



Cost-Benefit Analysis of the Electronic Stability Program (ESP)

**Prof. Dr. Herbert Baum
University of Cologne
Institute for Transport Economics**

**Choose ESC!
Rome, 8 May 2007**

Elements of the CARS 21 Road Safety Roadmap

CARS 21 Road Safety Roadmap

Infra- structure Measures

Conduct of road safety audits, impact assessments and inspections (including safety mapping, prioritisation and communication of high risk routes and locations)

Implementation of corrective measures

Stricter conditioning of Community financing in the road sector to projects which follow road safety best practice

Vehicle Technology Measures

Electronic Stability Control

Seatbelt reminders

Brake Assist Systems

Heavy Duty Vehicles' rear view vision (avoid blind spots) and conspicuity

Isofix child seats

Daytime running lights

Road user-related Measures

Accelerate the adoption and application of the directive on driving licenses to reduce fraud and reduce the casualty levels among motor-cyclists

Organise and facilitate increased co-operation among Member States to ensure improved cross-border infringement enforcement

Improve the enforcement of alcohol and possibly introduce a maximum alcohol level for novice and professional drivers

Improve the enforcement of speed limits

Promote and improve the enforcement of seat-belt use and motor-cycle helmet use

Source: CARS 21 Final Report.

Objectives of the Study

Research Objectives

How large is the safety potential of ESP if it would be installed in all cars (compared to a situation with no ESP cars) and what does it cost to realise this potential?

What can be achieved if the ESP deployment will be accelerated?

