Impact assessment on the introduction of the eCall service in all new type-approved vehicles in Europe, including liability/ legal issues

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PROJECT REPORT

Impact assessment on the introduction of the eCall service in all new type-approved vehicles in Europe, including liability/ legal issues

Final Report Issue 2

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1 Executive summary

The project analysis methodology developed an extensive list of "Indicators" both qualitative and quantitative to be addressed both by in-depth national studies and at a European level. The methodology also developed six clusters of countries based on a range of indicators.

Questionnaires were sent at European level and approximately 1/3 were completed to some degree. Some useful descriptive information about eCall in various countries was made available but little useful information was provided concerning the key benefits arising from casualty savings. Similarly, concerning costs, some information about infrastructure side was provided but the key commercial stakeholders deemed this sort of information difficult and commercially sensitive. Little new material was provided concerning legal issues although a few concerns were raised. For the ethical issues, many stakeholders felt unequipped to respond.

A study on the impacts of eCall was carried out in four in-depth studies: UK, Netherlands, Finland and Hungary. In the UK interviews, traffic and environmental modelling, accident analysis including in-depth fatal case studies and cost-benefit calculations were made as well as a critical analysis of a previous UK study. In the Netherlands, workshops and interviews were held and, contact with emergency services established. Traffic modelling and other studies were used to estimate congestion. In Finland previous studies were re-visited and reanalysed to investigate impact on incident management, congestion and secondary accidents, impact on the rescue operations, processes and organisations, impact on injury reduction and other socio-economic impacts. Also a workshop with relevant stakeholder was organised. In Hungary detailed analysis of accident statistics and fatal case studies were analysed. Traffic and environmental modelling was used to estimate congestion saving and implementation issues were studied.

Data was collected from all 27 EU-countries and some non-EU-countries. The results from the in-depth studies were scaled up to the 27 countries of the EU based on the clustering approach.

Issues concerning macro economics and ethics were typically regarded as "too complex" for many Stakeholders to engage with and they see this domain as one for policy experts. 'Vision Zero' is an innovative philosophical approach which is highly recognised but most national governments still use social cost-benefit as a starting point for policy development for decision making. An ethical critique of Social Cost Benefit (SCB) calculations can be developed to argue that it is demonstrably unsatisfactory and there are, for example, wide national variations in treatment of costs and treatment of benefits. Many frameworks exist that explicitly recognise qualitative as well as quantitative factors and public acceptability is often a decisive factor in deliverability of policies. Ultimately, every public policy decision is political and depends on factors beyond the purely economic ones.

In relation to the introduction of eCall potential liability questions primarily relate to damage as a result of an unsuccessful or corrupted eCall (aggravated injuries or death) and damage as result of false alarms (the costs of unnecessary dispatch of emergency services). After examining legal liability issues from a Dutch and English law perspective, and some specific case studies, it can be concluded that the legal issues appear to be manageable in terms of further development and roll-out of eCall such that they are not expected to be a barrier to deployment. Similarly, privacy issues are also not expected to be a barrier.

Three scenarios for eCall implementation were defined as:

1) Do nothing: Just left to the market with no further action from the Commission/eSafety Forum.

2) Voluntary approach: All European vehicle manufacturers, all member states and the EC agree by mid-2010 to provide eCall by signing an MoU (Memorandum of Understanding) on eCall deployment by 2015. The MoU sets specific responsibilities and timelines for the stakeholders signing the MoU.

3) Mandatory introduction: EC will produce an EU directive mandating eCall devices in all new vehicles by the end of 2014 and the member states to set up facilities for receiving and processing eCalls at PSAPs by the same date.

In order to estimate impacts in each of these three scenarios, some assumptions/values have to be chosen. The costs and benefits of the eCall implementation depend on the penetration rate of the system. In the 'do nothing' scenario the penetration rate is estimated at 6%, in the voluntary approach the penetration rate is estimated at 23% and in the mandatory introduction scenario at 42% in 2020. The average fleet of vehicles between 2014 and 2020 is estimated at around 330 million vehicles, including passenger cars, trucks and buses.

For each scenario, the price of eCall is different for various installation options as the price depends on the quantity of eCall installations. The costs are highest in the do nothing situation, due to less users and thus higher unit prices. In the do nothing scenario, the OEM price is 1000 euros and in the voluntary approach 450 euros. For OEM eCall, the cost of installation to new car (in the manufacturing phase) is estimated at 60 euros in the mandatory introduction scenario. For the nomadic device 30 euros cost is expected in all scenarios, as it is assumed that it is part of a service package. Standalone price is expected to be approximately 200 euros. For aftermarket device 200 euros is estimated in the do nothing and voluntary approach and 70 euros in the mandatory introduction is expected if the eCall is part of a service package.

Based on the casualty, congestion and other benefits identified for individual countries and the infrastructure costs for individual countries, an overall "snapshot" cost-benefit ratio for the EU-27 has been estimated for the three scenarios taking account of the in-year costs and benefits in 2020 and 2030.

Benefit-cost ratio/Year	2020	2030
Do nothing scenario:	0.06	0.08
Voluntary approach:	0.15	0.15
Mandatory introduction:	0.53	1.31

According to this analysis and with the assumptions outlined above, only the mandatory introduction scenario achieves a cost-benefit greater than 1 by 2030. Note that this is an overall European-level analysis using a particular economic calculation technique and at a national level with these assumptions or with different calculation methods the Benefit-Cost ratios may be substantially higher or lower.

Beyond the quantifiable benefits of eCall a number of additional potential benefits can be noted which were not (or not fully) been taken into account in the analysis.

- Mandatory eCall would mean that the public investment in eCall infrastructure was shared more equitably between citizens rather than the benefit of public investment falling preferentially on citizens who can afford optional in-vehicle equipment.

- The in-vehicle eCall equipment could form the basis for an in-vehicle platform that could support additional public or private telematic services giving further safety and economic benefits. For example, tracking of hazardous goods is one opportunity.

- eCall would reduce the amount of underreporting of crashes, which is a problem in some countries, thus increasing the robustness of accident statistics.

- eCall may have a positive or negative effect on false alarms. Automatically triggered eCall is likely to have a lower false alarm rate compared with conventional emergency calls. Also, future "consolidating" software could recognize eCalls as arising from the same incident with reference to geographic location. All this could increase PSAP efficiency.

- eCall provides benefit to road users travelling abroad who may be unfamiliar with the roads and their exact location. eCall also allows emergency calls to be made without language difficulties by virtue of the digital data. This is likely to reduce misunderstanding and stress. Thus, European implementation of eCall benefits foreign visitors.

- eCall may highlight the need for improved mobile network coverage along roads and cross-network co-operation to route emergency calls (some countries do not yet have such agreements between rival mobile network service operators).

- Implementation of eCall on a widespread basis would generate employment (or displace employment from other areas) involved in building and installing equipment. There may also be economic activity related to additional services on the eCall platform.

- European-wide implementation (rather than national initiatives) would involve economies of scale in terms of, for example, equipment costs and education campaigns.

A series of recommendation for further technical work is also provided in the report. These include:

- Further investigation of the time between an accident and it being reported. This can use data sources such as emergency services logs, accident investigation files and press reports.
- A substantial study of accident case studies to improve the robustness of the estimates of the impact of more rapid medical attention on injured road users.
- International agreement to clarify the definition of serious injuries (some countries define severity of injury in terms of trauma sustained and some define severity in terms of outcome).
- Further exploration of the congestion saving impacts of eCall.
- Further analysis and agreement concerning the process of cost-benefit calculation (as this study has revealed different approaches to social cost benefit calculations in different countries and at a European level).

2 Introduction

The European Commission has contracted a consortium to carry out an assessment of the potential impact of the introduction of the eCall service in Europe. The consortium is led by TRL with the following partners:

- TNO (Netherlands)
- VTT (Finland)
- ERTICO (Belgium/pan European)
- Inter-utXXI (Hungary)
- eSafetyAware (Belgium)
- Vrije Universitiet (Netherlands)

The specific objectives of the work are to:

- assess all impacts and benefits of eCall, also fully covering the indirect benefits due to lessened congestion, fewer secondary accidents, improved operations of rescue services, traffic management, national economy, etc;
- assess all costs of eCall;
- assess all other key deployment issues related to eCall; and
- to compare the three scenarios of do nothing/voluntary agreement/mandatory instalment with regard to their socio-economic profitability.

The longer term objectives of the work to the European Commission are to:

- utilise the results in deciding on further steps to accelerate the deployment of pan-European eCall; and
- solve the urgent deployment issues requiring to be settled.

This Final Report has been prepared for the European Commission according to the requirements of the specification. It describes the methods used and the results of the analysis. The report includes a review of previous studies and the Methodology for analysis. The results of four in-depth country studies for Finland, United Kingdom, Netherlands and Hungary are examined as well as data from other European countries. The ethical, moral and economic issues are covered in addition to the legal and liability ones. Finally a socio economic assessment of the policy options and resulting recommendations to the European Commission is made.

3 Review of Previous Studies

3.1 Objectives

The review had two main objectives: to identify previous national or regional studies providing information related to the impact assessment of eCall and to summarize the results of these studies related to safety, efficiency, environmental and economical impacts as well as other implementations issues such as ethical, moral, financial or legal issues. The results of previous studies provided input to the impact assessment of eCall on a European scale.

3.2 Approach

Studies and other material related to the impacts and implementation of eCall were collected with a literature survey and directly from project partners. All studies specified in the project proposal (eIMPACT, TRACE, AINO, SEiSS, SBD, Dutch Veerkehrsveiligheidskansen eCall, Austrian eCall study, ADAC study, E-MERGE review and Austrian eCall study) were obtained for review.

The literature survey was carried out by making a literature search on ITRD, TRIS, PubMed and ScienceDirect databases. In addition to the database search, search engines available on the Internet and web sites known to the authors were used to find studies related to the impacts of eCall.

