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

Summary Report

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Study Approach

Achieving the European Commission goal to halve the number of people killed in road traffic, requires a **holistic road safety approach** which integrates vehicle technology, infrastructure and human driver measures. Many road safety programs worldwide follow this approach. On European level, beyond action taken in the Road Safety Action Programme and the eSafety initiative, this view is adopted by CARS 21.

This study is motivated by the work carried out within the **CARS 21 High Level Group**. There it is pointed out that the most promising safety improving measures in all building blocks should be part of a ten-year roadmap. The Electronic Stability Program (ESP) is widely regarded as one of the most prominent measures in the vehicle technology pillar. In contrast to other systems which have still to prove their safety potential, ESP has been introduced onto the market over 10 years ago. Therefore, the potential of ESP to avoid or mitigate accidents under real world conditions has been analysed and proven in several studies. The results of the studies, i.e. the share of avoidable accidents, are quite homogenous and show a large potential to improve safety.

When policy action is considered in order to support the Electronic Stability Program implementation, a **socio-economic impact assessment** provides arguments for doing so. In the following such an impact assessment from the society point of view will be carried out **for ESP**. It will be quantified which amount of accidents and accident costs might be avoided in the European Union with the help of the ESP-equipment of cars. There are two main research objectives of the study:

- In a first step the accident cost savings, which can be achieved with ESP-equipment of cars, are compared with the costs of equipping cars with the system. This enables the calculation of a Benefit-Cost-Ratio, which is important in order to assess the overall efficiency of ESP and thus to decide, whether it is appropriate to foster market penetration of ESP.
- In a scenario approach it is further examined, how effective measures to foster market penetration could be in the future in terms of higher accident (cost) savings. In the Trend Scenario, the development of ESP-equipment-rates is forecasted under the assumption that ESP continues to be an optional system. The decision whether to install ESP in a passenger car is in this case up to the manufacturer (standard, optional or no equipment) and the user. In the Scenario “Mandatory Equipment”, the equipment rates are forecasted under the assumption that from 2008 onwards all newly registered cars in the European Union are equipped with ESP. From the impact assessment point of view it is essential that the equipment of all new cars is actually in place at a certain point in time. It is not essential whether this effect will be reached by legislative action or a self obligation of the automotive industry. For the two scenarios, the differences in accidents and accident cost savings in the time period from 2008 until 2012 are then calculated.

Geographically, the study refers to the EU-25 with special attention to the large European automotive markets Germany, France, Spain, Italy and the United Kingdom.

Methodology and Applied Values for Impact Assessment

The Cost-Benefit-Analysis (CBA) is a widespread **socio-economic assessment tool**, which provides methods for evaluating the social desirability of investments in certain projects, services, systems etc. The fundamental idea of a CBA is that public decisions should be based on economic considerations as it is done in the private sector (e.g. profit and loss accounts). Subject of the CBA in this study are the costs and benefits which are connected with the ESP-equipment of cars. The benefits lie in the improved vehicle stability due to ESP which leads to accident cost savings. Two steps are needed to assess the benefits: First, the benefits have to be quantified in physical terms. This means that the number of avoided accidents has to be determined. In a second step, the resulting physical benefits have to be valued monetarily in order to compare them with the costs (install and operate the ESP). After the temporal harmonisation of benefits and costs, the Benefit-Cost-Ratio can be calculated, constituting the final result of the analysis. If the benefits exceed the costs, the Benefit-Cost-Ratio is larger than one and the measure is profitable for society.

