Impacts of an automatic emergency call system on accident consequences

Ministry of Transport and Communications Finland
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Abstract:	The aim of the study was to estimate the impacts of an automatic emergency call system (eCall) on accident consequences in Finland. The estimated number of fatalities that could be avoided using the eCall system is based on the case reports of Road Accident Investigation Teams covering the period 2001–2003. The eCall system could very probably have prevented 4.7% of the fatalities in accidents involving motor vehicle occupants. In the accidents involving fatal unprotected road user, however, the system could probably have prevented no fatality. In all, eCall system was estimated to be able to reduce 4–8% of all road fatalities and 5-10% of motor-vehicle occupant fatalities in Finland. The benefit-cost ratio of the eCall system examined in this study was 0.5–2.3. The benefit-cost ratio would have been higher if the indirect benefits of the eCall system could have been taken into consideration.			
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ABBREVIATIONS

eCall	Pan-European in-vehicle emergency call
FDS	Full Data Set (for data in an emergency call)
ITS	Intelligent Transport System(s)
MDS	Minimum Data Set (for data in an emergency call)

KEY EVALUATION RESULTS

The eCall system could very probably have prevented 4.7% of the fatalities in accidents involving motor-vehicle occupants. In the accidents involving fatal unprotected road user, however, the system could probably have prevented no fatality. In all, eCall system was estimated to be able to reduce 5–10% of motor vehicle fatalities and 4–8% of all road fatalities in Finland.

The results showed that, in most accidents involving motor-vehicle occupants (82%), the emergency call had been made within five minutes of the accident. However, in 14% of the cases the emergency call had been made 5–30 minutes after the accident and in approximately 4% of the cases more than 30 minutes after the accident. In the accidents involving fatal unprotected road user, the delays were slightly shorter.

The benefit-cost ratio of the eCall system examined in this study was estimated to be in the range of 0.5–2.3. The benefit-cost ratio would have been higher if the indirect benefits of the eCall system could have been taken into consideration.

Based on the main findings of this study, the eCall system is recommended for immediate and widespread implementation in Finland. The study also indicated a need for developing statistics on severely injured accident casualties.

1. DESCRIPTION OF THE PROBLEM

1.1 SITE

The study involved the whole Finland.

1.2 ISSUES ADDRESSED

According to the goal set in 2001 by the Council of State of Finland the number of traffic fatalities annually should be under 250 by the year 2010. This goal calls for a reduction of at least 125 traffic fatalities from the number in 2004. The Pan-European emergency call system (eCall) developed on the initiative of the eSafety Forum composed of the European commission, industry and other traffic safety actors is believed to help in the meeting of this goal.

According to the international estimates of the fatality reducing impact of the eCall system the implementation of the automatic emergency call system would reduce the number of traffic fatalities by 4–56 annually. Such a vague result does not warrant objective decision making on government parcticipation in the deployment of eCall. In addition, these estimates have not been proportioned to Finnish emergency centre processes or Finnish accident data. The estimates are also not based on the kind of detailed analysis possible in Finland. Based on the above it is clear that the impacts of the eCall system should be explicitly evaluated based on Finnish accident data taking into account local circumstances.

2. DESCRIPTION OF THE ITS SYSTEM

2.1 OBJECTIVES

The objective of the study was to estimate the impacts of an automatic emergency call system (eCall) on accident consequences in Finland.

This report is a summary in English of a full-length Finnish report (Virtanen 2005).

2.2 SYSTEMS AND TECHNOLOGIES APPLIED

The Pan-European in-vehicle emergency call system is known as eCall. The eCall system is based on either the automatic detection of an accident with an instrument or a manual emergency call made by pushing a button. In both cases a normal voice communication is opened to the emergency center after a small delay, and accident vehicle identification and possible accident severity information is transmitted automatically. The automatic detection of an accident is based on the vehicles sensors or the sensors built into the eCall device. The in-vehicle sensors can detect e.g. triggering of an airbag, intense deceleration, vehicle roll-over or a sudden temperature increase. The schematic description of the system is given in Figure 1.