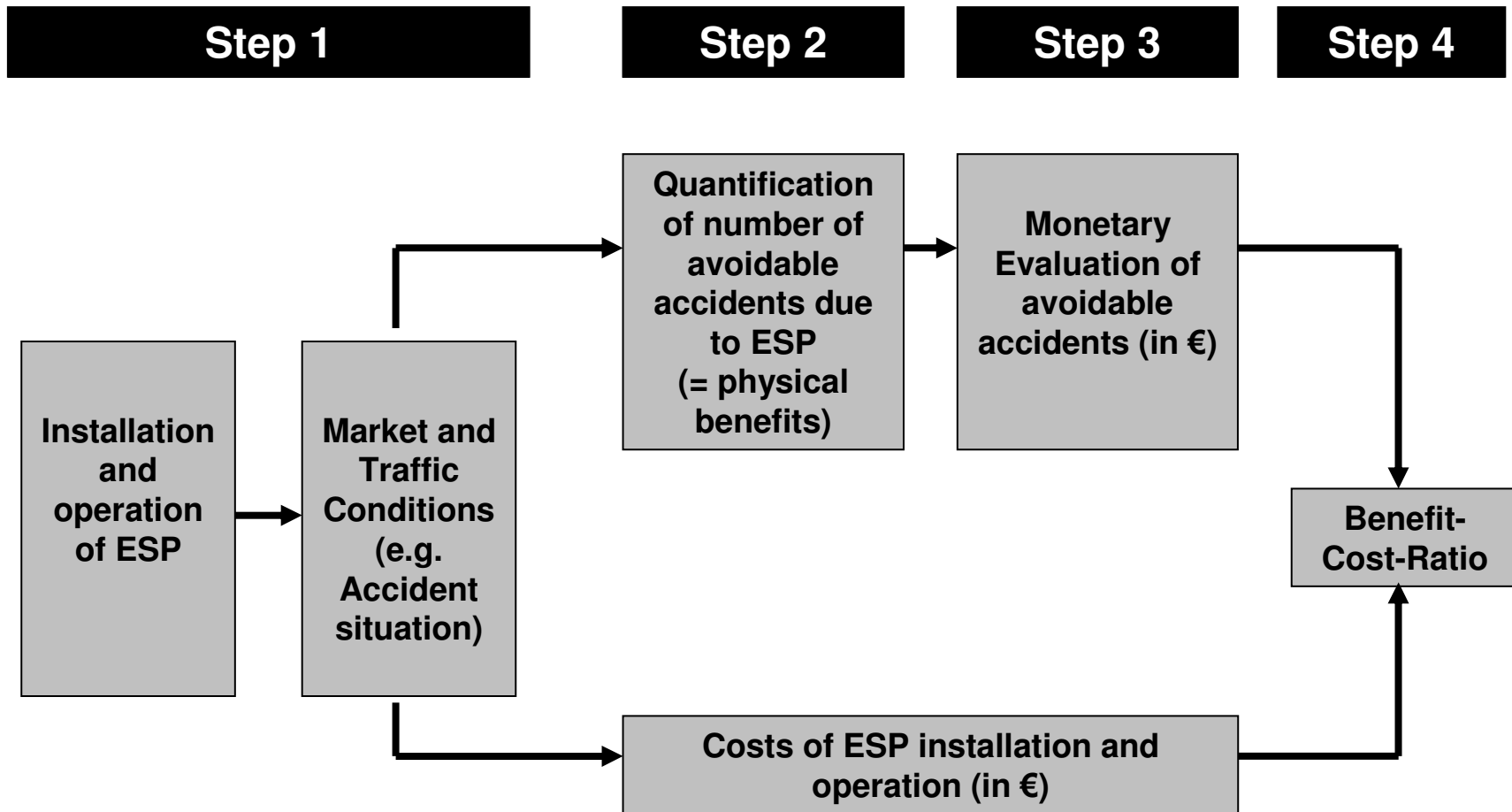
Approach of the Study

→ Cost-benefit analysis for ESP in passenger cars in the European Union (EU-25)

→ Cost-benefit development of ESP in the period 2008-2012 due to different market penetration scenarios:

- Trend scenario
- Mandatory equipment of all new cars beginning in 2008

Methodology of Cost-Benefit Analyses



Procedure for the Estimation of the ESP Safety Impact

- 1) Single vehicle accidents
- 2) Single vehicle accidents caused by skidding cars
- 3) Single vehicle accidents caused by skidding cars which can be avoided due to ESP
- 4) Correction of database needed in order to reflect that the system is already applied in road traffic and safety potential is partly realised already
→ Repeat steps 1) to 3)

Results for EU-25:

- approx. 4,000 lives per year could be saved
- approx. 100,000 injuries per year could be avoided

Safety Impact of ESP – Full Car Stock Penetration

	Hypothetical single vehicle accident situation without ESP-equipped cars (0 % ESP-penetration)			Share of single vehicle accidents caused by skidding car	Effective-ness of ESP	Acci-dents avoided ...	Fatali-ties avoi-ded...	Injured persons avoided ...
	Acci-dents	Per-sons killed	Per-sons injured			...with full ESP-penetration of car stock (100 % ESP-penetration)		
U.K.	32,526	857	41,445	34.96	0.8	9,097	240	11,591
Germany	101,301	2,908	121,196	34.27		27,773	797	33,227
Italy	38,796	1,805	48,407	29.47		9,147	426	11,412
Spain	27,396	2,056	39,358	30.84		6,759	507	9,710
France	19,601	2,308	23,423	31.53		4,944	582	5,908
EU-15	267,195	12,666	332,242	31.87		68,124	3,229	84,708
EU-25	300,186	15,642	372,815	31.87		76,535	3,988	95,053

Cost Unit Rates for Safety Impact Appraisal

Personal damage costs per killed / injured person	Costs in €
Killed person	1,000,000
Injured person	51,000
Property damage and congestion costs per accident	Costs in €
Property damage costs	6,000
Congestion costs	5,000

Accident Cost Savings per Year due to ESP – Full Car Stock Penetration

Member States	Personal damage costs in Mill. € (killed persons)	Personal damage costs in Mill. € (injured persons)	Property damage and congestion costs in Mill. €	SUM in Mill. €
United Kingdom	240.0	591.1	100.1	931.2
Germany	797.0	1,694.6	305.5	2,797.1
Italy	426.0	582.0	100.6	1,108.6
Spain	507.0	495.2	74.3	1,076.5
France	582.0	301.3	54.4	937.7
EU-15	3,229.0	4,320.1	749.4	8,298.5
EU-25	3,988.0	4,847.7	841.9	9,677.6

ESP Equipment Costs per Year – Full Car Stock Penetration

Member States	Car Stock 2003 in Mill.	Costs (on top of ABS) of equipping one car with ESP in €	Investment costs (K_0) in Mill. €	Yearly costs (g) in Mill. €
United Kingdom	26.992	130	3,508.96	352.52
Germany	44.657		5,805.41	583.22
Italy	32.584		4,235.92	425.55
Spain	18.688		2,429.44	244.07
France	29.360		3,816.80	383.44
EU-15	189.672		24,657.36	2,477.13
EU-25	212.496		27,624.48	2,775.21

$$g = K_0 \cdot \frac{i \cdot (1+i)^n}{(1+i)^n - 1}$$

g

= yearly costs

K_0

= investment sum (material and labour costs)

i

= interest rate

n

= economic lifetime

Results of the ESP Cost-Benefit Analysis

Accident cost savings per year	Benefits in Mill. €	Costs in Mill. €	Benefit-Cost Ratio
...without property damage only accidents (= Based on personal damage accidents)	9,677.6	2,775.2	3.5
...with property damage accidents	16,129.3	2,775.2	5.8

Benefit-Cost Ratio of ESP – Full Car Stock Penetration (including Property Damage Only Accidents)

