# SafetyCube - the European Road Safety **Decision Support System** European Road Safety Decision Support System

SafetyCube of DSS

nd further refine the results, is available for download here.

SafetyCube DSS is the European Road Safety Decision Support System, which has been produced within the European revearch project

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ety-dss.eu/#/

urch project funded by the European Commission under the Horizons 2020, the EU Fra Prof. George Yannis

Risk Factors

### National Technical University of Athens

**CARE Experts Group Meeting** Brussels, October 6, 2017



AC Cate

vCube, funded within the Horizons 2020

of to browse the system, make a search

Road Use

alled interactive information on a large

Itethodology

Calculator

# The SafetyCube project



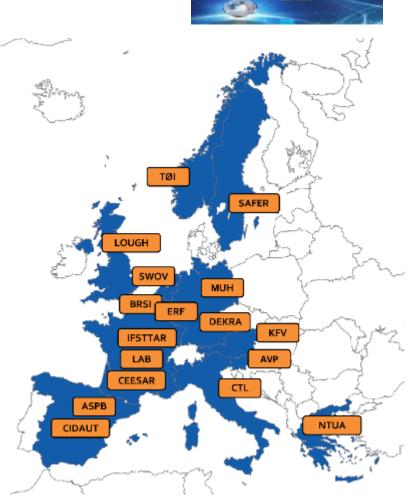
Funded by the European Commission under the **Horizon 2020** research framework programme

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 (<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, 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
- Exhaustive literature review and rigorous study selection criteria
- Use of a template for coding studies, to be introduced in the DSS back-end database
- Carrying out meta-analyses to estimate the effects of risk factors / measures.
- Drafting Synopses summarising results of risk factors / measures.
- Systems approach: links between infrastructure, user and vehicle risks
- Emphassis 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

## Keyword Search Factors Measures Groups Cated

### • 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 clearzone, low pedestrian rating (NCAP)

Behavior	Infrastructure	Vehicle	Post Impact Care
Law and enforcement	Traffic flow	Frontalimpact	Ambulances/helicopters
Education and voluntary training or	Traffic composition	Side impact	Extraction from vehicle
programmes	Formal tools to address road nettwork	Rear Impact	Pre-hospital medical care
Oriver training and licensing	deficiencies	Rollover	Triage and allocation to trauma facilitie
thess to drive assessment and habilitation	Speed management & enforcement	Pedestrian	First aid training drivers
	Road type	Child	
Iwareness raising and campaigns	Road surface treatments	PTW	
	Visibility / Lighting treatments	Cyclist	
<b>、</b>	Workzones	H3V	
)	Horizontal & vertical alignment beatments	Longitudinal	
	Conversion Lance elementaritment	and a second	

## **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

### 139 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



#### 1 Summary

Theofilatos A., Papadimitriou E., Ziakopoulos A., Yannis G., Diamandouros K., Durso C. September 2016

#### COLOUR CODE: RED

The passes of long workness is inhibitely considered as a risk factor, nices more crahes are likely to occur in antimic work zone areas (norsaed crash risk). This most ware arguested by all coded studies, which have show a consistent negative effect on the number of crashes (increased crash risk) and war also confirmed by the neta-analysis effect on the number of crashes (increased increased length of work zones increases that probability of crash occurrences.

KEYWORDS Work zones: length: crashes

#### 1.1 ABSTRACT

It can be somed that long work comes may increase shift of crashes, hences work zone are unfailed and an enterminent for most rate long, do to special responses that for comes, traffic displant, changes in nod delination and signage, presence of barries, obstace, works and an enterminent in the signal sequence, indicating that long work and majority of interactional fluctuum investigates can hengence, indicating that long work confidence work. This results a some and with an invested domains. The interaction of the signal sequence is the signal sequence indication work. This results down and by the meta-stack point was called and in the interaction work. This result is common and by the meta-stack point was called and in graduatility of exist accurates as non-calle accurace) was found, suggesting that work zone long the signal sequence can think and the common work zone.

#### 1.2 BACKGROUND 1.2.1 Definitions of workzone length

This risk factor has a straightforward definition in international literature. It is defined as "work zone length" and examined as numerical variable measured in miles or kilometers. However, a number of studies measure it as the natural logarithm of length, for modeling purposes.