The **costs of equipping a car with ESP** are stated with € 130. This reflects the additional equipment costs for ESP as an addition to an existing Antilock Braking System (ABS), which is standard in EU-25. The figure of € 130 is not the consumer price. The value refers to the production and installation costs since this is the appropriate figure in a CBA from a society's point of view, because they reflect the resource consumption (labor and capital) needed for equipment. Hence, higher prices due to e.g. marketing or management reasons are not relevant since they do not reflect real consumption of productive resources. The cost rate used can be interpreted as an average value between actual costs, which might be slightly higher than 130 €, and future costs, which will be lower due to economies of scale. The cost estimation was verified by experts (eIMPACT Market Scenario Workshop, Brussels 25 Sep 2006). Operation costs normally do not occur. Based on empirical evidence the average lifetime of the vehicles is assumed with 12 years.

The applied **cost unit rates for benefit assessment** represent average values for EU-25. A value of € 1,000,000 per fatality and of € 51,000 per injured person is applied. Moreover, each injury accident is on average accompanied by property damage costs of € 6,000 and congestion costs of € 5,000.

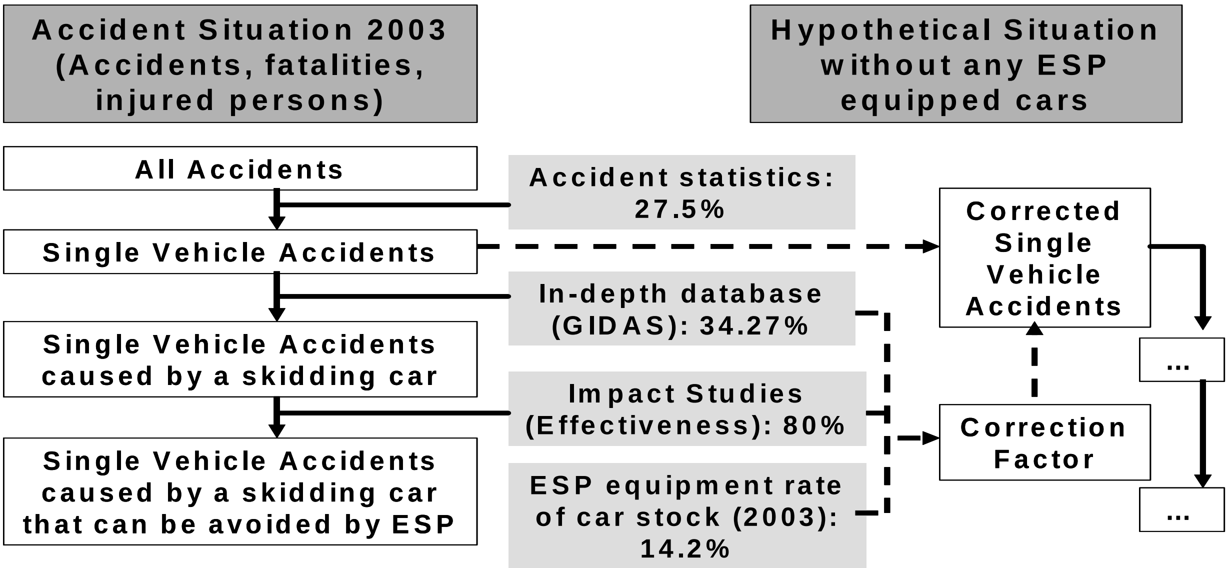
Several **impact studies** have demonstrated the road safety improvement due to ESP (e.g. Sferco et al. (2001), Langwieder et al. (2004), Page et al. (2004), Tingvall et al. (2004, 2006)). In accordance with these studies we focused on single vehicle accidents caused by skidding cars as the main accident category which can be avoided by ESP.

The **procedure for the estimation of the safety impact** is represented in figure 1:

- In a first step, the share of single vehicle accidents is applied from official national accident statistics (2003 data). In the EU-25 this share ranges between 15% (United Kingdom) and more than 30% (Sweden, Finland).
- In-depth accident databases – such as GIDAS for Germany – show that 34.27% of all single vehicle accidents are caused by skidding cars. Other countries have slightly different shares depending on the proportion of cars compared to the total vehicle stock.
- The effectiveness of ESP in avoiding single vehicle accidents caused by skidding cars is assumed with 80 % based on results by Zobel and the analysis of GIDAS data.