Member States	Yearly benefits in Mill. €	Yearly costs in Mill. €	Benefit-Cost-Ratio
United Kingdom	1,552.0	352.52	4.4
Germany	4,661.8	583.22	8.0
Italy	1,847.7	425.55	4.3
Spain	1,794.2	244.07	7.4
France	1,562.8	383.44	4.1
EU-15	13,830.8	2,477.13	5.6
EU-25	16,129.3	2,775.21	5.8

Benefit-Cost Results for ESP – Full Car Stock Penetration

Member States	Full Car Stock Penetration	Benefit calculation without Property Damage Only Accidents		Benefit calculation including Property Damage Only Accidents	
	Yearly costs in Mill. €	Yearly benefits in Mill. €	Benefit-Cost-Ratio	Yearly benefits in Mill. €	Benefit-Cost-Ratio
United Kingdom	352.52	931.2	2.6	1,552.0	4.4
Germany	583.22	2,797.1	4.8	4,661.8	8.0
Italy	425.55	1,108.6	2.6	1,847.7	4.3
Spain	244.07	1,076.5	4.4	1,794.2	7.4
France	383.44	937.7	2.4	1,562.8	4.1
EU-15	2,477.13	8,298.5	3.4	13,830.8	5.6
EU-25	2,775.21	9,677.6	3.5	16,129.3	5.8

Benefits and Benefit-Cost Ratio of ESP compared to other Driver Assistance Systems

Analysed Driver Assistance System	Benefits in Mill. € (rounded)	Benefit-Cost-Ratio	Remarks	Authors – Study / Project
ESP	10,000* – 16,000	3.5* – 5.8	Calculations for EU-25 Full penetration in car fleet	This study
Information and Warning Functions	40 – 300	1.2 – 1.5	Calculations for EU-15 Different penetration rates	Baum Schulz et al. (2004) CarTALK 2000
Communication-based Longitudinal Control	50 – 1,000	1.1 – 4.0		
Tow-Bar-System for Heavy Goods Vehicles	55 – 105	4.1 – 4.4	Calculations for Germany Different penetration rates	Baum Geißler et al. (2001) CHAUFFEUR
Longitudinal Control	50 – 140	0.8 – 1.3	Calculations for Germany Different penetration rates	Zackor Keller (1999) Study for BASt
eCall	5,870 – 25,900	1.3 – 8.5	Calculations for EU-25 Optimistic / pessimistic scenario	Abele Baum et al. (2005) SEISS
Adaptive Cruise Control	500 – 1,000	0.9 – 1.2	Calculations for EU-25 Different penetration rates	
Lane Departure Warning and Lane Change Assist.	170 – 1,500	2.0 – 2.1		

* ... excl. property damage only accidents

Additional Benefits of the Mandatory Equipment Scenario – Cumulated Effects for the Period 2008-2012

Member States	Additional accidents avoided	Additional fatalities avoided	Additional injured persons avoided	Additional accident costs saved in Mill. € (without PDO accidents)	Additional accident costs saved in Mill. € (including PDO accidents)
United Kingdom	6,058	160	7,721	620.2	1,033.7
Germany	8,109	233	9,703	816.7	1,361.2
Italy	6,547	306	8,170	793.8	1,323.0
Spain	4,177	313	6,001	665.4	1,109.0
France	2,794	328	3,340	529.8	883.0
EU-15	34,335	1,628	42,692	4,182.3	6,970.5
EU-25	34,746	1,811	43,156	4,393.6	7,322.7

Summary Results of the Cost-Benefit Assessment for ESP

ESP helps to save lives.

When all cars in the EU-25 would be equipped with ESP (compared to a situation without any ESP equipped car), approximately 4,000 lives per year could be saved and 100,000 injuries per year could be avoided.

ESP represents a building block of intelligence on the roads.

The ESP benefits – provided that the entire car fleet is equipped – accrue to about 10 – 16 bill. € per year. With that, ESP is a key element of an European Intelligent Transport System.

ESP equipment is very profitable from the society point of view.

A benefit-cost ratio of 3.5 – 5.8 indicates that every invested € will be paid off in 3.5 - 5.8 € cost savings. This is far more than the benefit-cost ratio of 1 which indicates the profitability for the society.

Policy action to accelerate the ESP equipment in cars in EU-25 can be strongly recommended based on the study findings.

If ESP would become mandatory in all new cars from 2008 on, this could save 1,800 lives and avoid more than 40,000 injuries in the period 2008-2012 compared to the trend scenario of ESP market penetration.

Contact

Prof. Dr. Herbert Baum

**Director of the Institute
for Transport Economics
University of Cologne**

**Universitaetsstrasse 22
50923 Cologne
Germany**

Tel: +49 221 470 2312

Fax: +49 221 470 5183

h.baum@uni-koeln.de