D1. Accident scenario search form - Select accident scenario	Page E1. Methodology page - About SafetyCube - Methodology	
	- Related Risks (behaviour, infrastructure, vehicle) - OR Related Measures (behaviour, infrastructure, vehicle)	- All Risks (benaviour, infrastructure, vehicle)	- All Risks (behaviour, nfrastructure, vehicle)		Related Risks (behaviour, infrastructure, vehicle) OR Related Measures (behaviour, infrastructure, vehicle)	- Disclaimer - Glossary	
Level 2		Page A2. Risk factors	Page B2. Measures				
Results pages		- Synopses of risk factors	s - Synopses of measures				
		- Results Table (list of studies / estimates)	- Results Table (list of studies / estimates)				
		- Refine search	- Refine search				
		Page A3. Risk factor	Page B3. Measure				
Level 3 Individual study		- detailed study info	individual study form - detailed study info				

Home Page Main Menu (Search - Tools)

Three Levels of Search (Search - Results pages - Individual study pages) Two Interlinked Search Streams (Risk Factors – Road Safety Measures)



DSS prototype demonstration

1/18/2017

SafetyCube DSS Homepage (Entry Points)

- Methodology
 Basic Information about SafetyCube and the DSS
- Search
 - Text search (key-words)
 - **Risk Factors** (Risk factors search engine)
 - Road Safety Measures (Measures search engine)
 - Road User Groups (Risk factors and Measures search engines)
 - Accident Scenarios

 (Risk factors and Measures search engines)



SafetyCube (Safety CaUsation, Benefits and Efficiency) is a research project funded by the European Commission under the Horizons 2020, the EU Framework Programme for Research and Innovation, in the domain of Road Safety. The project started on May 1st, 2015 and will run for a period of three years.

The primary objective of the SafetyCube project is to develop an innovative road safety **Decision Support System (DSS)** that will enable policy-makers and stakeholders to select and implement the most appropriate strategies, measures and cost-effective approaches to reduce casualties of all road user types and all severities in Europe and worldwide.

Funding Reference:



SafetyCube is a project financed by the European Commission: Innovation and Networks Executive Agency (INEA).

Contact

Pete Thomas Professor of Road and Vehicle Safety Safe and Smart Mobility Research Cluster Loughborough University Loughborough, LE11 3TU, UK Tel: +44 1509 226931 email: SafetyCube@iboro.ac.uk

Disclaimer

All the material included in the SafetyCube website reflect the authors' view and the SafetyCube Consortium cannot be held liable for third party use of data and information contained in the SafetyCube website.

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Risk Factors Search Parameters

Three categories of taxonomy fields

- <u>Categories (3)</u> road user, infrastructure, vehicle
- <u>Topics (57)</u>

e.g. roadside deficiencies, distraction inside vehicle, inappropriate speed

<u>Specific risk factors (175)</u>
 e.g.no clear-zone, mobile phone, too fast / too slow

Behaviour	Infrastructure	Vehicle	
Speed choice	Traffic flow	Prevalence of vehicle factors in crash data	
Influenced driving - alcohol	Road functional class	Injury mechanism	
Influenced driving - drugs	Road surface deficiencies (risk of ran- off road)	Crashworthiness	
Risk taking	Poor visibility and lighting	Technical defects / Maintenance	
Fatigue	Adverse weather	Protective equipment design	
Distraction and inattention	Workzones	- Visibility / conspicuity	
Functional Impairment	Horizontal/vertical alignment deficiencies		
Insufficient skills	Superelevation / cross- slopes (risk of ran-off road)		
Insufficient knowledge	Lanes / ramps deficiencies		
Emotions & Stress	Median / barrier deficiencies (risk of crash with oncoming traffic)		
Misjudgement & Oberservation Errors	Shoulder and roadside deficiencies (risk of ran- off road or crash with obstacle)		
Traffic Rule Violations	Poor road readability		
Personal Factors	Interchange deficiencies		
Age	At-grade junctions deficiencies		
Diseases and disorders	Rail-road crossings (risk of collision with train)		
	Poor junction readability		

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Risk Factors results parameters

Search results

- Short summaries of syntheses (meta-analyses) available
- Table listing the available synopses, meta-analyses and other studies
- Table columns concern main study characteristics (design, outcome variable, effect type and size, country, year etc.)