Only a few publications focusing on the ethical, moral or other issues related to the implementation of eCall were found during the literature survey. For this reason, issues known to the authors from their earlier work with eCall were included in these sections of the report.

3.3 Impacts of eCall

The literature search yielded a handful of studies related to the effects of eCall. Most of the studies were focused on the safety effects of eCall while the impacts on congestion were considered only in few studies. The impact categories analysed in various studies have been summarized in Table 1.

Table 1: Effects covered by different studies

Effects covered by different studies	Evaluated impacts				
Title	Safety effects	Effects on traffic efficiency	Environmental effects	Economic impacts	Notes
Socio-economic Impact Assessment of Stand-alone and Co-operative Intelligent Vehicle Safety Systems (IVSS) in Europe, Cost-Benefit Analyses for standalone and co-operative Intelligent Vehicle Safety Systems	X	X	-	X	eIMPACT
The effectiveness of Advanced Automatic Crash Notification systems in reducing road crash fatalities	X	-	-	X	TRACE
A priori evaluation of safety functions effectiveness - Results on safety increments	X	-	-	-	TRACE
Automaattisen hätäviestijärjestelmän vaikutukset onnettomuustilanteessa [Impacts of an automatic emergency call system on accident consequences].	X	-	-	X	AINO study
Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles	X	X	-	X	SEiSS
eCall – The Case for Deployment in the UK, Final report	X	-	-	X	SBD
E-call en Verkeersveiligheidskansen, DEEL 4: De verwachte directe en indirecte effecten van e-call in Nederland	X				Dutch eCall study
eCall Emergency Call System - For More Safety on European Roads, leaflet	-	-	-	-	ADAC Study
E-MERGE Compiled evaluation results	X	-	-	X	E-MERGE review
Ex-ante evaluation of an emergency call system (e-Call)	X	-	-	X	Czech eCall study
Ekonomisk värdering av eCall i Sverige [Socio-economic benefits of eCall in Sweden]	X	X	-	X	Swedish eCall evaluation
eCall pilot in Österreich	-	-	-	-	Austrian eCall pilot
Erie county automatic collision notification field test	X	-	-	-	Western New York field test
Cost-benefit assessment and prioritisation of vehicle safety technologies, Final report	-	-	-	X	EC2006

3.4 Impacts on traffic safety

The traffic safety impacts of eCall were analysed in 10 studies. Some of the studies were restricted to one country while others made conclusions for impacts at the European level. The studies were also based on different methods and assumptions about various factors. This means that the results can only be compared with caution. The main findings of the studies are presented below.

3.4.1 E-MERGE Review

The objective of the E-MERGE project was to provide the proof-of-concept testing to show the feasibility of eCall in a pan-European context. As a part of the project, the most significant potential effects of eCall on traffic safety were estimated on the basis of the golden hour principle and a questionnaire targeted to experts working at PSAPs (Geels & Lotgerink 2004).

The questionnaire was sent to all E-MERGE test sites in Italy, Spain, Germany, Netherlands, Sweden and UK. On the basis of the results of the questionnaire answered by PSAP experts, eCall was estimated to decrease the number of fatalities in road accidents by 5 - 10% in EU-15 countries (2000 to 4000 lives in a year in EU-15 countries in 2002).

According to the results of the questionnaire, there will be cases where the normal GSM location information will be sufficient but in situations where there are no other people around in quiet times and in more remote areas the benefits from emergency call system demonstrated in E-MERGE system will be significant (Geels & Lotgerink 2004).

A 5 - 10% reduction in the number of serious injuries was concluded by the authors on the basis of the results of the questionnaire. The results of the study showed no positive effect on slight injuries.

The E-MERGE project used also the results of the German STORM (Stuttgart Transport Operation by Regional Management) project to estimate the impact of eCall on the time between accident detection and arrival of emergency services. The results of the STORM project indicated that the rescue time would be reduced from 21,2 to 11,7 minutes in rural areas and from 13 to 8 minutes in urban areas. (Bouler 2009)

3.4.2 AINO Study

The objective of the AINO study was to estimate the effects on eCall on consequences of road traffic accidents in Finland. The annual number of fatalities that could be avoided using the eCall system, the effects of eCall on emergency response times and the effects of real-time information about the vehicle location and accident type on the consequences of the accident were estimated in the study (Virtanen 2005).

The study concluded that the eCall system could very probably have prevented 4.7% of fatalities in road accidents involving motor vehicle occupants. eCall was estimated to reduce the number of road fatalities in Finland by 4 - 8%.

The effect of eCall on the number of fatalities was evaluated by medical doctors (traumatology experts) on the basis of case reports of Road Accident Investigation Teams. When calculating the results, 100% penetration of eCall in the vehicle fleet was assumed and eCall was expected to function correctly in all relevant accidents.

The effects of eCall on the number of fatalities was evaluated on the basis of injuries suffered by persons involved in fatal accidents and assessment of whether there had been any delay in notifying the emergency services.

The time interval between the accident and notification of the emergency response centre was evaluated using three methods: based on the case reports of the Road Accident Investigation Teams, based on a questionnaire from the operators of emergency response centres, and by comparing the time of the accident estimated by the Road Accident Investigation Teams with the phone log of emergency response centres.

3.4.3 eIMPACT

eIMPACT was a European project whose aim was to assess the socio-economic effects on intelligent vehicle safety systems (IVSS) and their effects on traffic safety and efficiency. The project analysed the costs and benefits of 12 applications in which eCall was included (Baum et al 2008, Wilmink et al 2008).

eCall was estimated to reduce the number of fatalities in road accidents in EU25 countries by 5.8%, if 100% of the passenger vehicle fleet were equipped with eCall (low: 3.6%, high: 7.3%). eCall was found to cause a very small increase (0.1%) in the number of injuries caused by road accidents as most of the fatalities are turned into injuries, and not many injuries are avoided.

The expected percentage changes in the number of fatalities on different accident categories were mostly based on the Finnish AINO study (Virtanen 2005). The percentages obtained with Finnish data were transformed into EU-25 accident data with different distribution of accidents in various accident types.

3.4.4 SEiSS

SEiSS (Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles) was a project whose aim was to provide a survey of current approaches to assess the impact of new IVSS, provide factors for estimating the socio-economic benefits of IVSS, identify the major indicators influencing market deployment and develop deployment scenarios for selected technologies or regions. The developed methods for evaluation were tested with three case studies. Exemplary calculations were made for eCall, safe following (ACC), lane departure warning and lane change assistance (Abele et al 2006).

The study estimated that 2,492 - 7,477 road fatalities would be changed to severe injuries and 30,013 - 45,019 severe injuries would be changed to slight injuries in EU-25 countries in a year in 2002 as a result of the introduction of eCall. This means that the number of serious injuries would reduce by 27,521 - 37,542 injuries in a year.

The estimates above assumed a 100% eCall penetration in the European passenger car fleet. The results are based on the assumptions that the number of fatalities in all types of road accidents and all road user groups decrease by 5 - 15%, and 10 - 15% of serious injuries will be changed to slight injuries. These assumptions are mostly based on the results of the E-MERGE project (http://www.e-merge.org).

3.4.5 TRACE

The impact of OnStar (GM's proprietary automatic collision notification system) on the number of road fatalities in Australia was studied as a part of the European TRACE project (Traffic accident causation in Europe) (Lahausse et al 2007, Pappas et al 2008).

The results of the study pointed towards a 10.5% reduction in the number of road fatalities that could potentially be influenced by OnStar in urban areas and 12% in rural areas. 40.7 fatalities in urban areas and 63.0 fatalities in rural areas were predicted to be saved by OnStar in Australia in a year. This saving corresponds to 2.2% of the total of passenger vehicle occupants involved in crashes in Australia.

The elasticity of fatalities on rural roads with respect to the accident notification time was assumed to be 0.14 (Evanco 1999). OnStar was also assumed to reduce the time from accident to notification to one minute (Evanco 1999) from an average value of four minutes in urban areas and seven minutes in rural areas (Champion et al 1999).

OnStar was assumed to detect the accident, notify emergency services and determine its location successfully in 95% of the accidents. OnStar was assumed to reduce only the notification period (i.e. crash-to-EMS notification).

3.4.6 SBD

The socio-economic benefits and costs of eCall in the UK have been evaluated in a study which surveyed also barriers to deployment and impact of other initiatives using in-vehicle equipment (McClure & Graham 2006).

eCall was found to have potential to reduce by 3% the number of all road fatalities in UK (around 70 lives saved per year) in 2020. eCall was also found to have potential to reduce by 2% the number of all serious injuries in road accidents in UK in 2020 (around 490 people per year). These results are based on assumption that two thirds of all compatible vehicles on the road will have eCall at that time.

The effects of eCall on the number of fatalities and serious injuries were estimated on the basis of the reduction in the time between accident and notification of emergency services, classification of accidents on the basis of road type and time of accident and classification of casualties potentially benefiting from eCall or not.

At first, all road accidents except pedestrian and motorcycle accidents were included in analysis. Accidents were then classified by road type and time (daytime/night) into 'high', 'medium', 'low' and 'none' scenarios in regards of probable benefits of eCall. The authors assumed that eCall could improve total response times by 10 minutes and that all casualties with heart or respiratory failures will die with or without eCall (about 50% of fatalities). The other 50% of fatalities, where the cause of death is through massive bleeding, generally occur between 10 and 60 minutes after the accident. For these fatalities each minute that the total response time can be reduced, 2% of these fatalities were assumed to be prevented.

A similar ‘medium benefits’ reduction of 10% from serious injuries to slight injuries is assumed, based on the German STORM project.

When calculating the results, 90% success rate for eCalls in 2010 and 98% success rate in 2020 was assumed.