1.2.2 How does work zone length affect road safety?

It is expected that long work some may increase rick of conduct, bacars work some as a workmilter and workments for most may user, be to special rangement (sine closure, treffic disruptions, changes in med delineation and signage, presence of sarriar, obstacks, worker actutandros, diverse users to so chick yol ement in creases Consequence), it is likely tast they pose a guarant fractional source and out the source of sarriar, bettered and so the angements for frequent as generations and externions and segments. Therefore, presence of such angements for frequent as generations and entries and category wirelds.

1.2.3 Which selety outcomes are effected by work zone length? In international ilterature, 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

SafetyCube | Synopsis on work zone length

measured as crash risk (probability of crash occurrence versus probability of non-crash occurrence<sup>1</sup>). It is noted that no studies concerning crash or injury sevenity were identified through the literature search.

1.2.4 How is the effect of work zone length studied?

In general, when the impact of work zona length is examined, crash data from polica records are usually utilical. Agenting the methods of sanalysit, the effect of worksone length is usually examined by applying multivariable linear statistical models. When crash frequency is scamined, the additionally battered work can length and number of crashis is instratigated by applying hegative biomail models. Probability of crash occurrence was investigated by applying ram-events logistic regression models.

#### OVERVIEW OF RESULTS

The initial examination of relevant studies suggests that the effect of work zone length on road safety is generally consistent, phoning that when work zone have increased length the number of contants in increase. The same direction of the effect is downed when crash in the examined (probability of crash occurrence is non crash occurrence), where there is also a negative effect of work zone length on safety. on the frequency of crashes is constrained to be the same for all observations (all work zone segments). Consequently, the resulting parameter estimates may be biased.

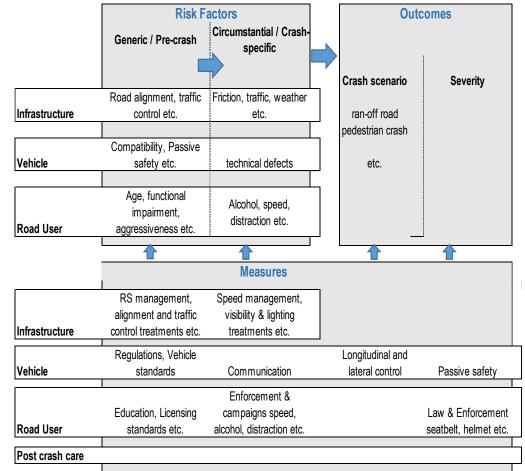
Overall, this risk factor could be considered to be adequately studied. However, there are no studies focusing on the effect of level k considered to be adequately studied. However, they all concern state of the US and there is no specific focus on different road users. In conclusion, data concerning more countries and different road users are needed.

### SafetyCube Links between Risks & Measures

### Based on a dedicated methodology

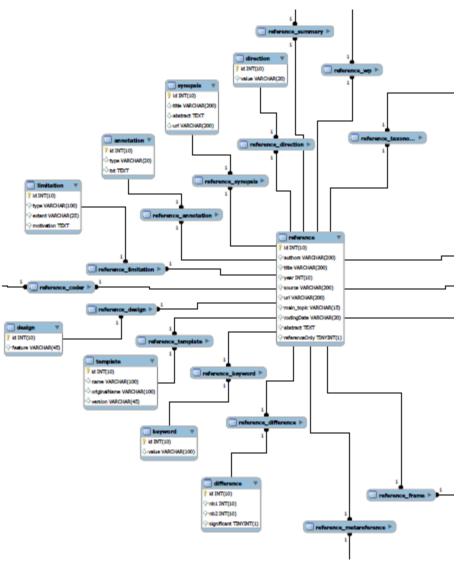
- Sequence of crash events
- Pre-crash events → crash → consequences/outcomes
- Risk factors can be:
  - Generic (e.g. alignment deficiency)
  - Circumstantial (e.g. alcohol)
- Measures may address:
  - Generic risks: (e.g. road safety audit)
  - Circumstantial risks (e.g. enforcement)

### Validated through studies and synopses results (ongoing)



# SafetyCube DSS back-end database

- Coded studies, Synopses and Links undergo a thorough checking and debugging process
- All inputs are eventually stored in a relational database, which serves as the back-end of the DSS
- Front-end DSS results are retrieved through the DSS search Engine (queries on the back-end database).