Moreover, it has to be taken into account that in the present ESP has already penetrated parts of the entire car fleet. Therefore, the number of single vehicle accidents in accident statistics would have been higher in absence of any ESP-equipped car. The stock penetration of ESP were used together with the share of single vehicle accidents caused by a skidding car and the applied ESP effectiveness rate to establish a correction factor which allows to calculate the (hypothetical) number of single vehicle accidents in absence of any ESP equipped car.

Figure 1: Procedure for the estimation of the ESP safety impact



Note: Country specific values apply. Here, German conditions are exemplarily illustrated.

Results

The **safety impact** of ESP (see table 1) is calculated based on the procedure outlined above. It is obvious that ESP can save lives. When every car in the EU-25 would be equipped with ESP, approximately 4,000 lives per year could be saved and 100,000 injuries could be avoided.

Table 1: 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	Effectiveness of ESP	Accidents avoided…	Fatalities avoided …	Injured persons avoided …
	Accidents	Persons killed	Persons injured			…with full ESP-penetration of car stock (100 % ESP-penetration)		
U.K.	32,526	857	41,445	34.96		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	0.8	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

Source: Own calculations

When it comes to **cost-benefit results**, two calculations of the benefits were carried out. The first one reflects the savings of accident costs, property damage and congestion in injury accidents. The second calculation considers that there are also property damage only (PDO) accidents which costs can be avoided. Table 2 provides an overview over the results. Considering costs of ESP-equipment per car of € 130, a car stock in EU-25 of 212 million cars and average lifetime of 12 years leads to overall investment costs of about 2.8 billion € per year. The benefits (without PDO accidents) account for about 9.6 billion € per year. When PDO accidents are included, the benefits rise to 16 billion € per year. With that, ESP represents a building block of an Intelligent Transport System in Europe. Benefits of the same magnitude can only be expected from the in-vehicle emergency call system (eCall). The Benefit-Cost Ratios for ESP result to 3.5 in the case without PDO accidents and respectively 5.8 when PDO accidents are also considered. So, every invested € will be paid by factor 3.5 – 5.8 in cost savings for the society. This is far more than the benefit-cost ratio of 1 which indicates the profitability for the society.

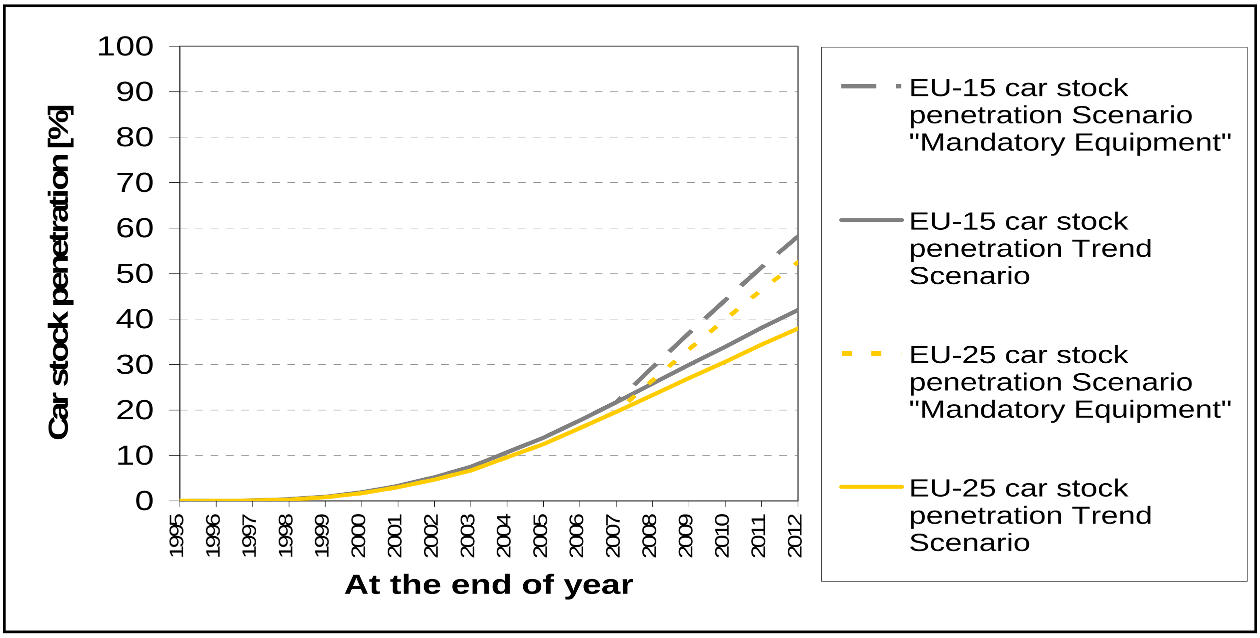
Table 2: Benefit-Cost Results for ESP – Full Car Stock Penetration