3.4.7 Erie county automatic collision notification field test

A field test was organised in Erie County located in western New York State in USA to demonstrate the technical feasibility of in-vehicle automatic collision notification system and its benefits to victims of motor vehicle crashes (Bachman and Preziotti 2001). The field test involved about 700 vehicles equipped with automatic collision notification (ACN) system and it lasted three years between July 1997 and August 2000. At the same time, 2500 vehicles were equipped with collision event timers to measure the response times of emergency services for crashes involving vehicles not equipped with ACN system.

During the test period there were 16 ACN crashes and 15 of them were available for crash event time analysis. At the same time, the vehicles equipped with collision event timers had 25 crashes which were available to crash event time analysis. The average notification time from the occurrence of accident to reception of call by appropriate emergency centre was 0,5 minutes for vehicles with ACN equipment and 5,6 minutes for vehicles with collision event timer but no ACN. However, the numbers of both types of crashes were too small to provide statistically significant results.

The potential of injury and fatality reduction of ACN was estimated by first defining the times between vehicle crash and medical response. The type of injuries resulting from vehicle crashes was then investigated with a literature study to establish a qualitative time dependence of trauma. Finally, the reduction in injuries and fatalities was estimated on the basis of studies found in medical publications. The qualitative analysis of earlier research showed that the benefits of ACN would be largest in rural areas. The study estimated that ACN systems have potential to reduce the number of fatalities in road vehicle collisions by approximately 20%. This result was obtained by extrapolating from the results of air transport fatality reduction studies (Baxt, W. G. & Moody, P. 1983; Urdaneta et. al 1984) conducted in 1980s.

3.4.8 Austrian eCall study

An eCall pilot was organised in Austria a couple of years ago (Anonymous 2006). The results were published as a research report after the project was completed (Gürtlich & Zweiler 2007). The pilot study focused on testing voice call and SMS as alarm mediums, studying social cognitions and interpretations, potential users' willingness to pay and their interest in other ITS services and the use of the information transmitted from the vehicle. No estimate for the effects of eCall on traffic safety was provided in the study.

3.4.9 Czech eCall study

A national study on the most probable socio-economical effects of eCall has been conducted in the Czech Republic in 2006. The original report was published in Czech, but a TEMPO report of the evaluation results was available from the authors (Riley, Holubová 2006).

eCall was estimated to reduce by 3 - 9% the number of fatalities in accidents on Czech motorways and roads. The reduction in the number of serious injuries was estimated to be 5 - 10%.

The effect on the number of fatalities was calculated on the basis of the classification of casualties in traffic accidents, reduced time between accident and notification of emergency services and the relation between the accident consequences and response time of emergency services.

The national rescue service resource was utilized in defining the time elapsed between the accident and time of reporting accident. The time from the accident to the beginning of the emergency call was estimated to be reduced to less than one minute. The eCall system was assumed to save time in a range of 3 - 5 minutes.

The impact of time delays after accident to severity of injuries was estimated on the basis of an American study carried out by Paul R. G. Cunningham.

It was determined that the rescue response time could not be on average under 11 minutes. For this reason, calculation of possible impacts was focused on casualties involving cessation of respiration. 10 - 30% of all fatalities on motorways and roads (951 fatalities) were assumed to be cases with respiration trauma, which means 95 - 285 victims could have benefited from the eCall system.

3.4.10 Swedish eCall study

Socio-economic benefits of eCall in Sweden have been estimated in a paper published on the eSafetySupport.org web site (Anonymous 2005). eCall was estimated to reduce the number of road traffic fatalities by 10 - 20 annually in Sweden, which corresponds to a 2 - 4% reduction in the number of fatalities. eCall was also estimated to reduce the number of serious injuries by 3 - 4%.

The results of the Swedish eCall evaluation were based on the results of earlier research such as E-MERGE, SEiSS and STORM, the golden hour principle and Swedish statistics of traffic accidents. The relation between the probability of survival and the time between accident and medical attention was obtained from a Swedish research report (Handell & Dahl 1996) and the golden hour principle. On the basis of the results of the STORM project eCall was assumed to reduce the time between accident and arrival of emergency services from 20 minutes to 10 minutes in urban areas and from 9 to 5 minutes outside urban areas.

3.4.11 Dutch eCall study

A direct reduction of 1 - 2% of the number of fatalities in the traffic was expected on the basis of the results of the study, because eCall enables immediate detection and location of accidents (Donkers & Scholten 2008). The severity of injuries was expected to be reduced for about 1% of the injured people brought into hospitals.

The estimate for the reduction of fatalities was obtained by analysing a set of accidents. Of all fatal accidents on the road (involving potentially eCall equipped vehicles) they looked at all in which the fatal cases were not killed instantly but died shortly after the accident (at the incident location or at the hospital). The data contained the number of events in which eCall could have helped to inform the emergency services more rapidly. From those, eventually fatally injured, a certain percentage could be saved thanks to eCall because of quicker treatment.

3.4.12 Summary of individual studies

The impacts of eCall on the number of road traffic fatalities have been summarised in Table 2 and the Impact of eCall on the number of serious injuries summarised in

Table 3.

Table 2: Impact of eCall on the number of road traffic fatalities

Impact of eCall on the number of road traffic fatalities	
Study	Reported effect on the number of fatalities
Socio-economic Impact Assessment of Stand-alone and Co-operative Intelligent Vehicle Safety Systems (IVSS) in Europe, Cost-Benefit Analyses for standalone and co-operative Intelligent Vehicle Safety Systems	eCall reduces the number of fatalities in road accidents in EU25 countries by 5.8%, if 100% of the passenger vehicle fleet is equipped with eCall (low: 3.6%, high: 7.3%)
The effectiveness of Advanced Automatic Crash Notification systems in reducing road crash fatalities	- 10.5% reduction in the number of road fatalities that could potentially be influenced by OnStar in urban areas and 12% in rural areas. 40.7 fatalities in urban areas and 63.0 fatalities in rural areas were predicted to be saved by OnStar in Australia in a year. - This saving corresponds to 2.2% of the total cost of passenger vehicle occupants involved in crashes
Automaattisen hätäviestijärjestelmän vaikutukset onnettomuustilanteessa [Impacts of an automatic emergency call system on accident consequences].	- The eCall system could very probably have prevented 4.7% of the fatalities in accidents involving motor vehicle occupants. - eCall system was estimated to be able to reduce 4–8% of road fatalities in Finland.
Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles	- 2492-7477 road fatalities would be changed to severe injuries in EU-25 countries in a year in 2002 - 30013-45019 severe injuries would be changed to slight injuries in EU-25 countries in a year in 2002 - According to E-Merge, 5% to 15% of road fatalities can be reduced to severe injuries and 10% to 15% of severe injuries can be reduced to slight injuries (E-Merge, Compiled evaluation results)
eCall – The Case for Deployment in the UK, Final report	- eCall was found to have potential to reduce by 3% the number of all road fatalities in UK (around 70 lives saved per year) in 2020. Two thirds of all compatible vehicles on the road were assumed to have eCall at that time.
E-call en Verkeersveiligheidskansen, DEEL 4: De verwachte directe en indirecte effecten van e-call in Nederland	- A direct reduction of 1-2% of the number of fatalities in the traffic was expected on the basis of the results of the study, because eCall enables immediate recognition of accidents
eCall Emergency Call System - For More Safety on European Roads, leaflet	not discussed
E-MERGE Compiled evaluation results	- 5-10% decrease (2000 to 4000 lives in a year in EU-15 countries in 2002) in the number of road fatalities was assumed on the basis of the questionnaire answered by PSAP experts
Ex-ante evaluation of an emergency call system (e-Call)	- eCall was estimated to reduce by 3-9% the number of fatalities in accidents on Czech motorways and roads
Ekonomisk värdering av eCall i Sverige [Socio-economic benefits of eCall in Sweden]	- eCall was estimated to reduce the number of fatalites by 10-20 in a year in Sweden, which is about 2-4% of all fatalities in a year
Erie county automatic collision notification field test	- Automatic collision notification was estimated to have the potential to reduce by 20% the number of fatalities in motor vehicle collisions
eCall pilot in Österreich	- not analysed in the study
Cost-benefit assessment and prioritisation of vehicle safety technologies, Final report	- eCall was assumed to change 4% of fatal accidents to accidents with severe injury.

Table 3: Impact of eCall on the number of serious injuries

Impact of eCall on the number of serious injuries	
Study	Reported effect on the number of injuries
Socio-economic Impact Assessment of Stand-alone and Co-operative Intelligent Vehicle Safety Systems (IVSS) in Europe, Cost-Benefit Analyses for standalone and co-operative Intelligent Vehicle Safety Systems	- eCall was found to cause a small increase (0.1%) in the number of injuries caused by road accidents (because of fatalities changed to injuries because of eCall)
The effectiveness of Advanced Automatic Crash Notification systems in reducing road crash fatalities	- Impact on the number of serious injuries not analysed
Automaattisen hätäviestijärjestelmän vaikutukset onnettomuustilanteessa [Impacts of an automatic emergency call system on accident consequences].	- Impact on the number of serious injuries not analysed
Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles	- eCall was estimate to reduce the number of serious injuries by 27521-37542 injuries in EU25 countries in a year in 2002
eCall – The Case for Deployment in the UK, Final report	- eCall was found to have potential to reduce by 2% the number of all serious injuries in road accidents in UK in 2020 (around 490 people per year). Two thirds of all compatible vehicles on the road were assumed to have eCall at that time.
E-call en Verkeersveiligheidskansen, DEEL 4: De verwachte directe en indirecte effecten van e-call in Nederland	- The severity of injuries will be reduced for about 1% of the injured people brought into hospitals
eCall Emergency Call System - For More Safety on European Roads, leaflet	- Impact on the number of serious injuries not analyzed
E-MERGE Compiled evaluation results	- 5-10% decrease (2000 to 4000 injuries in a year in EU-15 countries in 2002) in the number of serious injuries in road accidents was assumed on the basis of the questionnaire answered by PSAP experts
Ex-ante evaluation of an emergency call system (e-Call)	- Impact on the number of serious injuries not analysed
Ekonomisk värdering av eCall i Sverige [Socio-economic benefits of eCall in Sweden]	- eCall was estimated to reduce the number of serious injuries in road accidents by 3-4% in Sweden
Erie county automatic collision notification field test	- Impact on the number of serious injuries not analysed
eCall pilot in Österreich	- Impact on the number of serious injuries not analysed
Cost-benefit assessment and prioritisation of vehicle safety technologies, Final report	- eCall was estimated to change 7% of accidents with severe injury to accidents with slight injury.