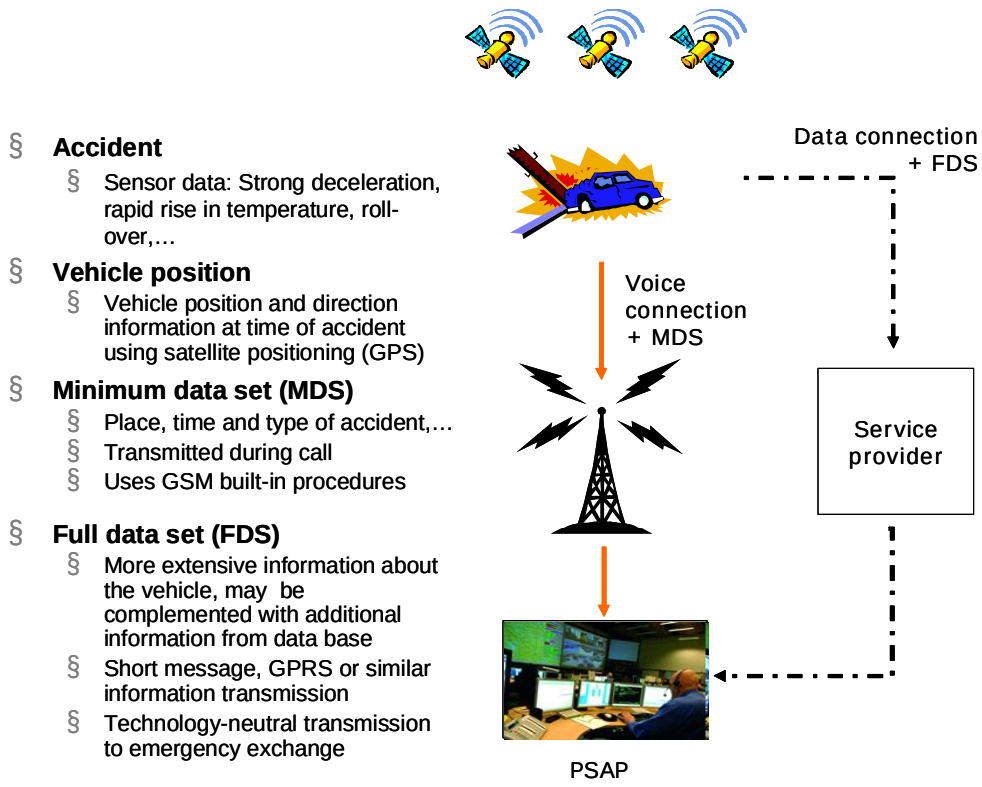

Figure 1. Function of the eCall system.

The data of the vehicle location and direction at the time of the accident is obtained from satellite positioning (GPS, Global Positioning System). The location can be determined to within 10 metres using absolute positioning. In the future the positioning will be even more precise. According to plans an even more accurate GPS-like positioning system, Galileo, will be implemented in 2008. This enables positioning to within one metre.

The receiving of an automatic emergency call does not alter the process at the emergency center but the procedure is the same as with a usual emergency call. The goal is that the data packets transmitted by the eCall system can give the duty officer all the necessary information needed for the placement of an emergency call. After the eCall device detects an accident it composes and transmits to the emergency centre a minimum data set (MDS) containing the following information:

- when (timestamp)
- where (precise location and direction)
- who (vehicle identification information)
- where to get more information (emergency centre data)
- severity of accident (manual/automatic emergency call, which detector/sensor).

After the transmission of the minimum data set (MDS) a voice communication is opened between the emergency centre and the accident vehicle.

In addition to the minimum data set the eCall device composes a full data set (FDS) and transmits it to a service provider providing that the vehicle holder or owner has a contract with the emergency centre transmission service. The service center receives the message containing the full data set sent by eCall and relays it to the emergency centre. The FDS message is relayed as is and, in addition, the service centre seeks vehicle information from its databases and sends it to the emergency centre.

2.3 STATUS OF THE SYSTEM

The Pan-European emergency call system (eCall) developed on the initiative of the eSafety Forum composed of the European commission, industry and other traffic safety actors has met with widespread support both from EU member states and car manufacturers. The aim is to equip all new vehicles with eCall terminals from the beginning of 2010.

Finland has been active in the EU in promoting the eCall system. A consortium commissioned by the Ministry of Transport and Communications produced a national eCall pilot programme and implementation plan in June 2004. Finland was the first state to sign the eCall Memorandum of Undestanding and realised the eCall terminal transmission test bench taken into production use in the summer of 2005. The on-going renewal of Finnish emergency centres and their data systems promote the swift widespread implementation of the eCall system. All Finnish emergency centres will be available to receive eCalls by the end of 2006.