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	352.5	931.2	2.6	1,552.0	4.4
Germany	583.2	2,797.1	4.8	4,661.8	8.0
Italy	425.5	1,108.6	2.6	1,847.7	4.3
Spain	244.1	1,076.5	4.4	1,794.2	7.4
France	383.4	937.7	2.4	1,562.8	4.1
EU-15	2,477.1	8,298.5	3.4	13,830.8	5.6
EU-25	**2,775.2**	**9,677.6**	**3.5**	**16,129.3**	**5.8**

Source: Own calculations

An **accelerated market penetration process** is also beneficial from the society point of view. The calculations underlying figure 2 assume that from the year 2008 on every new car is mandatory equipped with ESP. Therefore, the car stock penetration shows from this year on a steeper gradient than the trend scenario curve. Each year the gap will become wider. In 2012, the difference between the scenarios is close 15%-points of the EU-25 car stock.

Figure 2: Car stock penetration with ESP for the Trend Scenario and the Scenario "Mandatory Equipment" in the European Union



Source: Own estimations, information from manufacturers

Compared to the trend scenario, additional benefits accrue in terms of lives saved or accident costs saved due to the mandatory equipment of ESP in cars assumed from the year 2008 on. Table 3 provides an overview over the **safety impact and the resulting benefits**. In the period 2008-2012 about 1,800 lives can be saved and 43,000 injuries can be avoided. This represents the additional benefits of the mandatory equipment compared to the trend scenario. In economic terms, this is equivalent to additional benefits of 4.4 billion € to 7.3 billion € for the period of 2008 to 2012.

Table 3: 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**

Source: Own calculations

Conclusion

The recommendation to be drawn from these findings is that equipment of cars with ESP should be fostered, because it is a cost-effective measure. The cost-effectiveness (= Benefit-Cost-Ratio) is not influenced by the way the system is further introduced into the market, if it is assumed, that system costs are independent from the introduction scenario. While the Benefit-Cost-Ratio is independent from the market introduction strategy, the point in time, where the full safety potential of ESP can be exhausted (i.e. where full car penetration is reached), varies depending on the introduction strategy. Every year, in which ESP-penetration is lower than 100 %, persons are killed in road traffic which could have been saved with the help of ESP. Therefore it can be recommended that full ESP-equipment of cars should be realised as soon as possible. The mandatory equipment for all newly registered cars with ESP from 2008 onwards would contribute to that aim of soonest possible ESP-equipment of cars. The calculations show that with this mandatory equipment more than 1,800 additional lives and € 4.4 – 7.3 billion accident costs could be saved only between 2008 and 2012 (calculations based on accident figures from 2003). Thus, the mandatory equipment for all newly registered cars from 2008 onwards can be recommended based on the accident analysis carried out in this study.