3.5 Impacts on congestion

3.5.1 eIMPACT

The effects of eCall on congestion were considered to be low, because eCall was expected to be most effective in low traffic densities e.g. roads with low traffic volumes and dark periods of the day (Wilmink et al 2008). In other words, eCall was assumed to be most effective for reaching accidents more quickly in the night and during off-peak hours when accidents are more likely to go unnoticed.

When analysing the effect on congestion, eCall was considered to be most effective on rural roads where there is less traffic and therefore it is more probable that accidents happen without eyewitnesses, and it will take more time before a non-involved road user will come to the accident site. eCall was expected to be less effective on motorways and hardly effective on urban roads.

The cost-unit rate for congestion due to an accident with fatality was estimated at 9,473 euro and the one due to an accident with injury was estimated at 3,101 euro. With the previous assumptions and the estimated safety effects, the avoided congestion costs were estimated to be 5 - 7 million euros in 2020 in EU25 countries.

3.5.2 SEiSS

The study estimated eCall to reduce congestion time related to an accident by 10 - 20%. With 1,365,598 accidents in 2002 and an average time cost unit rate for each accident of 15,000 €, the total costs of delays was estimated to be 20 billion euro, while the average delay due to an accident was expected to be 100 minutes. The socio-economic benefits related to reduced congestion and delays were then calculated to be 2 - 4 billion euro (Abele et al 2006).

The authors of the SEiSS study noted, that the estimate presented above may be too optimistic, because it is not probable that eCall will be used successfully in all accidents. Therefore, an alternative way to calculate congestion cost savings was formulated. The study estimated that congestion caused by accidents can be reduced by 15 - 30%, which leads to congestion cost savings of 170 - 469 million euros in EU25 countries (Abele et al 2006).

3.5.3 Swedish eCall evaluation

No calculations about the most probable effects of eCall on congestion in Sweden were performed in the paper, but an expert opinion about the possible socio-economic benefits was provided (Anonymous 2005).

The effect of eCall on delays was considered possible on roads with dense traffic. The amount of time saved between accident and notification of emergency services was considered marginal on these roads, because Sweden has high mobile telephone penetration. The authors also expected that eCall has only marginal effect on the accident clear-up time.

The socio-economical effects of eCall on congestion were estimated to be 5 - 10 million Swedish crowns in a year in Sweden. These figures were based on the expert opinion expressed by the authors.

3.6 Impacts on environment

None of the studies reported any effects on environment. However, reduced congestion can be expected to have a slight positive effect on emissions and local air quality.

3.7 Socio-economic profitability

The socio-economic profitability of eCall was analysed in several studies. Some of the studies covered only one country while others included several European countries. The methods used in the studies differed in some points. There were differences also in assumptions needed to calculate the benefit-cost ratio (BCR).

Because of limited space and resources, exact description of methods of the different studies and assumptions made to calculate the results is outside the scope of this report. The main aspects of each study are described below.

3.7.1 eIMPACT

The socio-economic costs and benefits of eCall were estimated by the eIMPACT project in 2008 (Baum et al 2008). The starting points for analysis were expected situations in 2010 and 2020. In 2010, 0.1 - 0.3% and in 2020 35.6 - 46.9% of vehicles were assumed to be equipped with eCall. The shares of vehicle kilometres driven by vehicles equipped with eCall were expected to be 0.2 - 0.5% and 44.6 - 61.2%, respectively. Because penetration rates were estimated to be low in 2010, no cost-benefit analysis was performed for that year.

The cost of an eCall in-vehicle system was assumed to be 61 euro in 2010 and 60 euro in 2020. The cost of the infrastructure needed by eCall was assumed to be 29.4 million euro in a year in Europe. This estimate is based on the results of the SEiSS study and the cost estimate presented in the Finnish AINO study for eCall infrastructure costs in Sweden. When the cost estimate for Sweden is scaled with the population of EU-25 countries, the result for EU25 level is 19 million Euros in a year. The SEiSS study provided two values for infrastructure costs in EU-25 countries: 29.9 million euro and 49.9 million euro (mean: 39.9 million euro). For eIMPACT the mean of both studies was taken: 29.4 million euro.

eCall was assumed to change 535 - 728 fatalities to serious injuries in 2020 with 35.6 - 49.8% fleet penetration. The net reduction in the number of serious injuries was estimated to be 4,003 - 5,413. The socio-economical benefits related to the reduction in the number of fatalities were found to be 869.6 - 1,183.4 million euros in a year. Benefits related to the net reduction in the number of serious injuries were estimated to be 756.6 - 1,023.0 million euros annually. The safety benefits were then calculated by summing together these two figures (1,626.2 - 2,206.4 million euros annually).

Benefits related to decreased congestion were calculated to be substantially smaller. eCall was estimated to save 3.4 - 4.6 million euros in congestion costs in Europe in 2020. The unit cost for congestion due to an accident with fatality was estimated at 9,473 euro and the one due to an accident with injury was estimated at 3,101 euro.

The benefit-cost ratios were then calculated for the scenarios of high and low fleet penetrations. In the case of low fleet penetration (35.6%), the calculated benefit-cost ratio was 2.4, and in the high fleet penetration (49.8%) case 2.3.

Because the benefit-cost ratio was considered low, further analysis on the socio-economic profitability was made. A potential case, a pessimistic scenario and an optimistic scenario were defined, and benefit-cost ratios were calculated for these cases. The fleet penetration was assumed to be 100% in the potential case.

In 2010, the benefit-cost ratio is 2.7 in the potential case. This figure was calculated by dividing the benefits of 4,558 million euro with costs of 1,710 million euro (274.2 million vehicles * 6.13 euro per system and year + 29.4 million euro for infrastructure). In year 2020, the BCR is 1.9. The figure was calculated by dividing the benefits of 3,542 million euro with costs of 1,878 million euro.

The benefit-cost ratio of eCall was found to decrease over time for various reasons. The first reason was the expected decrease in the number of accidents which results in less fatalities and serious injuries avoided with eCall. The second cause was found to be the growth of vehicle fleet while the cost of an eCall in-vehicle system and the benefits were expected to stay the same.

In the pessimistic scenario, the potential of eCall in avoiding accidents was assumed to be lower (3.6%). The benefit-cost ratio was found to be 1.5 for the year 2010 and 1.1 for the year 2020 in this scenario in the potential case. The safety effect was assumed to be 7.3% in avoiding fatalities in the optimistic scenario. The benefit-cost ratio for the optimistic case was found to be 3.6 for the year 2010 and 2.5 for the year 2020.

Considering the pessimistic and the optimistic scenario, the BCR of the potential case is between 1.5 and 3.6 in the year 2010 and between 1.1 and 2.5 in the year 2020.

3.7.2 TRACE

The OnStar automatic collision notification service was estimated to reduce the number of road fatalities in urban areas by 40.7 and in rural areas by 63.0 per annum in Australia (Lahausse et al 2007). The unit cost for a traffic fatality was assumed to be 1,872,000 Australian dollars. The benefits were calculated by multiplying the number of fatalities saved by OnStar with the unit cost of a road fatality.

The costs were then calculated by multiplying the costs per vehicle by the number of registered passenger vehicles in Australia. The installation cost per vehicle was assumed to be 843 Australian dollars, which includes also the first year subscription fee of the service. The annual subscription fee was assumed to be 243 Australian dollars now and in the future.

The benefit-cost ratio was then calculated in various cases. When vehicle life was assumed to be 15 or 25 years, the benefit-cost ratio was found to be 0.05:1 and 0.03:1 respectively, using a 5% discount rate. The mandatory installation of OnStar in all passenger vehicles was found not to be a very cost-effective measure (Lahausse et al 2007). It should be noted, however, that the eCall functionality is not the only one in OnStar. Thereby, either the benefits of the other functionalities should also be included in the calculation or only a part of the costs should be allocated for the eCall functionality and thereby included in the calculation.

3.7.3 AINO study

The probable impacts and socio-economic profitability of eCall in Finland were studied as a part of Finnish AINO programme in 2005 (Virtanen 2005). The benefit-cost ratio was calculated for both pessimistic and optimistic cases.

The benefits related to fatalities changed to various types of injuries were estimated to be between 22.30 and 44.33 million euro annually in Finland. Based on Swedish figures, benefits related to serious injuries changed to less severe were estimated to be between 31.71 and 42.35 million euro per year in Finland. Finnish unit cost values were used for fatalities and various types of injuries (death: 1.9 million euro, non-temporary serious injury: 1.1 million euro, temporary serious injury: 0.26 million euro, slight injury: 0.050 million euro). Savings in congestion costs were evaluated on the basis of a Swedish estimate. eCall was estimated to reduce congestion costs by 0.28-0.63 million euros annually in Finland.

The costs of eCall in-vehicle equipment were calculated by assuming that the cost of a retrofitted eCall system is 200 euro, which includes installation, and that the unit cost of OEM equipment is 75 euro. The costs were calculated with equipment life of eight years and 3% discount rate. The operating costs on the PSAP side were assumed to be 0.37 million euro in a year.

The benefit-cost ratio of the eCall system examined in the study was 0.5–2.3. It was highlighted, that the benefit-cost ratio would have been higher if the indirect benefits of the eCall system could have been taken into consideration.

3.7.4 SEiSS

The SEiSS study analysed the socio-economic profitability of eCall deployment in EU-25 countries. The study provided two benefit-cost ratios for eCall: the lower value was calculated with higher costs and lower benefits while the higher value was based on optimistic estimate for benefits and lower estimates for the costs of eCall. The benefit-cost ratio of eCall was found to be between 1.3 and 8.5.

