

Økonomisk analyse av ITS-baserte trafikksikkerhetsteknologier: en eksplorerende studie

Basert på EU-prosjektet IN-SAFETY

ITS-fagdag, Oslo

12. april 2010

Jeg skal si litt om følgende:

- Det finnes foreløpig få økonomiske analyser av ITS-baserte trafikksikkerhetstiltak
- Fire ITS-tiltak vurdert i EU-prosjektet **IN-SAFETY**
- “Feilhandlingsbasert tilnærming” til estimering av trafikksikkerhetspotensialet
- Partiell nytte-kostnadsanalyse
- Oppsummering

Det finnes foreløpig få økonomiske analyser av ITS-baserte trafikksikkerhetstiltak

- ITS-baserte trafikksikkerhetstiltak – fortsatt noe nytt?
- Har manglet data på trafikksikkerhetseffekter, tidsbruk, og andre effekter
- Få gjennomførte nytte-kostnadsanalyser (alle partielle?)

Fire ITS-tiltak vurdert i EU-prosjektet **IN-SAFETY**

- **Infrastructure and *safety* (IN-SAFETY)**
 - 1. feb. 2005 – 31. jan. 2008 (6. rammeprogram)
 - Konsortiumleder: CERTH/HIT
 - TØI: R. Elvik, A. Høye, K. Veisten
- **Formål:** “To use intelligent, intuitive and cost-efficient combinations of new technologies and traditional infrastructure best practice applications, in order to enhance the *forgiving* and *self-explanatory* nature of roads”

Fire ITS-tiltak vurdert i EU-prosjektet IN-SAFETY

Name	Description	Type of system	Data needed for operation	Main contributing factor in target accidents
A. In-car curve speed warning (rural roads)	Safe curve speed calculated based on curve geometry and weather conditions	Vehicle autonomous (self-explaining)	Current speed, curve geometry, environmental data, vehicle characteristics	Inappropriate speed in curves on rural roads
B. In-car lane departure warning (motorways)	Lane departure warnings based on lane markings and road side beacons in road work zones	Warning into vehicle (forgiving)	Lane markings, speed, local conditions (e.g. roadwork)	Lane departure on motorways
C. Overtaking assistant blind spot vehicle detection (motorways)	Warning when overtaking while vehicle approaching from behind	Vehicle autonomous (forgiving)	Position and speed of vehicle approaching in blind spot, current speed	Overseeing vehicle approaching from behind while overtaking
D. Overtaking assistant approaching vehicle detection (rural roads)	Warning when overtaking with oncoming traffic	Vehicle to vehicle communication (forgiving)	Location and speed of own vehicle and oncoming traffic	Overseeing oncoming traffic while overtaking

Fire ITS-tiltak vurdert i EU-prosjektet **IN-SAFETY**

Navn
A. Svinghastighets- varsling (tofeltsveg)
B. Feltskifte- varsling (firefeltsveg)
C. Blindsone- varsling (firefeltsveg)
D. Møtende- kjøretøysvarsling (tofeltsveg)

“Feilhandlingsbasert tilnærming” til estimering av trafikksikkerhetspotensialet

- Addressable vehicles rate
- Addressable drivers rate
- Acceptance rate

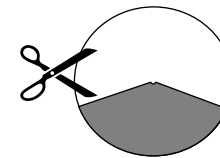
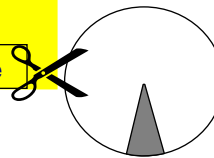
ITS-based measure

Infrastructure measure



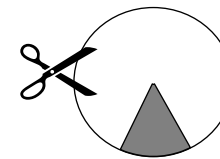
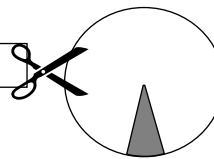
How many percent of accidents/fatalities have been caused by errors that are addressed by the system/measure?

Addressable accidents rate



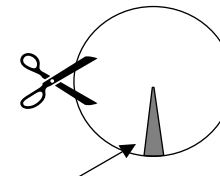
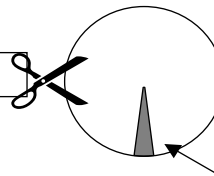
Is the system/measure effective area wide or only at certain locations (e.g. road design measures, or only accident black spots)? How many percent of accidents/fatalities have been at the realised locations?