The significance of the retrofittable terminal is essential especially in Finland due to slow renewal of the vehicle fleet. Services utilising the location capabilities of the eCall system appended to the terminals are also believed to promote the entire traffic telematics service production.

The consumers are also interested in emergency call systems. An interview of almost 100 drivers made in March 2004 revealed that an automatic emergency call system is the second most required accessory or service for a vehicle. Only anti-lock brakes were deemed more essential. The necessity of an automatic emergency call system compared to other equipment was not affected either by the annual kilometres driven or whether the driver drove mainly on rural roads or in towns. One third of the drivers are willing to pay 100-299 euros for eCall equipment and one third 500-999 euros. (Ministry of Transport and Communications 2004.)

3. EVALUATION

3.1 TIMING AND TYPE OF EVALUATION

The evaluation was carried out prior to the implementation of the eCall system (ex-ante evaluation), but based on an analysis of empirical data of actual accidents that had occurred in Finland in 2001-2003.

3.2 OBJECTIVES FOR THE EVALUATION

The main objective of the study was to determine the quantitative effect of the eCall system on the number of traffic fatalities in Finland. An additional objective was to estimate the impacts of precise accident location and other information obtainable from the eCall system on accident consequences.

Other objects of the study were to

- gain information about delays in emergency procedures and estimate by how much and in which number of accidents the eCall system would expedite emergency calls and the arrival of help
- examine the impacts of the eCall system on official activities in traffic accident situations
- estimate the benefits of the eCall system against the costs of the system
- suggest possibly more effective processes for the compilation of statistics of personal injury accidents if the current statistical methods do not enable reliable impact evaluation.

3.3 EXPECTED IMPACTS

Based on the basic functionality and possible impacts of the automatic emergency call system it has been assumed that

1. The system does not decrease the total number of accidents.
2. The system decreases the number of traffic fatalities because swifter arrival of help should prevent some traffic fatalities. E.g. the fatalities in which the delay between the time of accident and the reporting of the accident has been unusually long or the accident has been located incorrectly can be partly avoided.
3. The system decreases the injury levels in some degree: swifter arrival of help alleviates the injuries of some accident victims.
4. The swifter arrival of help and more exact location provided by the system will improve the road keepers' incident management and decrease traffic incidents.

This study determined the impact of eCall on the decrease in traffic accident fatalities and the time spent in the calling and arrival of help.

3.4 METHODS

Road accident investigation team data

The impacts of the eCall system on the number of fatalities in traffic accidents and the time between the time of the accident to the accident call were studied using the data from the road accident investigation teams. The data was limited to 2001–2003 when the cellular phone density had reached the current level of practically maximum penetration. The study was limited to include only traffic accident fatalities as only the accidents leading to fatalities are investigated in detail and for them the statistical coverage is 100 percent.

The road accident investigation teams investigate each fatal road accident in Finland that results in death within three days. The teams consist of a police officer, road specialist, vehicle specialist, physician and psychologist. Additional experts are involved, if needed. The investigations include the description of the accident and its consequences as well as the assessment of contributing risk factors and the reasons for the consequences of the accident. The reports include e.g. the following information: detailed description of the event, the location and situation related information, use of safety devices, information about the users and the vehicles, a police report of the accident, description of injuries and the total extent of the injuries. In every case the investigation team also investigates whether any alcohol was involved in the accident.

The study examined accidents resulting in the death of a person inside a motor vehicle and accidents resulting in the fatality of an unprotected road user that had been investigated by the road accident investigation teams. Unprotected road user accidents were defined as accidents involving motor vehicles and unprotected road users, accidents between pedestrians and bicyclists and bicycle single accidents e.g. falls. The falls of pedestrians are not traffic accidents and are thus not included in the unprotected road user accidents of the road accident investigation teams (Liikenneturva 2005).

The study material was composed of investigation folders that contain all the collected material of an accident. The folder consists of a public investigation report, accident site diagram, and photos, accident investigation team member forms and e.g. the police registration forms and examination records, autopsy records and death certificates.