Savings in accident costs were calculated with two sets of unit cost values for accidents involving death, severe injury or slight injury. According to European cost unit rates for accident evaluation, the average cost of a fatal accident is 1,000,000 euro, and the corresponding figures for accidents involving severe or slight injuries are 135,000 and 15,000 euro. The savings in accident costs were calculated to be 5,700 – 11,800 million euros annually.

However, the E-MERGE project and the eCall driving group had suggested somewhat different unit cost values for different types of traffic accidents. The suggested unit cost values were 977,000 euro for an accident with fatalities, 502,109 euro for an accident with severe injuries and 93,546 for an accident with slight injuries. The annual savings in accident costs were calculated to be 13,400 – 21,900 million euros when these unit cost values were used.

The lowest value (5,700 million euro) for the annual savings in accident costs was used to calculate the benefit-cost ratio in the pessimistic case (1.3). The highest calculated value (21,900 million euro) was used in the optimistic case, whose result was the benefit-cost ratio of 8.5.

3.7.5 SBD

The viability of public eCall service in the UK has been analysed in a report published in 2006 (McClure & Graham 2006). The report addressed the business case for eCall, issues and barriers to deployment and impact of eCall on other initiatives and implications to British government. A range for the benefit-cost ratio of eCall deployment in the UK was also calculated for a period of ten years between 2010 and 2020.

eCall was found to have potential to reduce by 3% the number of all road fatalities in UK (around 70 lives saved per year) in 2020. The potential to reduce the number of serious injuries was found to be 2% in UK in 2020 (around 490 people per year). Two thirds of all compatible vehicles on the road were assumed to have eCall at that time. Unit cost values defined by UK Department for Transport were used to value the benefits calculated in the study. The unit cost values for a fatality and a serious injury were £1,384,437 and £155,527.

Three values for the socio-economical costs of eCall were calculated: low, mean and high costs. In the low cost scenario, the cost of an eCall in-vehicle unit was assumed to be £100 and the operational costs £5m per year in the UK. For the mean and high cost scenarios, the corresponding figures were £250 and £7.5m (mean) and £400 and £10m.

The monetary values for the benefits of eCall between years 2010 and 2020 were calculated in three deployment scenarios: eCall fitted in all new vehicles, all type-approved vehicle models equipped with eCall and market-based slower take-up. The values of the safety benefits in these scenarios were found to be £1,121m, £578m and £389m between years 2010 and 2020. Benefit value is split roughly equally from reducing fatalities and reducing the number of serious injuries (which are more numerous but with a lower value).

To deal with the uncertainty related to the benefits and costs, the range for the benefit-cost ratio was calculated. The lower boundary value was calculated by dividing the low estimate for annual benefits by the high estimate for annual costs. The higher boundary value was calculated the opposite way. The monetary values of benefits were discounted to year 2010.

The socio-economical benefit-cost ratio was found to be in the range of 0.1 - 0.7 in the UK with the assumptions and analytical framework described above. The authors concluded that none of the scenarios included in the study gives a robust business case and that eCall always costs the British government and users more than it gives benefits.

3.7.6 E-MERGE review

The E-MERGE review focused on the business case from eCall on the viewpoints of various stakeholder groups such as governments, private companies and individual drivers (Geels, Lotgerink 2004). The benefits and costs for the various stakeholder groups were quantified, but no cost-benefit analysis was made.

3.7.7 Czech eCall study

The impact of eCall system on reduction of fatalities was estimated to be in a range of 3 - 9% and impact on reduction of severe injuries was assigned to be in a range of 5 - 10%. The estimate for the reduction in the number of severe injuries was based on the E-MERGE study (Geels, Lotgerink 2004). Travel time savings was roughly calculated around 2 million Czech crowns per year (ca. 75 000 euro).

A cost of 80 euro was assumed for a piece of OEM-installed eCall in-vehicle equipment, and 160 euro for a retrofitted one. The initial investment cost related to software development and licenses needed in PSAPs was estimated to be about 3.7 million euro in the Czech Republic. Annual operating costs were assumed to consist of the mobile subscriptions of in-vehicle terminals (30 €/year), service charges of PSAP software (3,600 €/year) and annual cost of the training of PSAP staff (42,000 €/year).

Monetary values of safety benefits and travel time savings were calculated on the basis of Czech unit cost values. The monetary value used to represent the loss of well-being in society was 330,392 euro for a fatality, 110,974 euro for a severe injury and 12,467 euro for a slight injury.

The benefit-cost ratio of the eCall examined in this study was estimated to be in a range of 0.29-0.59. The benefit-cost ratio would have been higher if the indirect benefits of the eCall system could have been taken into consideration. The low benefit-cost ratio was also a result from low unit cost values related to human fatalities and injuries.

3.7.8 Swedish eCall evaluation

The benefits, costs and socio-economic profitability of eCall in Sweden were analysed in a paper published on the eSafetysupport web site (Anonymous 2005). eCall was estimated to reduce the number of fatalities by 2 - 4% in Sweden and reduce the severity of injuries in 3 - 4%. The monetary values for the benefits were calculated on the basis of unit cost values defined by Swedish Road Authority (Vägverket).

The unit cost value used in the study for a road fatality was 17.5 million Swedish crowns, 3.1 million crowns for a serious injury and 0.175 million crowns for a slight injury. Fatalities were assumed to change to serious injuries and serious injuries to slight injuries. Benefits from reduced delay to other road users were estimated to be between 5 and 10 million Swedish crowns in a year.

When calculating the benefits, 100% fleet penetration was assumed. The total value of socio-economical benefits was found to be in the range of 550 - 830 Swedish crowns in a year. This estimated was compared against the results of the Finnish AINO study, in which the yearly socio-economical benefits in Finland were estimated to be of the same level (91 million euro or 830 million Swedish crowns).

The cost of eCall in-vehicle equipment was estimated to be 500 - 750 Swedish crowns for a vehicle. This cost estimate refers to the case in which eCall is provided as a standard option in new cars. With equipment life of eight years, 4.9 million registered vehicles and 3% discount rate, the annual cost of in-vehicle equipment was calculated to be 350 - 500 Swedish crowns.

Costs related to upgrading of PSAPs were found to be much smaller. SOS Alarm AB - a Swedish government-owned company operating PSAPs in Sweden – estimated that the implementation of eCall in PSAPs is possible with an annual cost of 3.5 million Swedish crowns.

The benefit-cost ratio for eCall in Sweden was calculated for two cases: a pessimistic case with high costs and low benefits and an optimistic case with high benefits and low costs. In the pessimistic scenario, the benefit cost ratio was found to be 1.1. For the optimistic scenario, the paper provides a benefit-cost ratio of 4.2. However, by dividing the higher estimate of yearly benefits (830 million crowns) by the lower estimate for costs (350 million crowns), one obtains 2.4 instead or 4.2.

The conclusion was that eCall will be socio-economically profitable in Sweden even if its costs turn out to be high and the benefits will be low. If costs were low and benefits were large, eCall would be clearly socio-economically profitable.

3.7.9 Cost-benefit assessment and prioritisation of vehicle safety technologies

The socio-economic profitability of various vehicle safety technologies was analysed in a report prepared for European Commission and published in 2006 (Bøgelund et al 2006). The report involved 16 ITS applications and four other technologies including eCall. When estimating the most probable effects of eCall, results of previous research such as E-MERGE, SEiSS and AINO studies and Swedish eCall evaluation were reviewed in the report. eCall was assumed to change 4% of fatal accidents to accidents with severe injury and 7% of accidents with severe injury to accidents with slight injury.

When calculating the monetary values of safety benefits, unit cost values defined in Directive 1999/62/EC (Annex III) were used as a starting point. The unit cost value defined in the directive was 1000,000 euro for a fatality, 135,000 euro for a severe injury and 15,000 euro for a slight injury. Because these were unit costs for fatalities and injuries, conversion factors were needed to calculate the unit cost values for accidents involving fatalities or serious or slight injuries. The authors assumed that there were 1.36 injuries per injury-causing crash and 1.15 fatalities per fatal crash (ICF 2003).

The socio-economical benefits and costs of eCall between years 2006 and 2025 were calculated and discounted to year 2005 with 5% discount rate before the benefit-cost ratio was calculated. The benefit-cost ratio of eCall was calculated for two scenarios. The cost of an eCall in-vehicle unit was assumed to be 400 euro in the high-cost scenario. The second scenario was the low-cost scenario in which the cost of an in-vehicle unit was assumed to be 90 euro.

The study estimated also the costs related to implementation of eCall at PSAPs and other call centres and cost related to the training of PSAP staff. Cost of the implementation of eCall was estimated to be 40,000 euro per call centre and the number of call centres in Europe was estimated to be 1,500. Costs related to training of the PSAP staff was expected to be 900 euro per employee per year and an average PSAP was expected to have 60 employees. The costs for mobile network operators were not included in the calculation of costs because they were considered impossible to quantify. The net present value of the costs of eCall between years 2006 and 2025 was calculated to be 107,258 million euro (106,271 M€ in-vehicle systems + 54 M€ adjusting call centres + 932 M€ training of PSAP staff) in the high-cost scenario and 20,115 million euro (19,129 M€ in-vehicle systems + 54 M€ adjusting call centres + 932 M€ training of PSAP staff) in the low-cost scenario.

The effects of eCall were estimated to increase with the fleet penetration over time. eCall was estimated to reduce the number of fatalities by 1,392 and the number of serious injuries by 27,485 in 2020, when 100% fleet penetration was expected. The number of slight injuries was expected to increase because serious injuries will be changed to slight injuries.

The net present value of savings in accident costs between 2006 and 2025 was estimated to be 41,127 million euro of which 12,858 million euro was estimated to be related to the reduction in the number of fatalities and 34,059 million euro to the decrease in the number of serious injuries. The value of the increase in the number of slight injuries (5,790 million euro) was then subtracted from the sum of the two previous figures.