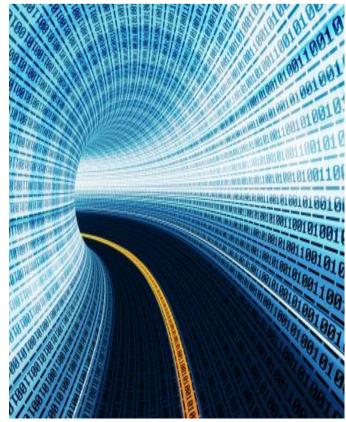
# SafetyCube DSS Search Engine

### 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 Structure

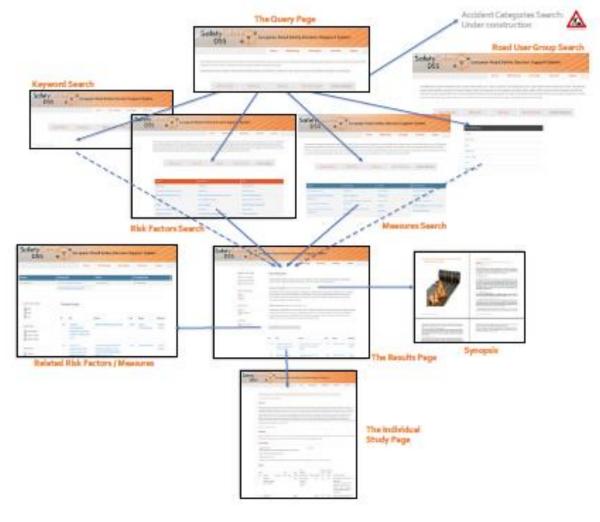
### **Five entry points**

### Three Levels of Search

- Search pages
- Results pages
- Individual study pages

### **Two Interlinked Pillars**

- Risk Factors
- Road Safety Measures



## SafetyCube DSS Menu

Search
 Risk Factors & Measures

# • Knowledge

### Calculator

Econ. Efficiency Evaluation (under development)

### Methodology

System documentation

### Support

Contact, help, feedback



is the European Road Safety Decision Support System, which has been produced within the European research project SafetyCube, fundec uropean Commission, aiming to support evidence-based policy making. The SafetyCube Decision Support System provides detailed interac risk factors and related road safety countermeasures. A Quick Guide on using the SafetyCube DSS, with instructions on how to browse the e 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)

afety <mark>Cube</mark> DSS	Europ	pean Road Safe	ty Decision	Support System	<b>n</b>				
			Sear	ch Knowledge	Calculator	Methodology	Support		
CHILD PEDESTRIANS PEDESTRIANS PEDESTRIAN CROSSING PEDELEC	PEDESTRIANS	word earch	Risk actors	Measures	<b>T</b>	A la er ups	Accident Categories		
MOPEDS PEDESTRIAN CRASHES	Risk Fectors	Risk Factore			Weasures				
PEDESTRIAN DETECTION	Behavior	Infrastructure	Vohicle	Behavior	Infrastructure	Vehicle	Post Impact Care		
PEDESTRIAN SIGNAL	Functional Impairment	Adverse weather	Lev	Education and	Traffic signals	Not Applicable	Not Applicable		
	Treffic Rule Violationa	Poor junction readability	Passenger Cars	voluntary treatings/programs	treatments				
		At-grade junctions deficiencies	Pedestrian		Road markings at junctions				
		Veclan / barrier deficiencies	PTW/ATY		Speed management				
each grou	p)	Insk of crash with encoming Traffic)			Elenforcement Speed management				
		Traffic flow			Traffic signs treatments				
					Reli-toed crossings				