In 2001–2003 the road accident investigation teams examined 797 accidents with at least one fatality in a motor vehicle and 263 accidents with at least one unprotected road user fatality. The number of dead in motor vehicle accidents was 929 and 264 in unprotected road user accidents. The study included 99 percent of the material.

No accidents of any vehicle types were deleted from the study material even though the eCall device is not designed for two wheel vehicles or snow mobiles. This was because the eCall technique is supposed to develop so that the above vehicles can be equipped with them in the future. It is important for future studies to gather data also from two wheel vehicle and snow mobile accidents, the injuries and delays in the calls for help. The accidents have thus been divided into two groups:

- accidents with at least one vehicle that can be equipped with an eCall device (eCall currently possible)
- accidents with no vehicles that can be equipped with a current eCall device (eCall currently impossible).

Unprotected road user accidents were divided in a similar fashion into two groups: the first included the accidents involving pedestrians and bicyclists with a car, van, lorry, bus or combined vehicle and the second group unprotected road user single accidents (mainly falls of bicyclists) and accidents between a two wheel vehicle, train or tram and an unprotected road user.

The in-depth analyses were carried out by a research team involving two medical doctors, who are specialists in traffic accident traumatology. First, the patients whose injuries had been fatal regardless of any immediate medical treatment were excluded. Those injuries typically included substantial head, chest, aorta or heart injuries, which resulted in immediate death. In addition, the cases with no indication about delays and injuries rated as 6 in the Abbreviated Injury Scale (AIS) were classified to this category.

Second, the remaining cases were categorised into three groups: (1) eCall could very likely have prevented the fatality, (2) the very likely effect of eCall could not be authenticated and (3) those with insufficient data. The classification was based on the examination of the injury reports, estimated delays and possibilities to a rapid medical treatment such as the vicinity of first aid. Specifically, the following information were examined: the time of the accident, development of injuries, characteristics of injuries (principal and immediate cause of death), time and place of death, time of the accident based on police report, time of the beginning of the accident investigation based on police report, time of notification of police based on police report, eye witnesses, manner to request for help, estimated notification delay and any problems in determination of the accident site.

Rescue service resource and accident data system

The national rescue service resource and accident data system was utilized in defining the time elapsed between the accident and the emergency call. The system contains information about the accidents in which the rescue services have been at the accident site.

The database contains the following time variables for each accident:

- time when emergency call was received at emergence centre and maker of call
- unit alert time
- unit departure time
- time of unit arrival on site
- time of unit return at station

- reporting time and the officials reported to.

The database also includes the following uncoded data written by the duty officer:

- address and location of accident site
- description of the development of the accident situation
- description of the actions by the fire brigade and their profitability.

Interviews of emergency centre duty officers and rescue workers

In order to understand the emergency centre processes, emergency call processes and delays in accident situations better, interviews of officials acting in different phases of traffic accident situations were carried out. The first ones to be interviewed were the first to receive the information about accidents i.e. emergency centre duty and senior officers. The officials at the accident site i.e. a traffic and special police sergeant, a flying squad police sergeant, a fire brigade taskmaster, a leading fireman, ambulance men and doctor unit were also interviewed. In addition to these a police sergeant acting as the police member and foreman of an accident investigation team was interviewed. Information about the possible impacts of eCall on incident management was obtained by interviewing two employees of the Finnish Road Administration traffic centre.

The body of the interview was the same for all the interviewees but the questions were emphasized on the functions of each actor in the accident situation. First each interviewee was asked to explain how they receive the information about the accident and what they do next. After this each actor group was questioned emphasizing their job description. The emergency centre duty officers were asked e.g. to tell how the whole emergency process was handled from answering the phone to whom is contacted and in which order, how much time is elapsed in each phase, what information they require from the accident site in order to raise the alarm and how well the callers can give the information. In the interviews of the people going to the emergency site information especially about the delays involved with finding the right location and the significance of right equipment for the handling of the accident was emphasized. In the interviews of the police the main issues were the impacts of eCall on traffic control, speeding up of police traffic control actions for re-routing and decreasing the delays for other traffic.

Surveys of emergency centre duty officers

In an email emergency centre survey sent to all Finnish emergency response centres the emergency centre duty officers were asked to evaluate what kind of delays there exist currently in raising alarms and accident site location, The survey was for all the duty officers at the emergency centre. At the time of the survey there were eight municipal and twelve national emergency response centres in Finland. The municipal emergency response centres do not receive the calls to the police emergency 10022 but the calls are connected to the police emergency response centre. The national emergency response centres receive the calls for both (112 and 10022) emergency numbers.