The benefit-cost ratio of eCall was estimated to be 0.4 in the high-cost scenario and 2.0 in the low-cost scenario. The authors concluded that that it is highly uncertain whether eCall is a cost-effective measure for improving road safety.

3.8 Other Implementation Issues

3.8.1 Ethical issues

The objective of eCall is to improve the safety of road users. Private sector organisations may set their objectives themselves, but public sector is usually committed to the values of social equality. In addition to equality, fair sharing of the costs and benefits has to be taken into account.

The effect in in-vehicle safety systems (IVSS) on income distribution was studied in the SEiSS study (Abele et al 2006). The study mentions that people with high incomes tend to purchase more expensive cars more commonly equipped with ITS systems. The owners of vehicles equipped with IVSS systems get most of the benefits, but they pay also most of the costs of IVSS. In most cases, other stakeholders who do not participate in costs of IVSS also benefit from these systems.

It is possible that at least during the first years of deployment eCall may be available only to motorists who can afford high-end models of new cars. On the other hand, these vehicle owners also pay most of the costs of eCall, but at least some funding from public sector is still needed to implement eCall in PSAPs. The question, whether it is justified to spend public money to implement an application which benefits only some relatively well-off part of the whole society at least in the first years, can be raised only when the introduction of eCall is left to market forces. In case of mandatory introduction of the system, the take up rate would increase exponentially and thus issues related to infrastructure investments would be surpassed early in the deployment proces.

3.8.2 Moral

One possibility is to make eCall mandatory in all new passenger vehicles. However, this approach requires political decisions which will have various impacts to European citizen and different stakeholders.

It is widely accepted that national governments or international organisations may set regulations to improve traffic safety and that those regulations may make some safety features or systems mandatory in vehicles even if this causes costs to be paid by vehicle manufacturer or buyers of new vehicles. These kinds of decisions are usually best accepted, when the evidence about the benefits of the proposed system is clear and understood by the public, the technical and other risks are managed, costs and benefits are shared fairly between various stakeholders, and the rights of an individual citizen are respected.

Thus, the end-users should be given a realistic view on the functionality and effects of eCall product they are choosing as well as the level of service which can be expected. For example, proposed inexpensive crash notification solutions such as airbags paired with a mobile phone by Bluetooth (Hansson, Bartz 2008) offer a more restricted functionality and probably also lower performance than fully functional eCall solutions implemented as a separate telematic box installed in a car. If eCall is sold as a service, the end-user should be given adequate and correct information about the content, coverage and benefits of the service.

The vendors of eCall products are also responsible for educating their customers and making sure that their products are implemented with a quality suitable for purpose. However, the vendors of consumer eCall devices and services probably have an incentive to maximise their sales and to bring their products to market as early as possible. These goals may turn out to be in conflict with the objective of educating the end-users and provide only products partially services of high quality.

The question of whether information collected by in-vehicle eCall equipment can be used for other purposes than supporting rescue services is somewhat open. Law enforcement organisations, accident investigation teams and insurance companies are naturally interested to know as many details as possible about road accidents. It is also probable that this information might be used against an individual who has driven a car with eCall equipment involved in an accident. The result is linked to the question of whether it is acceptable to make the use of eCall mandatory – even in cases in which it may produce self-incriminating evidence against an individual. Privacy and data protection issues related to eCall are discussed in detail in chapter 7.

3.8.3 Legislation

The literature review raised several questions which may have an impact on the present legislation of the EC or the Member States. Legal issues related to eCall may be found in the domains of privacy and data protection, regulation of emergency services, regulation of telecommunications, consumer protection and product liability. As mentioned above, in some cases eCall may also produce self-incriminating evidence against an individual. Liability issues and questions related to privacy and data protection are discussed further in chapter 7.

3.8.4 Technical and organisational issues

The literature review provided no answer to the question of how reliable the future European eCall service will be. eCall as well as other kinds of alarm systems have the same objective: to report correctly all events in question and at the same time generate as few false alarms as possible.

In case of other in-vehicle automatic collision notification systems or services, little information about the achieved reliability levels was available. Most studies on the impacts of European eCall service assumed that eCall would function as intended in all accidents, and thereby it would probably have a positive effect on safety.

The reliability of an automatic collision notification similar to eCall was assessed in a study which evaluated the automatic collision notification system tested in Erie County, New York, USA (Kanianthra 2000). The field operational test started in late 1990s and it ended in 2000 after about three years. The in-vehicle equipment was installed into 850 cars, and the local sheriff's office was equipped with systems needed to receive the collision messages from the test cars. The in-vehicle equipment detected correctly 76% of collisions during the test period, and 20 accidents above the notification threshold were successfully reported to the PSAP. The five observed failures were caused by insufficient cellular network coverage, in-vehicle equipment damaged during the crash or problems in power supply to the in-vehicle equipment, disconnected telephone line to the modem at the PSAP and one unknown cause.

A number of false alarms were also observed. The number of false alarms during the test period was 31 of which most were related to faulty accelerometer mounting in the in-vehicle system or unstable or intermittent power supply to the in-vehicle equipment.

The organisation of service provision affects the reliability of eCall and the time between accident and actions taken by emergency services. In the pan European eCall case both MSD and the voice connection are received by the local PSAP directly from the end-user. There are also Third Party Supplier (TPS) models in which the data set orand the voice call is received first by a service centre operated by a private service provider.

Organisational issues and operating protocols related to automatic collision notification systems have been briefly reviewed in a paper (Benson & Cima 1996), which was written on the basis of the results of PuSHMe project (Puget Sound Help Me). The authors stated that a service centre should have a clear understanding of what services it will provide and what technologies will be used as well as documented internal protocols. A service centre should also be able to communicate with existing service providers and be able to refine its service to best interface with the operating procedures and technologies of its operating area. The authors concluded that a service centre should be able to transfer a call it has received to other parties because PSAPs often prefer a direct voice contact with the caller in case of an emergency.

eCall may also have indirect benefits. It is possible that eCall will be implemented with a shared in-vehicle telematic platform which can be used by several applications. This means that eCall may accelerate the deployment of other in-vehicle telematic applications such as usage-based insurance, tracking of stolen vehicles, floating vehicle data collection and various traveller information services.

3.9 Discussion and analysis

The literature survey yielded several studies focused on the impacts of eCall and automatic collision notification systems. However, some of them relied on other studies in determining the magnitude of impacts, so all the obtained studies were not independent from each other. For example, results of the E-MERGE study were used by several other studies.

In some impact studies the success rate with which eCall detects accidents and transmits the MSD to the correct PSAP has been assumed to be 100% or near that figure. In practice, this can be questioned because there are some points in which there is a certain probability of failure. For example, mobile network coverage may not be perfect, in-vehicle equipment may be damaged in a crash or the in-vehicle system may not detect an accident because of sensor faults or other problems such as failed backup battery. In some cases, there is also a possibility that the MSD and the voice connection are not received in time by the appropriate PSAP.

The probable number of false alarms and their implications to the effects of eCall and PSAP performance have not been analysed in detail in earlier research. It can be reasonably expected that the ratio of false alarms to real ones has an effect on the ways the PSAPs deal with automatic or manual eCall alarms. For example, if there are many false automatic alarms or the manual alarm function of eCall is widely abused, calls from eCall devices may be given a low priority in relation to other emergency calls received by a PSAP.

If an emergency call is received from a mobile phone, the PSAP can usually obtain the caller’s position from the mobile network operator. All GSM networks allow positioning on the basis of the cell ID, while more accurate technologies such as TDOA (time difference of arrival) are implemented in some GSM and UMTS networks. The accuracy of already implemented network-based emergency call location techniques and the way the PSAPs use them have an effect on the amount of time which can be saved by eCall. However, the accuracy of present network-based positioning technologies and the way PSAPs use them are specific to a country or an operating environment inside a country.

The golden hour principle has not been questioned in any of the studies. However, there are differences between studies in the causal links between notification time and accident outcomes. For example, different patient groups have been expected to benefit from faster accident notification in different studies. The SBD study assumed that the patient group suffering from massive bleeding would benefit most from eCall while the Czech eCall study assumed that also patients with respiratory failure would be the ones whose chances of survival are affected.

There is considerable variation in the estimates of the time between accident and arrival of emergency services saved because of eCall. This can be partly explained by differences in the operating practises of PSAPs and emergency services and physical environment between countries.

Most of the studies present no single figure for either reduction in fatalities or injuries or the benefit-cost ratio of eCall. The reason for this is the uncertainty which is related to these estimates. However, the benefit-cost ratio of eCall has been estimated to be above 1 in many of the studies reviewed in this report.

The studies present no single answer to the question of the cost of full-scale eCall deployment. There is considerable variation in the estimates for the costs of in-vehicle equipment as well as costs on the PSAP side. Because the number of passenger vehicles is large, the overall cost is sensitive to the cost of the in-vehicle equipment. Providing accurate estimates for the costs involved in the PSAP side is problematic, because there are large differences between European countries in both the number of PSAPs and the level of their existing equipment and staff.

The obtained benefit-cost ratio of eCall or the ACN system under analysis has been more than 1 in all but two studies. Low benefit-cost ratio obtained in Czech eCall study can be explained by the low unit cost values for fatalities and injuries used in the study. The results of the SBD study can’t be explained by any single factor: magnitude of the safety effects was at the same level as other studies, but unit costs for eCall in-vehicle equipment were considerably higher than other studies such as eIMPACT or AINO study. The costs estimated for PSAP were also higher in the SBD study than in the Swedish eCall paper. The SBD approach will be further analysed in the in-depth UK study. Some remarks to the analysed studies have been collected in Table 4 below.