Area coverage rate



How many of the addressable accidents/fatalities can be avoided/mitigated at all if the systems is working at the right moment in the right place, and drivers are following the instruction?

Avoidable accidents rate



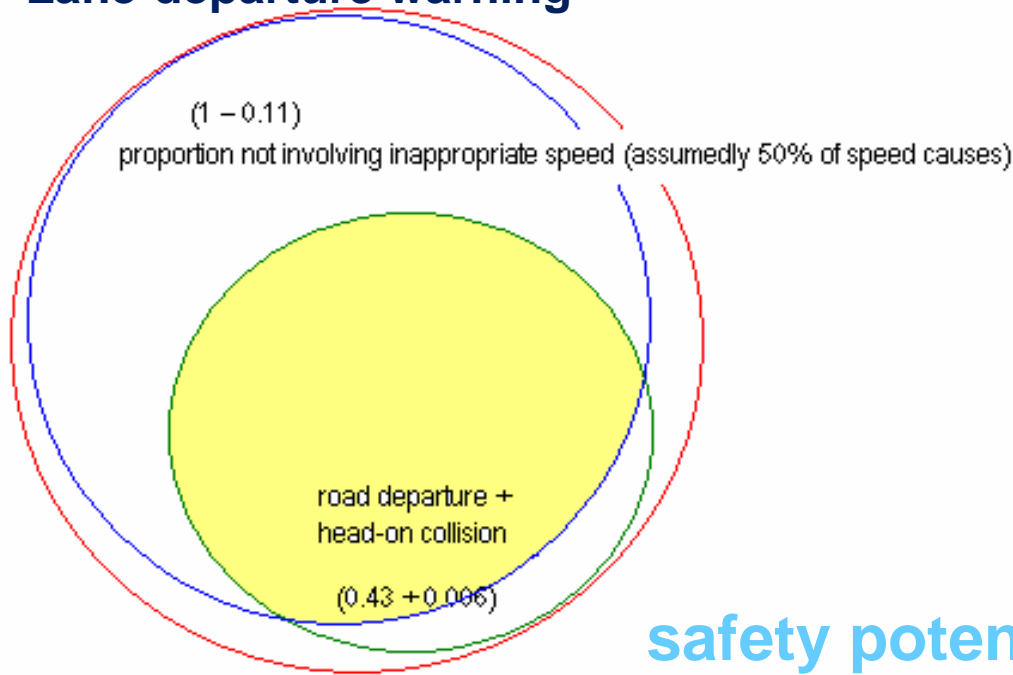
safety potential

Kilde: Wiethoff *m.fl.* (2006)

“Feilhandlingsbasert tilnærming” til estimering av trafikksikkerhetspotensialet

Measure B (motorways)

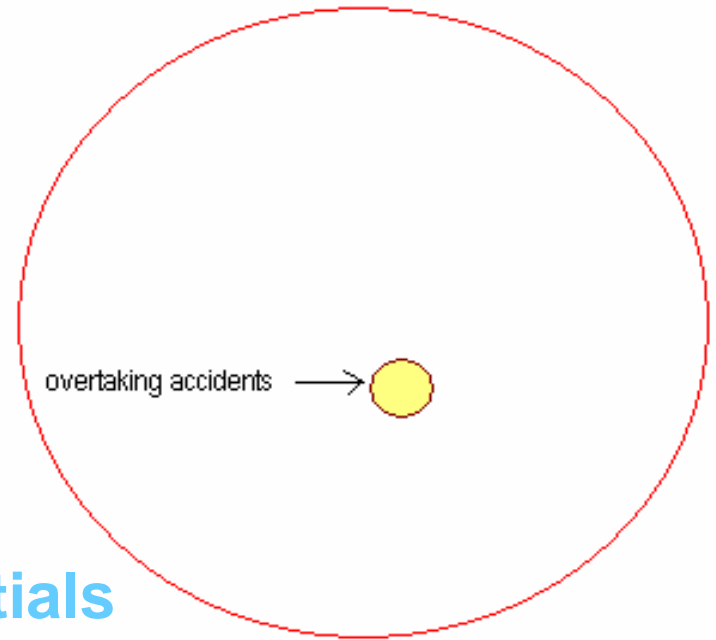
Lane-departure warning



$(0.43 + 0.006) * (1 - 0.11) = 0.39$ of injury accidents on motorways

Measure C (motorways)