In total, 181 survey forms sent to the emergency response centres were returned, representing 18 of 20 emergency response centres. The number of filled forms from an individual emergency response centre ranged from 2 to 20.

4. THE IMPACT OF THE SYSTEM

4.1 RESULTS

4.1.1 Traffic fatalities

Table 1 shows the estimated impact of eCall on Finnish road fatalities involving motor vehicle occupants. The classification "eCall could probably have prevented death of the victim" means that the medical specialists regarded it very likely that the system would have prevented the fatality.

Table 1. Estimated impact of eCall on Finnish road fatalities involving motor vehicle occupants in 2001-2003.

Influence on traffic accidents' consequences	Fatalities with eCall possibility		Fatalities without eCall possibility		Total	
	n	%	n	%	n	%
eCall could very probably have prevented the fatality	39	4.4	4	10.8	43	4.7
the very probable impact of eCall could not be validated	831	94.2	32	86.5	863	93.9
Unclear cases (not enough data)	12	1.4	1	2.7	13	1.4
Total	**882**	**100**	**37**	**100**	**919**	**100**

According to the study the eCall system would very likely have prevented 4.7% of the fatalities of participants inside motor vehicles in 2001–2003. With the number of motor vehicle fatalities in 2004 this comes to ca. 14 fatalities less annually. In addition to this there were approximately 5% of the fatalities where the eCall could possibly have helped, i.e. eCall was estimated to be able to prevent 5–10% of all motor vehicle fatalities in Finland.

According to estimates the eCall system would have had no likely impact on the number of fatalities in the accidents involving unprotected road users and motor vehicles. The number of unprotected road user fatalities that the eCall might have prevented was estimated to be about 1%. In total the eCall system was estimated to have been able to prevent 4–8% of all traffic fatalities in Finland.

4.1.2 Delays in calling for help

According to the results of the study in about 82% of all motor vehicle accidents the call for help was made within five minutes of the accident. In about 14% of the accidents the delay between the accident and the call for help was 5–30 minutes and in about 4% over 30 minutes. The delays were a bit shorter in the accidents involving unprotected road users resulting in fatality (Table 2).

Table 2. The estimated emergency call delays in fatal accidents involving motor vehicles in Finland in 2001-2003.

Emergency call delays	Case Study			Case Study + Phone Log			Questionnaire
	accidents with eCall possibility (n=758)	accidents without eCall possibility (n=37)	Total (n=795)	accidents with eCall possibility (n=759)	accidents without eCall possibility (n=38)	Total (n=797)	All fatality accidents (average of 157 answers)
	%	%	%	%	%	%	%
Less than 5 min	87.5	56.9	86.1	79.8	70.8	79.5	81.2
5-30 min	8.6	26.9	9.5	17.0	4.2	16.6	15.3
More than 30 min	3.8	16.2	4.4	3.2	25.0	3.9	3.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The study of delays showed that the percentage of the over five minute delays was much greater in the accidents with vehicles in which the current eCall equipment can not be installed than in the accidents where the current eCall equipment could be installed in at least one of the vehicles. This is because the first are mainly two

wheeled single accidents, loss of control accidents and deer accidents. The analysis of the material showed that of all accident types, the percentage of over five minute delays was indeed greatest in loss of control accidents and animal accidents.

4.1.3 Delays in the arrival of help

The interviewed officials and the emergency centre duty officers who answered the survey estimated that the location of the accident is sometimes unclear to the persons reporting the accident. 30% of the duty officers estimated that the arrival of rescue units on the scene was sometimes delayed due to vague or incorrect location information. The location is unclear especially in the accidents that occur on big main roads outside built-up areas. The clarification of a problematic location can take several minutes and even after this the location can remain unclear. The eCall system thus eases and shortens the work of the emergency centre duty officers in determining the location of the accident by transmitting the exact location of the accident automatically. eCall also enables a quicker and more exact route planning to the accident site for the rescue units. eCall would, however, not seem to have a great effect on the optimisation of rescue resources.