Table 4: Remarks to previous studies

Remarks to previous studies	
Study	Remarks
eIMPACT	Accident risk per vehicle kilometre was expected to decrease and vehicle fleet was assumed to grow over time.
TRACE	The consumer price of OnStar in-vehicle equipment was used as the unit cost of an in-vehicle ACN system.
AINO	Estimates for the effects of eCall based on assessment made by medical doctors.
SEiSS	-
SBD	The unit cost of an in-vehicle unit was assumed to be £400.
Dutch eCall study	eCall was assumed to affect only the time between reception of information at PSAP and arrival of emergency services to the accident site.
E-MERGE	Estimates for the effects of eCall based on a questionnaire answered by PSAP experts.
Czech eCall study	Unit cost values lower than in other studies were used for human injuries and fatalities.
Swedish eCall evaluation	Swedish unit cost values used for valuation of safety effects. Magnitude of safety effects comparable to the results of AINO study.
EC2006	Unit cost values defined in Directive 1999/62/EC used for valuation of safety effects.

3.10 Conclusions

The socio-economic profitability of eCall is quite sensitive to the magnitude of its safety effects also because of the large number of vehicles to be equipped. This can be expected, because the socio-economical benefits of eCall are directly related to the number of fatalities changed to serious injuries and the number of serious injuries changed to slight injuries (as well as the unit cost values used to obtain the monetary values).

The safety effects of eCall are different in European countries and within regions of countries. The most probable reasons for variation are differences in physical environment, population density, road density, operating practices of PSAPs and emergency services, availability and accuracy of network-based positioning technologies and the current accident rate.

The existence of the positive safety effects has not been questioned in any of the studies reviewed in this report. All studies in which safety effects were estimated reported reductions in the number of fatalities.

The cost side of the equation is most sensitive to the unit cost of eCall in-vehicle system. Because the needed functionality and other requirements for the eCall in-vehicle system have not been defined, the tolerance of the cost estimates is in the range of tens of percents. Some studies such as SEISS and eIMPACT have explicitly specified the costs of the system rather than its price to the end user, whereas some studies evidently use the price of the system in the cost calculations. As the price may be two to three times higher than the cost, this will cause major differences in the calculations. Costs on the PSAP side were marginal compared to the costs of in-vehicle equipment in scenarios of large or full-scale deployment of eCall.

At present, there are uncertainties on both the benefit and cost side of eCall. The benefits of eCall have been analysed in several studies, but information about the probable costs of eCall is still of limited accuracy. Because the specifications and regulations for the eCall in-vehicle unit are still under preparation, it is challenging to provide an accurate estimate for the costs of production, installation and maintenance of the eCall in-vehicle unit.

Before the requirements for the eCall in-vehicle unit have been defined, one can only calculate the unit cost values for the in-vehicle unit in a transparent way based on assumptions. It is also recommended that different unit cost values are calculated for different deployment scenarios. For example, the cost of retrofitted eCall system is different from a system integrated in the vehicle, and the cost of a single unit is heavily dependent on volumes achieved in manufacturing. Finally, the probable costs of eCall functionality 'bundled' in a navigator would be much lower than any of the costs reported in the studies analysed.

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4 Method for European Analysis

4.1 Objectives

The objectives were to develop an assessment framework for this study to cover all required aspects of the eCall impact assessment to:

- define the assessment criteria and indicators for all assessment topics;
- determine the data to be collected; and
- prepare a template for compiling the results and other output in a consistent manner from Stakeholder consultation

The assessment and methods covered both individual EU member states and the whole EU-27.

4.2 Approach

In developing these areas, special concern was given to covering also all indirect impacts and benefits of eCall such as improved traffic and incident management, impacts on vehicles beyond cars (e.g. motorcycles), generally improved processes and operations of emergency centres, rescue operators, police, and traffic centre operators as well as reduced number of secondary accidents and thereby reduced congestion, national economy impacts, etc. The areas agreed upon were the following:

- Safety
- Congestion
- Environment
- Energy
- Incident and rescue management chain
- Other benefits
- Investment costs
- Other costs
- Financial aspects
- Ethical issues
- Legal issues
- Institutional issues
- Technical issues

For each assessment area, the relevant indicators for assessing the impacts and implementation issues of eCall were defined. On the basis of the indicators, a common template for data collection from the case countries, other countries and stakeholder was defined and is shown in Annex 1. This template has also been used in the Stakeholder Consultation for the preparation of a questionnaire aiming at collecting the data necessary for the assessment. A dedicated questionnaire has been produced for every group of stakeholders as follows:

- Questionnaire for the Car Makers
- Questionnaire for the Service Providers,
- Questionnaire for the Mobile Network Operatots
- Questionnaire for the eCall Suppliers
- Questionnaire for the Member States
- Questionnaire for the PSAPs
- Questionnaire for the Insurances

An copy of the Member States questionnaire is included in Annex 2.

The information collected in the literature review was analysed for gaps and reliability of information. The information was checked against each assessment area and its indicators. Cases of lacking, incomplete or unreliable information were used as a basis for definition of information required from the countries.

The data collection aimed to collect values of a similar level of reliability and validity for the indicators from all EU-27 countries, where possible data from the year 2007 was used. In the case of missing or deviant data, the data was created or interpolated on the basis of comparisons with similar countries, consultation with the country contacts, and/or consortium round table judgement. The actual information collection took place mostly in the country studies, concentrating in terms of resources largely in the case countries, but also in later work. The collected data was used to carry out the in-depth studies and socio-economic assessment.

The following table gives an overview of the stakeholders' participation to the questionnaires:

Table 5: Responses to stakeholder questionnaire

	Sent	**Received**
Service Providers	34	10
Member States	42	19
PSAP	35	12
eCall Suppliers	28	11
Insurances	13	4
MNO	1	0
Automotive Manufacturers	1	1[1]
Total	154	57

For managing missing data and extending the results of case studies to all countries, the basic variables defining the operating environment for eCall were used in clustering the countries. Our hypothesis for the clustering was that all countries within one cluster would have a similar enough operating environment for eCall and hence similar enough impacts, costs and implementation issues.

[1] It appears like only 1 automotive manufacturer has been contacted because all European car makers wanted to participate to the study by providing a common input through ACEA. Therefore the questionnaire has been sent only to ACEA.

The clusters was planned to be formed with the Self Organising Maps (SOM) neural network tool (Kohonen 2001). However, it was noticed that the amount of variables and observations was too low for the model and no clear and logical clusters were formed. The aim was to have at least one case country (Finland, Hungary, the Netherlands, and the United Kingdom) in each cluster and thereby preferably four clusters.

4.3 Methods for collecting data through in-depth studies

The method presented below was an 'ideal' plan for collecting data through in-depth studies and there was lot of country-specific variation because of available data and resources. The country-specific methods are described in in-depth country studies. The method described in this chapter can be used in further studies as a guideline.

The results from the in-depth case country studies were scaled up to the 27 countries of the EU based on the clustering approach. Based on the casualty, congestion and other benefits identified for individual case countries, an overall cost-benefit ratio for the EU-27 was estimated. The methodology for calculating the overall cost-benefit ratio for the EU-27 is explained in Chapter 9.

<u>Notification delays</u>

The time delay from the moment the accident took place and the PSAP was contacted is difficult to estimate. The range of this time can vary from few seconds to several hours or more.

One possibility to estimate the time delay between accident occurrence and notification of the PSAP is to compare the information of the phone log of the PSAP (time of the emergency call) and the information provided by the road accident investigation teams (time of the accident). Because of the inaccuracies embedded in the method, it is proposed to classify the delays in the following categories:

- less than 5 min
- 5–15 min
- 15–30 min
- 30–60 min
- more than 1 hour
- no knowledge
- no reference to emergency notification but at least one witness reported in the in-depth data set (rationale: if there is a witness, the delay cannot have been long)
- no reference to emergency notification and no eye-witness, the first road user passing the location called emergency authorities (rationale: longer delay is possible)
- no emergency notification was made.

The accidents within each category can be further classified according to whether the accident had had an eye-witness and whether the accident involved persons, who had received only slight or no injuries at the accident.

<u>Location information</u>

The delays in the rescue service chain can be estimated based on information received from operators of emergency response centres. The survey can be sent, e.g. by e-mail, to all emergency response centres. In the letter recipients of the forms are requested to deliver one to each operator. The questions in the survey deal with accuracy and potential errors in the definition of the accident site by emergency callers, as well as potential problems of the rescue units in finding the accident site. However, it is noteworthy that the questions concern all types of severe road accidents, because operators do not know, at the time of the emergency call, whether the accident resulted in fatalities or not.

Examples of potential questions:

- How frequently a caller cannot locate the accident site sufficiently accurately?
- How frequently a caller locates the accident incorrectly?
- How frequently the rescue units request additional location information while driving to the scene of accident?
- How frequently the rescue unit gets lost because of insufficient or incorrect location information?
- How frequently there are delays in arrival at the accident site because of insufficient or incorrect location information?

Alternative responses: Always/almost always, quite often, sometimes, rarely, never, I don't know

Basic PSAP-information

The same survey also can include question to the head of the PSAP concerning overall PSAP performance.

- Average phone answering time in PSAP (seconds/accident)
- Average time between answering the emergency call and notifying the rescue services and police (Alert time of rescue brigade) (minutes/accident)
- Average time between notifying the rescue services and police and their arriving at the scene (travel time) (minutes/accident).

Safety: Fatalities

The estimated number of fatalities that could be avoided using the eCall system is proposed to be estimated based on the case reports made by the road accident investigation teams in recent years, during which the cellular phone ownership rate has already reached the 100% level. For statistical reasons, objective is to have circa 1 000 fatal road accidents in the in-depth database. However, in this study the amount was not possible taken into account the available resources.

The reports of the road accident investigation teams normally include information such as the following: a detailed description of the event, the location and situation-related information, the 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. Diseases and conditions are documented as well.

