Cost-Effectiveness Evaluation of Selected Road Safety Measures

Knowledge

Euronean Road Safety Decision Support System

The De Carlo

Colonator

- automotivery



and secondaria advantation to a week

WED STORYM THE DEVENT, THESE & STORYM



ety-das.eu/#/

SafetyCuber DSS

of tarber where the results, is available for devenuesd nets.

whether which these the European Wald stately benacion support system, which these been produced within the support of

storeshie bee is the European Wilds savey benaring support or Mint, which the been provided within the Synopean and when hyperian and the European Communication, lamming to support endence based painty reaking. The Synopean endence was a support ender the support and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the S

and the European Community, to subject enterior basic power making. We subject use Oreanity wave against in the same straight the langest and related rows and the Countermonetures. A Court Guide on using the sates/core Data, while enterior in



hEART 2018 – 7th Symposium of the European Association for Research in Transportation



C.at



Introduction and Scope

- Evidence based road safety policies: more desirable and crucial for targeted road safety improvements
- Comprehensive analysis and ranking of risk factors and road safety measures required – aim of the SafetyCube project
- Economic Efficiency Assessment (EEA) of road safety measures is necessary for quantification and prioritization of road safety measures
- Assessment and ranking leading to the European Road Safety Decision Support System (DSS)



Methods for prioritizing measures (1/3)

Cost-Effectiveness Analysis (CEA)

Number of crashes prevented by the measure/ unit cost of implementing the measure

• Benefits

- less information is necessary
- not necessary to have an estimation of the monetary value of a crash

Limitations

- economic evaluation regarding only one outcome of the measure
- not possible to account for different crash severity levels or different policy fields (environment, mobility)



Methods for prioritizing measures (2/3)

Cost-Utility Analysis (CUA)

Measures impact expressed by Quality Adjusted Life Years (QALY) Fatalities assessed by Years of Life Lost (YLL) Injuries assessed by Years Lived with Disability (YLD) CUA calculates the cost per QALY

Benefits

- possibility to account for different crash severity levels

Limitations

 not possible to account for different policy fields (environment, mobility)



Methods for prioritizing measures (3/3)

Cost-Benefit Analysis (CBA)

Monetary values are assigned to each type of benefit that results from the measure. Sum of benefits is then compared to the costs of the measure. Ranking based on:

- 1. Net Present Value (NPV) = Benefits Costs
- 2. Benefit-Cost Ratio (BCR) = Benefits / Costs

(If BCR > 1, measure is cost-effective)

Benefits

- possibility to account for different crash severity levels and different policy fields (environment, mobility)
- determines right balance between safety and other objectives

Limitations

- requires more input than CEA, CUA



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
- 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)



	manutur	vehicle	Partinger Day			
e anal anticessmente	Traffic (ow	forstations and	Antickensisterantee			
cation and Achievary Security or	heffic service box	: tido import	monochun barn vehich;			
periods	Formal tools to address tood hortwork addressing	incorrenaut	Pro boopital (incideal care			
cur la drive assessment and destance mercene middle and comparison	speed management is influences. Heat type	Seventrary	Fire addatog trans			
	Bratsature malmeria	oran Gene				
	Vadates / Englising Intelligences					
	Workzonca					
	elorizontal la vertical alignment torditri pris	(emphasized)				
	Supervision / most super teamert	Salarial control				

Examined measures

Measures where relevant studies/ financial figures were available

- Road infrastructure (5 measures)
- Road safety audits (light/heavy measure case)
- Traffic signal installation (county roads/highways)
- Installation of safety barriers
- High risk sites treatment
- Installation of chevron signs
- Behavior (2 measures)
 - DUI checkpoints/breath testing
 - General police speeding enforcement

2 measures warranted two separate approaches



Cost-Benefit Analyses inputs

For the selected measures:

- Crash cost data
 Distinguishing between injury severity categories
- Measure effectiveness and implementation costs Obtained from high quality studies and reports $Benefits = \sum_{s} Target Crashes_s * Effectiveness_s * Crash costs_s$
- Formation of a common baseline
 Reference currency: €, Reference year: 2015
 present value = actual value
 (1 + discount rate)^{year}



• Different scenario predictions to mitigate uncertainty

Cost-Benefit Analyses outputs

Formation of 7 possible prediction scenarios with respective BCR calculation:

- **1**. Best estimate
- 2. Low measure effectiveness (lower limit of 95% CI)
- 3. High measure effectiveness (upper limit of 95% CI)
- 4. Low measure cost (-50%)
- 5. High measure cost (+100%)
- 6. Worst case (combining 2 and 5)
- 7. Best case (combining 3 and 4)