4.1.4 Benefit-cost ratio

The benefit-cost ratio of eCall was calculated by including all of the costs of the system and the direct traffic benefits due to decreased accident and time costs.

Costs

The fatality decreasing impact of eCall was calculated based on the assumption that all vehicles were equipped with the eCall terminal. It was also assumed that the unit would be cheaper than when the terminal would be in only some of the vehicles.

The number of registered vehicles (cars, vans, lorries, busses, special vehicles, tractors, motor work machines, motorcycles, mopeds, snow mobiles) was 3 482 516 in Finland at the end of 2004 (Tilastokeskus 2005). The equipment costs were calculated with two prices. The first estimate assumed that the eCall terminal would be retrofitted to all vehicles. The other estimate assumed that the eCall terminal would be standard equipment for the vehicles.

The price used for the retrofittable terminal was 150 euros because this is the price the consumers are willing to pay for the equipment (Ministry of Transport and Communications Finland 2004). The additional installation costs of the retrofittable terminal used was 50 euros per terminal. Swedish estimations show that the price of standard equipment is half that of retrofittable equipment. Thus the price used for the terminal as standard equipment was 75 euros. The standard equipment eCall terminal has no additional installation costs.

The service life used for the in-vehicle terminal was estimated to be 8 years. The costs were divided into annual costs with the annuity method using the annual interest rate of three percent.

With the above presumptions the total costs of retrofittable eCall terminals are 99 million euros and the total costs of standard equipment eCall terminals are 37 million euros if the terminals were installed to all registered vehicles. eCall was calculated to be installed in also the vehicles in which the current eCall terminal can not be installed to (motorcycles, mopeds and snowmobiles). This was because the impact of eCall on traffic fatalities was estimated on the assumption that also these vehicles had eCall equipment.

The costs of the eCall system for emergency centres have not yet been estimated in Finland. Therefore this study utilised the costs estimated by the Swedish emergency centres (0.37 million euros/year) that were estimated to be the best possible approximation of the costs for the Finnish emergency centres. The Swedish estimation included e.g. equipment costs and maintenance, and the training of personnel.

Benefits

In the study the very likely fatality reducing impact of eCall was calculated as 3.6%. With the number of accidents resulting in fatality in the study data of 2001–2003 this percentage means the reduction of 14 traffic fatalities annually. If the eCall system had been operational 20% of the fatalities would instead have been permanent injuries, temporary severe injuries for 40% and temporary mild injuries for 40%.

In addition to the very likely fatalities it would be possible to avoid fatality in about 4% of the traffic fatalities using the eCall system. A third of these would be converted to permanent injuries, a third to temporary severe injuries and a third to temporary mild injuries.

The accident cost savings for the conversions from fatality into injuries was calculated using the personal injury unit costs defined for different injuries (Table 3). The Annual savings were 22–44 million euros.

Table 3. Traffic accident personal damage unit costs on public roads at the price level of 2000 (Finnish Road Administration 2001).

Accident type	Unit cost (euros)		
	Financial costs	Loss of well-being	Total
Fatality	437 289	1 496 873	1 934 161
Permanent injury	260 691	824 121	1 084 812
Temporary injury	5 887	145 483	151 369
- Severe injury	8 409	252 282	260 691
- Miid injury	4 205	46 252	50 456
Injury on average	**33 638**	**214 440**	**248 077**

This study did not examine the impacts of eCall on the severity of the persons' injuries. As it can, however, be assumed that the implementation of the eCall system would alleviate also the severity of the injuries the accident cost savings have been calculated based on Swedish estimates. In Sweden the eCall system has been estimated to convert 3–4% of severe invalidities into mild injuries. This estimate could, however, not be directly utilised for Finland in Table 1 because the Finnish and Swedish compilation of statistics on injuries and disability classifications differ significantly.

The accident cost savings in Finland from the conversion of severe disabilities into mild were calculated assuming that the ratios of traffic accident fatalities and different severity class injuries are about similar in Sweden and Finland. The accident cost savings based on the Swedish estimates were converted into the Finnish situation as follows: First the ratio of the mean number of fatalities in traffic accidents in Sweden and Finland in 2001-2003 was calculated (409 / 537 = 0.76). This was then multiplied with the Swedish estimated accident cost savings (42–56 million euros). Thus the annual possible savings in Finland would be 32–42 million euros.