Refine search

- Specific risk factor
- Search filters:
 - <u>Road user types</u>: All, car occupants, drivers, passengers, PTW riders, pedestrians, cyclists, HGV.
 - Road types: All, motorways, rural roads, urban roads
 - <u>Region / Country</u>: EU, EU countries (all names), US and Canada, Australia, Asia.
 - <u>"Colour code"</u>: Risky, probably risky, unclear, probably not risky

Links to related measures

Go to measures search page, where the list of related measures is displayed as a pre-filled search

• Inttp://www.safetycube-ds		,			G	☆ 🔒 🗄		
Sc	DSS	European Road Safety I	Decision Support Syste	in a start star				
			Search Meth	odology				
	Risk Factors	Search Results						
Refine Search				-				
Infrastructure	The following information on Work Zones Risk Factor fulfill your search criteria. Refine							
Workzones V	your search, view the SafetyCube Synopses on Risk Factor, choose a study to obtain more detailed information, or go to the respective Road Safety Measures.							
Specific Risk Factors Work Zone duration								
duration		uration of workzones was ini						
Work zone length	likely to occur. This was reported by almost all coded studies which show a consistent increase in the number of accidents and confirmed by the preliminary (uncorrected for publication bias) meta-analysis carried out. However,							
Insufficient signage	publication bias was detected and the corrected meta-analysis showed a non-significant effect.							
Road User Types	Work Zone length 🔳 🔛							
Car occupants	The presence of long workzones was initially considered a risk factor as more accidents are likely to occur in extensive work zone areas. This result was found by all coded studies which show a consistent negative effect on							
Drivers	the number of accidents and confirmed by the meta-analysis carried out. One study also indicates that increased lengths of work zones are associated with high probability of accident occurrence.							
Passengers								
PTW riders	Related Road Safety Measures							
Pedestrians								
Cyclists	Risk Factor	Source	Outcome variable	Effect estimator	Effect size	Country		
🗌 нgv	Work zone duration	SafetyCube Synopsis	Accident frequency	Meta-analysis	Non significant			
Road Types	Work zone length	SafetyCube Synopsis	Accident frequency	Meta-analysis	Significant			
Motorways	Work zone duration	Khattak et al., 2002	Accident frequency	Slope	Significant	USA		
Rural Roads	Work zone duration	Ozturk et al., 2013	Accident frequency	Slope	Significant	USA		
Urban Roads	Work zone duration	Pal and Sinha, 1996	Accident frequency	Slope	Significant	USA		
Region	Work zone duration	Venugopal and Tarko, 2000	Accident frequency	Slope	Significant	USA		
🗌 Asia	Work zone duration	Yang et al. 2015	Accident risk	Slope	Non significant	USA		
Australia	Work zone length	Khattak et al., 2002	Accident frequency	Slope	Significant	USA		
Europe	Work zone length	Ozturk et al., 2013	Accident frequency	Slope	Significant	USA		
🔲 US & Canada	Work zone length	Ozturk et al., 2014	Accident frequency	Slope	Significant	USA		
Color Code	Work zone length	Chen and Tarko, 2012	Accident frequency	Slope	Significant	USA		
📕 Risky	Work zone length	Chen and Tarko,2014	Accident frequency	Slope	Significant	USA		
Probably risky	Work zone length	Yang et al., 2013	Accident frequency	Slope	Significant	USA		
Probably not risky	Work zone length	Venugopal and Tarko, 2000	Accident frequency	Slope	Significant	USA		

SafetyCube DSS

SafetyCube synopses

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)

- Comprehensive comparative analysis of available studies designand results
- Analysis results
 - Meta-analysis
 - Vote-count analysis
 - Qualitative analysis

Supporting document (3-10 pages)

- Literature search strategy and study selection criteria
- Detailed analyses

Author(s) and Year		Beta coefficient [95% CI]
Pal and Sinha, 1996 Pal and Sinha, 1996 Khattak et al, 2002 Khattak et al, 2002 Khattak et al, 2002 Oziurk et al, 2013 Venugopal and Tarko, 2000 Venugopal and Tarko, 2000		0.004[0.002.0.006] 0.000[0.005.0.011] 3.049[0.802.5206] 3.427[1.044.5810] 3.307[1.253.5.762] 2.034[-0.096.4.166] 0.513[0.037.0.966] 0.526[-0.058.1.110] 0.495[-0.068.1.058]
Random effects model		1.035[0.247,1.823]
2.000 Adju:	0.000 2.000 4.000 sted beta coethcient of .WZ du	6.000 uration