Blind spot vehicle detection



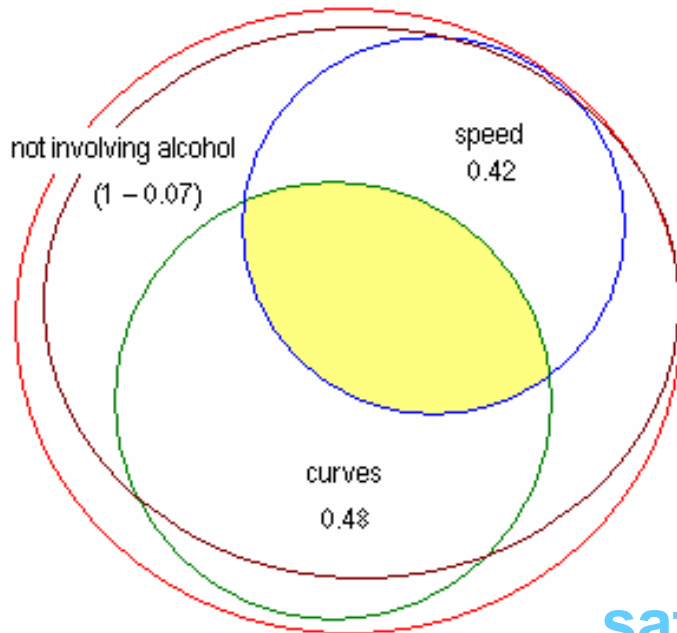
0.04 of injury accidents on motorways

safety potentials

“Feilhandlingsbasert tilnærming” til estimering av trafikksikkerhetspotensialet

Measure A (rural)

Curve speed warning

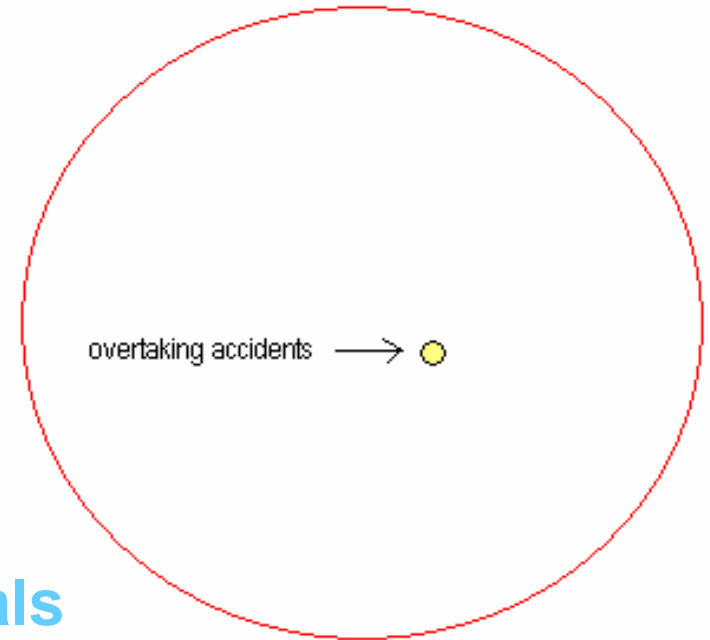


safety potentials

$$0.48 * 0.42 * (1 - 0.07) * (1 - 0.01) = 0.18 \text{ of injury accidents on rural roads}$$

Measure D (rural)

Approaching vehicle detection



$$0.02 \text{ of injury accidents on rural roads}$$

“Feilhandlingsbasert tilnærming” til estimering av trafikksikkerhetspotensialet

- Bruker ulykkesdata fra Tyskland:
 - ulykkesårsak er inkludert (type feilhandling)
<https://www-ec.destatis.de/>; “Verkehr im Überblick - Stand 12.09.2006 - Fachserie 8 Reihe 1.2 – 2005”
- Avgjørende forutsetninger i NKA:
 - korrekt identifisering av ulykkesårsak
 - ”riktig førertilpasning” til ITS-tiltak