The swifter clearing of accident situations and more efficient incident management and information decrease the time costs for other traffic and also reduce additional accidents. In Sweden the decreased travel times were estimated to correspond to 0.5–1.1 million euros annually. This estimate was converted in proportion to Finnish and Swedish car populations. Thus the decreased travel times would correspond to 0.3–0.6 million euros annually in Finland.

With the above assumptions the annual socio-economic direct benefits of the eCall system would be 55–88 million euros.

Benefit-cost ratio

Based on the above costs of implementing the eCall system and direct benefits the benefit-cost ratio is 0.5–2.3 (Table 4).

Table 4. The costs and direct benefits of implementing the eCall system.

Annual benefits	minimum estimate	maximum estimate
Fatalities converted to injuries	22 300 000	44 330 000
Milder injuries	31 710 000	42 350 000
Congestion savings(shorter travel times)	280 000	630 000
Total benefits	54 290 000	87 310 000
Annual cocts	**maximum estimate**	**minimum estimate**
System costs (retrofitted/standard)	99 220 000	37 210 000
Emergency centre costs	370 000	370 000
Total costs	99 590 000	37 580 000
Benefit-cost ratio	0,5	2,3

The study did not consider the indirect benefits from the eCall system such as:

- the utilisation of the eCall terminals and their features in other services.

- the eCall system in operation in all European countries would increase the sense of safety of Europeans travelling abroad. The derivative benefits are diverse: increased trust in the emergency services, reduced stress, reduced dependence on verbal communication and less traffic jams.

If the indirect benefits would have been included in the calculations the benefit-cost ratio of the system would be even better.

4.2 OVERALL ASSESSMENT

4.2.1 Safety

According to the decrease in the number of fatalities in motor vehicle and unprotected road user accidents in the study the eCall system would have very likely prevented in total 43 traffic fatalities in 2001–2003. This is 3.6% of all the traffic fatalities in those years. Fatalities that the eCall system might possibly have prevented were estimated to be about 4%. In total, 5–10% of motor vehicle fatalities and 4–8% of all Finnish traffic fatalities could be prevented with the eCall system.

The percentage of the fatality decreasing impact of the eCall system was greatest in the accidents involving vehicles in which the current eCall equipment can not be installed. This is due to also the greatest percentage of long emergency delays in these accidents.

The study was unable to evaluate the impact of the precise location information given by eCall on the swifter arrival of rescue units at the accident site in the evaluation of decrease in traffic fatalities. The surveys of emergency centre duty officers and interviews of officials showed that there was some inaccuracy in the location information given by the emergency callers. The decrease in traffic fatalities can thus be greater than the result of the study. The study assumed that all vehicles were equipped with the eCall terminal and that each terminal would function properly. If this is not the case the benefits of eCall would be smaller. The decrease in the traffic fatalities arrived at was, however, deemed to be the most realistic result with the available data.

4.2.2 Financial

The benefit-cost ratio of the eCall system has been estimated as between 1.1 and 8.5 in earlier foreign studies. In this study the benefit-cost ratio of the eCall system was estimated to be in the range of 0.5–2.3. The estimate does not take into account the indirect benefits of the eCall system like the several new location utilising services that can be based on eCall. The impact of these services on the price of the eCall terminal was also not known at the time of the study. A further consideration is that the current hospital centralisation under way at many locations will increase the distance between hospitals emphasising the benefits of the eCall system. It can be assumed that the indirect benefits of the eCall system will improve the benefit-cost ratio.

The reliability of the benefit-cost ratio estimate is reduced by the fact that the benefits of the eCall system for the trauma of the injured could not be estimated dependably due to inadequate data of those injured in traffic accidents. The study thus had to use the Swedish estimates the suitability of which for the Finnish accident data may be uncertain.

With the data used in the benefit-cost calculations it could be found that if half of the vehicle fleet would be retrofitted with an eCall terminal and half had eCall as standard equipment the benefit-cost ratio would be 0.8–1.3. If the whole vehicle fleet would be equipped with the eCall system so that 73% of the vehicles had eCall as standard equipment the system would be socio-economically profitable (b/c ratio > 1) even with the most negative benefit estimates.