# SafetyCube DSS Results Pages

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### Search results

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

### **Refine search**

- Specific Risk factor / Measure
- Other **search filters**:
  - <u>Road user groups</u>: All, car occupants, drivers, passengers, PTW riders, pedestrians, cyclists, HGV.
  - <u>Road types</u>: All, motorways, rural roads, urban roads
  - <u>Country</u>: 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

etyCub DSS	0	Europ	ean Ro	ad Safety I	Decision Si	upp	ort System	
			Search	Ksowledge	Calculator	- 54	rhodology	Support
c Risk Factor	Sear	ch Results						
kzone lengen kzone durzsion discient legen ge				e' fulfil your search of ron, or go to the respec			me SaletyCube Syno	pees, chaose
line Group	And State	ASTER		ingth • RED (VERY CC				
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(ype L sronwy iee		4.	The prosents workzones at which show a	ration. © DYET (UNCL of long duration of vs wassec and with more consistent increase in for publication bias) m	ekzenne was mitally a e accidente. This was othe number of occide	reported	by almost all coded a openinged by the pro-	studies minary
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# 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

Yang H., Ozbay K., Ozturk O., Yildirimoglu M.

#### Abstract

Work zones are temporary traffic control zones that can potentially cause safety problems. Maintaining 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 upterformed 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.2013.02.031.

#### Summary

The study investigates workzone crashes in New Jersey state. 7 years of data are exploited. 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 non-injury (property damage only) accidents.

#### Study Design

Topic: RISK FACTOR Year: 2013 Source: ACCIDENT ANALYSIS AND PREVENTION 55 (2013) 192&#8211: 201

Design: OBSERVATIONAL CROSS-SECTIONAL

Countries: UNITED STATES

Keywords: FULL BAYESIAN MEASUREMENT ERROR NEGATIVE BINOMIAL MODEL CRASH FREQUENCY SAFETY ANALYSIS WORK ZONE

#### Effects

Effect No Outcome Expo	Group Exposure Type	Effect Estimator	Effect Estimator Specifications Sa	Sample	mple Estimate	Estimate Lower Limit	Estimate Upper Limit	Conclusion Comments		
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			0.538	0.415	0.634	SIGNIFICANT NEGATIVE EFFECT OF ROAD SAFETY

## SafetyCube Related Risks / Measures

Safety <mark>Cul</mark> DSS

#### 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	Enhanced Headlights (automated, adaptive, advanced system,)	Not Applicable
	improvement of existing lightling	Night Vision	
		Vehicle backup camera - Reversing Detection or Camera systems (REV)	

Countries	10		Source	M	Decision	Countries
CANADA	ID	Title	Source	Year	Design	Countries
NETHERLANDS	327	Relationship Between	TRANSPORTATION	2015	CROSS-	UNITED
UNITED KINGDOM		Roadway Illuminance Level	RESEARCH RECORD:		SECTIONAL	STATES
UNITED STATES		and Nighttime Rural	JOURNAL OF THE			
		Intersection Safety	TRANSPORTATION			
			RESEARCH BOARD, NO. 2485,			
			PP. 88#8211;15			
	328	Road Lighting Effects on	TRANSPORTATION	2016	CROSS-	CANADA
		Bicycle and Pedestrian	RESEARCH RECORD:		SECTIONAL	
		Accident Frequency Case	JOURNAL OF THE			

CARE Experts Group Meeting Brussels, October 6, 2017

# SafetyCube DSS Calculator

### **Economic Efficiency Evaluation Tool (E3)**

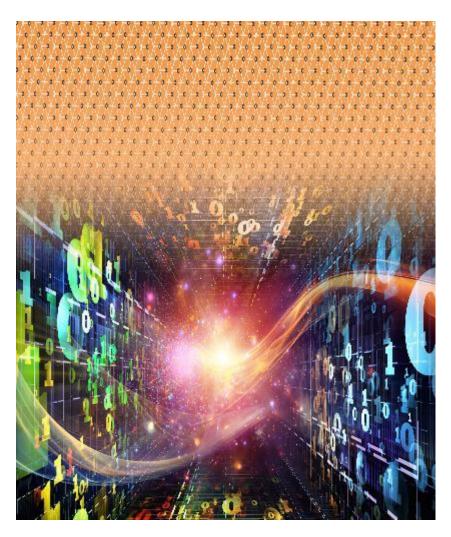
- Combines information about the **effectiveness of a measure** (i.e. the percentage of crashes or casualties prevented) with the **costs** of this measure.
- Integrates updated information of crash-costs in the European countries
- Allows to express all costs and benefits of a measure in monetary values 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...



## **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



# 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



Dreams

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SafetyCube of DSS

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Risk Factors



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Road Use

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