Partiell nytte-kostnadsanalyse

Parameter	Assumption / description
Time horizon	15 years (2008-2022)
Result year ("year 0")	2007
Discount rate	3%
Implementation	Full scale infrastructure installation from year 1 and equipment installation in all new vehicles entering the market from year 1
Impact delineation	Measures have safety impacts on either motorways or (other) rural roads
Impact measure	Estimated decrease in fatalities/injuries
Costs	Infrastructure and vehicle equipment costs
Benefits	Proposed European valuation (for Germany) of reduced fatalities/injuries

Inkluderer kun (nytten av) trafiksikkerhetseffekter

Partiell nytte-kostnadsanalyse

Kjøretøykostnader

Vehicle device	Cost per device	ITS-based measures				
		A	B	C	D	All
Warning device, incl. information processing and interface	150	150	150	150	150	200
Information receiver	100		100			100
GPS, incl. digital map	150	150		150	150	150
Measurement equipment for road and weather conditions	200	200				200
Safe curve speed model and calculation	50	50				50
Detection lane markings	150		150			150
Detection approaching vehicle (from in front / behind)	150			150	150	150
Vehicle to vehicle communication	300				300	300
Sum of units per measure (€)		550	400	450	750	1,300
Total vehicle investment costs (mill €), pres. value		24,453	17,784	20,007	33,345	57,799
Total vehicle maintenance costs (mill €), pres. value		17,769	0	0	0	17,769

Partiell nytte-kostnadsanalyse

Infrastrukturkostnader

Measure	Unit cost		Lifetime	Present value (3% discount), mill €		
	Investment	Maintenance		Investment	Maintenance	Total
A	€10 mill input GPS maps	50% of investment cost	15 years	10	60	70
B	Lane markings: €2,500 per km motorway	€1,000 per km motorway	5 years	98	128	226
	Road side beacons: €4,550 per beacon	10% of investment cost				
	Sum					
C	No infrastructure					0
D	€10 mill input GPS maps	50% of investment cost	15 years	10	60	70
All				118	247	365

Partiell nytte-kostnadsanalyse

Reduksjon i trafikkdøde/-skadde – firefeltsveger

	Motorway accidents	Measure B lane-departure warning		Measure C blind spot vehicle detection		Benefit unit value
		Safety potential		Safety potential		
Fatalities	432	59%	240	1%	5	1,496,000
Serious injuries	4,383	55%	2,321	3%	136	209,400
Slight injuries	22,759	31%	6,511	4%	821	17,100

Partiell nytte-kostnadsanalyse

Reduksjon i trafikkdøde/-skadde – tofeltsveger

	Rural road accidents	Measure A curve-speed warning		Measure D approaching vehicle detection (oncoming)		Benefit unit value
		Safety potential		Safety potential		
Fatalities	2,288	27%	623	6%	148	1,496,000
Serious injuries	22,470	23%	5,178	4%	924	209,400
Slight injuries	76,226	17%	12,933	3%	2,054	17,100

Partiell nytte-kostnadsanalyse

Resultater for de fire ITS-baserte tiltakene (mill. €)

trafikksikkerhetseffekter – feilhandlingsbasert tilnærming – tyske data

	A svinghastighets- varsling	B feltskifte- varsling	C blindsone- varsling	D møtende- trafikkvarsling	Alle
Infrastrukturkostnader	70	226	0	70	365
Kjøretøykostnader	42.222	17.784	20.007	33.345	75.567
Trafikksikkerhetsnytte	26.179	11.190	585	5.265	43.219
Nytte-kostnadsbrøk	0,62	0,62	0,03	0,16	0,57

Oppsummering

- Partiell nytte-kostnadsanalyse
 - kun trafiksikkerhetsnytte (ikke tidsbruk, etc.)
 - nytte-kostnadsbrøk < 1
 - nærmest 1: svinghastighetsvarsling og feltskiftevarsling
 - for optimistisk trafiksikkerhetseffekt (førertilpasning)?
 - for høye (kjøretøy)kostnader (og for avgrenset virkningsområde)?
- Finnes få økonomiske analyser av ITS-based trafiksikkerhetstiltak → selv en partiell NKA nyttig?

Oppsummering

- Forskningsbehov
 - trafiksikkerhetseffekter og andre effekter av de ITS-baserte tiltakene **Takk!**
 - ATFERDSEFFEKTER (atferdsstudier)
 - kjøretøykostnadsutvikling for av de ITS-baserte tiltakene
 - følsomhetsanalyser / usikkerhetsanalyser/