When comparing the benefit-cost evaluations made in different countries it is useful to note that the methods for calculating the costs of traffic accidents differ by country. The differences come especially from the valuation of so-called loss of well-being. In Finland individual willingness to pay is used in the calculation of accident costs. This method is currently used in many countries (e.g. Sweden and Norway). (Finnish Road Administration 2001.)

When comparing other benefit-cost calculations with the ones in this study one should take into account the differences in the size of the vehicle fleet used in the calculations. In this study all registered vehicles were to be equipped with eCall terminals also including motorcycles, mopeds and snowmobiles. This was because the impact on traffic fatalities was estimated on the assumption that also they are thus equipped.

If the vehicle fleet used in the benefit-cost calculations was stripped of the vehicles in which the benefits of the eCall system would probably be lower than with other vehicles the estimated costs of the eCall system would decrease without a similar decrease in the benefits. Such vehicles include e.g. museum vehicles with a low utilisation rate.

5. EUROPEAN DIMENSION: TRANSFERABILITY OF THE RESULTS

Compared to almost all the rest of Europe Finland has a lot of lightly trafficked roads and severe winter conditions and thus the self-alarming eCall system could be more beneficial here than in the rest of Europe. In Finland 70% of the accidents leading to fatality occur outside urban areas where the distances to hospital and other institutions are long and the alarms are delayed with greater probability than in urban areas. The description of location is also more difficult outside urban areas. This is why the delay from the detection of an accident to the call and arrival of help is often long. The benefits of the eCall can be assumed to be greatest just in the countries where a great percentage of accidents occur outside urban areas.

When comparing the results from different countries one should bear in mind that different countries and their traffic accidents and emergency centre and medical treatment procedures have their own typical characteristics. E.g. in Finland the percentage of single accidents of all fatal traffic motor vehicle accidents (47% in 2004) is greater than in many other European countries (e.g. only 7% in Denmark). In the U.S.A. the percentage of single accidents leading to fatality of all fatal traffic motor vehicle accidents is closer to the Finnish figures. The benefits of the eCall system were found to be greatest just for single accidents with no eyewitnesses and in which the trauma to the injured were so severe that they were unable to call for help by themselves.

The comparison of the 4–8% decrease in traffic accident fatalities arrived at in this study with the figures of other European studies one can see that the results are similar to the German (5%) and Dutch (7%) estimations. The estimations in Sweden (2–4%) and Great Britain (2%) are smaller and the estimate for the whole 25 member state EU area (5–15%) greater than the estimate in this study. The American estimation for the decrease in traffic accident fatalities based on field studies was smaller (2–3%) than in this study. the estimate made by the doctors was, however, greater (9–11%).

When comparing the estimates from Finland and elsewhere one should remember that, unlike the other studies, the Finnish estimate is based on detailed accident analysis. Therefore the results of this study can be deemed somewhat more reliable than the other estimations based solely on statistics and accident databases.

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The study investigated the effects of the eCall system in accident situations. The results of the study can be utilised when making decisions on public and private sector support to and participation in the roll-out of eCall systems. Finland has so far acted very actively with regard to eCall, and has signed as the first country the Memorandum of Understanding on eCall in the spring of 2004. All Finland's emergency response centres are able to receive and handle eCalls by the end of 2006 and the objective is to obtain benefits from eCall as soon as possible.

The study was supervised by a Steering Group chaired by Anu Lamberg from the Ministry of Transport and Communications. The other members of the Steering Group were Seppo Öörni from the Ministry of Transport and Communications, Mikko Jääskeläinen from the Ministry of Interior / Emergency Response Centre Administration, Pekka Sulander from the Finnish Motor Insurers´ Centre, Timo Ernvall from HUT and Risto Kulmala, Juha Luoma and Anna Schirokoff from VTT as well as Kari Karkola and Jari Salo, who acted as the medical experts in the study investigating the medical sheets of Accident Investigation Teams, the autopsy protocols and death sertificates in the study. The study report was peer reviewed by Inkeri Salo from the Finnish Motor Insurers´ Centre and Jorma Helin from the Finnish Road Administration.

The study was also published in December 2005 as a Master's Thesis for the Helsinki University of Technology (HUT) for Niina Virtanen at VTT. The thesis was supervised by Research Professor Juha Luoma at VTT and Professor Timo Ernvall at HUT. The project manager of the actual study was Anna Schirokoff at VTT. The study also involved interviews of a large number of authorities working with accident situations in their regular activities.