Adjusted estimates of WZ duration (beta coefficient)

Individual study results

Title, author, source, abstract

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

Study design info

- Country
- Research Method, Design, Sample N
- Control group, Risk Group
- Modifying Conditions

Study results:

- Table listing the effects reported in the study
- Table columns concern main study / effect characteristics (outcome variable, effect type, size and confidence intervals, statistical significance)

SafetyCube DSS - 0 × ♦ ○ http://www.safetycube-dss.eu/structure C \$ ↑ ↑ E SafetyCube OS DSS European Road Safety Decision Support System Search Methodology

Effects of work zone presence on injury and non-injury crashes

Khattak et al., 2002, Accident Analysis and Prevention, 34 pp 19-29

Abstract

Work zones in the United States have approximately 700 traffic-related fatalities, 24 000 injury crashes, and 52 000 non-injury crashes every year. Due to future highway reconstruction needs, work zones are likely to increase in number, duration, and length. This study focuses on analyzing the effect of work zone duration mainly due to its policy-sensitivity. To do so, we created a unique dataset of California freeway work zones that included crash data (crash frequency and injury severity), road inventory data (average daily traffic (ADT) and urban/rural character), and work zone related data (duration, length, and location). Then, we investigated crash rates and crash frequencies in the pre-work zone and during-work zone periods. For the freeway work zones investigated in this study, the total crash rate in the during-work zone period was 21.5% higher (0.79 crashes per million vehicle kilometer (MVKM)) than the prework zone period (0.65 crashes per MVKM). Compared with the pre-work zone period, the increase in non-injury and injury crash rates in the during-work zone period was 23.8% and 17.3%, respectively. Next, crash frequencies were investigated using negative binomial models, which showed that frequencies increased with increasing work zone duration, length, and average daily traffic. The important finding is that after controlling for various factors, longer work zone duration significantly increases both injury and non-injury crash frequencies.



url: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.525.2933&rep=rep1&type=pc

Study design

Country: USA

Research methods: Negative Binomial Models Design: Observational study, Cross-sectional Sample: 2038 total accidents in 36 work zone sites in Indiana state, US, for the years 1992 ar Risk group: Work zone Control group: Modifying conditions: AADT

The following effects on Work Zones are reported in this study:

Risk factor	Unit	Outcome variable	Effect type	Effect size	Main outcome
Ln of workzone duration	Days	Injury and non-injury crashes	Slope	1.1149	Significant negative effect on road safety
Ln of workzone duration	Days	Non-injury crashes	Slope	1.2317	Significant negative effect on road safety
Ln of workzone duration	Days	Injury crashes	Slope	1.2549	Significant negative effect on road safety
Ln of workzone length	Km	Injury and non-injury crashes	Slope	0.6718	Significant negative effect on road safety
Ln of workzone length	Km	Non-injury crashes	Slope	0.6112	Significant negative effect on road safety
Ln of workzone length	Km	Injury crashes	Slope	0.7842	Significant negative effect on road safety



Next steps

SafetyCube DSS Development <u>Next s</u>teps

- Development of the static DSS (Wire Frames)
 - Completed
 - [further improved incorporating comments from this Workshop]
- SafetyCube DSS **Development phase**
 - between September and December 2016
 - including all risk factors (~3.500 effects from 600 studies) and several measures
- SafetyCube DSS Pilot Operation
 - starting early 2017
- SafetyCube DSS Opening
 - Starting mid 2017
- Continuous Enhancement and Update
 - Starting on April 2018 (end of SafetyCube project)



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 DSS <u>Delivering a long waited powerful tool</u>

- The SafetyCube DSS is a Road Safety Decision Support Tool : - long waited,
 - powerful,
 - full of scientific evidence,
 - user friendly, web-based and interactive
- 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



Dreams True



www.SafetyCube-project.eu

Pete Thomas, Professor of Road and Vehicle Safety p.d.thomas@lboro.ac.uk

Smart and Safe Mobility Research Cluster Loughborough University Leicestershire, LE11 3TU, United Kingdom Tel: +44 (0)1509 226931



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