Cost-Benefit Analyses results

		Benefit-to-cost ratio (BCR)						
	Me asur e	Best estimate	Low measure effect	High measure effect	Low measure cost: -50%	High measure cost: +100%	Worst case scenario = high cost + low effect	Best case scenario = low cost + high effect
	Road safety audits – light measure case	21.7	16.4	27.0	43.5	10.9	8.2	54.0
	Installation of safety barriers	19.5	10.6	25.4	39.1	9.8	5.3	21.2
ucture	High risk sites treatment	16.1	13.2	18.4	32.2	8.1	6.6	36.8
nfrastr	Traffic signal installation – highways	3.7	1.8	5.2	7.4	1.9	0.9	10.5
Road i	Road safety audits – heavy measure case	2.9	2.2	3.6	5.7	1.4	1.1	7.1
-	Installation of chevron signs	2.7	1.4	5.5	5.5	1.4	0.7	10.9
	Traffic signal installation – county roads	1.1	0.5	1.5	2.2	0.5	0.3	3.1
avior	Law and enforcement – DUI checkpoints, breath testing	7.3	5.7	9.4	14.6	3.7	2.9	18.8
Beh	Law and enforcement – General police enforcement of speeding	1.0	0.7	1.3	2.0	0.5	0.4	2.6

Discussion of results

- Road safety measures addressing a critical point in a focused manner (road safety audits, installation of safety barriers and high risk sites treatment) have highest BCRs
- Overall, most measures appear to be cost-effective (BCR >1)
- 5 measures appear to be cost-effective consistently – in all 7 scenarios
- CBA is a tool to enable comparisons, however singular cases must be treated with caution, taking particularities into account



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 all SafetyCube example CBAs on:

- Behaviour (12 examples)
- Infrastructure (19 examples)
- Vehicle systems (4 examples)
- Post-impact care (1 example)

000	•						
		Saarab	Roowledge	Colesion	Nettedology	Bupport	
IA	Calculator Provide provide testamen The orbital and the Descent (The large research in the parameter of the large research in the cargo of the large test and the information of the large test	Ere ust an (23) of so the association pro- efficiency to exceeds a cast benefit with you of the pro- 921th.	ed actory courses tensors and actory courses tensors at a server was seend to of a searches, or particular a searches, or particular	e sa ulione na combine la phone se tre arte e monume no francese carrament ne nigate	Attractive about the later also a legation of callies whe accurate and callies whe accurate and anticipant own about data	dhasharsan of seel o farmha soo secola s	
Input			Cost-Ben	efit Analy	sis		
Min Maraga autori Annas Investamenta			Infrastructure safety management - Speed management & enforcement - 30-zones implementation				
knustracture selfcty-	nanogarient specemenogeneint bi	anorenu -	Costs (prese	nt values)			
			Decting Property	0099.	823	et etum	
Unitation	Thrandelaral		(Mean and Transfer			NUMBER OF TAXABLE	
			Tend com viziering	Index Parts	0.00	NCTOR.	
Country	LIC.		Declete		1.00		
Measure			Didenterisia	ad clubs	100	24918	
Metallicated	10		1				
our states			Benefits				
Personal Course	g innder		-tradiction into		165.8. 0,116		
and investories	di Charles		Socio-economic return excluding side-effects				
			National states		90076/5818 1.8		
Variai r ⁱ liria Reference			Cost-tended into:		1.4		
Vartiel d'Lord Rokroske Costs			Socio-econor	nic return inc	luding side-eff	ects	
Vatterstrum sectoristic Quality geocanization	Ber can		Socio-econor Imprentivata	nic return inc	luding side-eff	ects	

SafetyCube DSS Overview

- 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)
- Calculator: Economic Efficiency Evaluation
- Links between Risk Factors: Information about which risks can be remedied by which types of measures
- Methodology: System documentation
- Support: Contact, help, feedback
- Available online since April 2017: https://www.roadsafety-dss.eu/



Cost-Effectiveness Evaluation of Selected Road Safety Measures

Knowledge

Euronean Road Safety Decision Support System

The De Carlo

Colonator

- automotivery



and secondaria advantation to a week

WED STORYM THE DEVENT, THESE & STORYM



ety-das.eu/#/

SafetyCuber DSS

of tarber where the results, is available for devenuesd nets.

whether which these the European Wald stately benacion support system, which these been produced within the support of

storeshie bee is the European Wilds savey benaring support or Mint, which the been provided within the Synopean and when hyperian and the European Communication, lamming to support endence based painty reaking. The Synopean endence was a support ender the support and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the support ender the support of the Synopean and the S

and the European Community, to subject enterior basic power making. We subject use Oreanity wave against in the same straight the langest and related rows and the Countermonetures. A Court Guide on using the sates/core Data, while enterior in



hEART 2018 – 7th Symposium of the European Association for Research in Transportation



C.at