For the safety evaluation, the accident data is classified by type of fatally injured person(s): (a) motor-vehicle occupant and (b) unprotected road user. Furthermore, both categories are divided in two sub-categories as follows. The first category involving motor-vehicle occupants is classified by the type of vehicle involved: (1) one or more motor vehicles for which eCall has been designed (i.e., cars, vans, lorries and buses) and (2) only one or more vehicles for which the current version of eCall has not been designed (i.e., single-vehicle accidents involving motorcycles, mopeds and snowmobiles, as well as accidents involving one of these vehicles and a train or tram). It is assessed that the inclusion of the latter category could provide useful information, even though the results could not be applied as soon as those relating to the first category. The second category involving unprotected road users is classified by the fact of whether any motor vehicle (with eCall feasibility) was involved.

In the analyses, it is assumed that eCall would have been installed in each vehicle involved in these accidents, except for bicycles, trams and trains. The injury reports, estimated delays and the possibility of rapid medical treatment such as first aid are examined by a research team that includes medical doctors who are specialists in traffic accident traumatology. Specifically, the following factors are identified: 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 the police report, time of notification of police based on police report, eye witnesses, manner of the request for help, estimated notification delay and any problems in the determination of the accident site.

The analyses of fatalities have three phases. Firstly, the patients whose injuries would have been fatal regardless of any immediate medical treatment are excluded from the data. Such injuries typically include severe bleeding, head, chest, aorta or heart injuries that result in immediate death. In addition, the cases with injuries rated as 6 in the Abbreviated Injury Scale (AIS)[2] and no indication of delays are classified into this category. The cases in this category would not have been affected by eCall at all. Secondly, the remaining cases are classified into three categories: (1) eCall could very probably have prevented the fatality; (2) the very probable effect of eCall could not be authenticated and (3) those with insufficient data to determine classification into (1) or (2). Thirdly all possible cases are analysed with regard whether the resulting injury would have been severe or slight.

The analyses also considers how rapidly quick was access to hospital care was accessed. This means that with similar injuries and emergency unit arrival delays, those involved e.g. in an accident in an urban area closer to a hospital have a higher probability of survival than those in an accident in the countryside.

<u>Severe injuries</u>

In many countries the information about severe injuries is very limited. In the US (Blincoe, L et al.,2002) were able to use AIS to provide the basis for stratifying societal costs by injury severity. This analysis deals with all severe injured in the in-depth accident data set available. First, all those persons with injuries maximum AIS score of 1 or 2 (minor or moderate), are removed from the data as eCall is expected to have no effect on slight injuries. Secondly, those having at least one AIS score of 6 (fatality) are removed as they have been dealt with separately. It is also expected that only few persons with AIS 3 injuries could benefit from eCall. Hence, severe injuries consist of cases where at least one of the person's injuries had an AIS score of 4 or 5.

The doctors remove from these all such cases, where quicker medical care would not have had any impact. The remaining cases are classified into two categories: (1) severe injury would have stayed severe, (2) severe injury would have turned into slight injury if eCall had been available.

[2] The AIS describes the severity of injury to one body region: 1 Minor, 2 Moderate, 3 Serious, 4 Severe, 5 Critical, 6 Maximal (currently untreatable).

4.4 References

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5 In-depth Country Studies

5.1 Introduction

Four in-depth studies of strategic EU countries were carried out. These countries represent the EU-countries in population density, quality of emergency services and traffic management, length of road network and subscription to mobile phone services. These countries form the basis for the drawing conclusions for the EU-27 and associated countries.

The objective of this work was to analyse the benefits and costs derived from the introduction of the pan-European eCall in all vehicles in Europe. This task carried out in-depth analyses of direct and indirect costs and benefits in four European countries: the United Kingdom, the Netherlands, Finland and Hungary. The analysis produced and /or validated the reduction in the number of fatalities and the mitigation of accident consequences per country. It is also estimated what the reduction of traffic congestion and secondary accidents is because of eCall, and the optimisation of intervention resources / reducing costs in the value chain. Finally, the implementation costs of eCall in the emergency services chain have been estimated.

The in-depth country analyses differed in approach but aimed to produce similar results: an in-depth analysis of each of the countries, addressing the safety impacts, complemented with the estimates of the reduction in congestion and secondary accidents as a result of eCall implementation as well as contact with stakeholders about the impact of eCall on the emergency services chain. The emphasis in activities in each country depends on the quality of the analyses already available in each of the countries. The safety impact assessment made use of country-specific data, complemented by expert judgment in assessing the possible impact of eCall. The reduction in congestion and in secondary accidents was approached using a combination of models (in the Netherlands) and expert judgement (UK, Finland, Hungary), combined with country-specific data. Contact with Stakeholders was a common element in all countries, either by interview or in a workshop, in order to estimate the gains achievable by reduction of the arrival time of emergency services to the accident scene, as well as the indirect benefits of availability of accident-related data to the police and traffic management centres. Also, stakeholders were asked about the impact on costs for the introduction of eCall, who is affected, and on what timescale. The stakeholders also provided information on the costs to upgrade and handle eCall.

5.2 UK Approach and Results

5.2.1 Objectives

The in-depth study in the UK evaluated the direct and indirect costs and benefits of eCall in some detail, including the impacts on accident consequences and the rescue chain, and examined implementation issues.

5.2.2 eCall provision in the UK

The current implementation of eCall in the UK was instigated around 2000 and, at the moment, has distinct national characteristics. It has similarities to the Pan-European eCall and the Third Party Support (TPS) eCall that have subsequently been defined through standardisation work.

5.2.2.1 Glossary

VASS - Value Added Service Supplier
MNO - GSM Mobile Network Operator
EDSP - Emergency Data Service Provider
PSAP1 - Public Service Answering Point (999 Call Handling Agency)
EA - Emergency Authorities (PSAP2): Fire, Police, Ambulance and Coastguard services
GSM - Global Standard for Mobile phones
GPS - Global Positioning by Satellite
MSD - the eCall Minimum Set of Data

5.2.2.2 Summary Description

The UK eCall system is shown in figure 1 below.

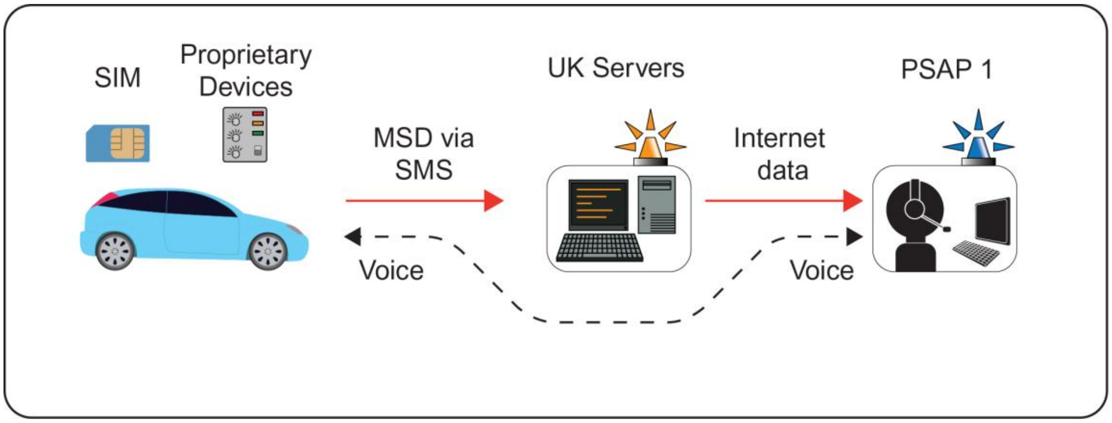


Figure 1: UK eCall system

The proprietary in-vehicle devices (sometimes called telematics units) typically comprise a GSM mobile phone with a GPS device and a signal/data processor. The system can be linked to an airbag and other crash sensors for automatic triggering as well as having a separate button for manual activation. When triggered the system provides a voice channel directly to the PSAP 1 and a separate data call via SMS carrying the Minimum Standard Data (MSD).

5.2.2.3 Organisations involved in delivery

- Value Added Service Supplier (VASS): They are responsible for the specification of the hardware and customer support (e.g. Trafficmaster, the AA, BMW, Volvo).
- Mobile Network Operator (MNO): They enable the GSM Voice call and transport the data message from the on-board telematics unit to the Emergency Data Service Provider (e.g. O2, Vodafone).
- Emergency Data Service Provider (EDSP): They receive the MSD message from the MNO, process it and pass it on to the PSAP1 (e.g. Trafficmaster, AA, Mondial, ATX).
- PSAP1: They match together the voice and the data message; provide 999 call handling and link to the (PSAP2) Emergency Authorities. The UK PSAP1 providers are BT and Cable and Wireless Communications.
- Emergency Authorities (EA): These are the Police, Fire, Ambulance and Coastguard services.

5.2.2.4 Government Policy

The UK government (Home Office) policy requirements include:

- The voice call should be connected directly to the PSAP1 and quickly reach the EA in line with standard, voice-only 999/112 calls
- The location data should be processed immediately and forwarded to the PSAP1
- The data available from SOS-Alert calls should always include the Ordnance Survey map reference. The data should also include the vehicle's make, model, colour, registration number, the registered subscriber's/consumer's name and an indication of whether the alert was generated manually or by a crash sensor (along with crash sensor details, e.g. airbag, rollover, front, back, etc).

5.2.2.5 Some operational Details

- The MNO has knowledge of the cell from which the call was made (and sometimes an approximate location within the cell). It uses the cell details and a translation table to add a zone code that indicates to the PSAP1 the correct Emergency Service area.
- The voice call is delivered to the PSAP1's network as a 998 call (not 999 or 112) in a manner that ensures the call set-up message carries the caller's telephone number and the digits 998IIABCD (instead of 999IIABCD for normal GSM emergency voice calls), where II is the network identifier and ABCD is the zone code or cell identity.
- In the event that a data message is received with no matching voice call the PSAP1 will initiate a voice call to the Police and forward all available details.
- Service Level agreements are in place concerning call handling times amongst the delivery organisations.

5.2.2.6 Recent Developments

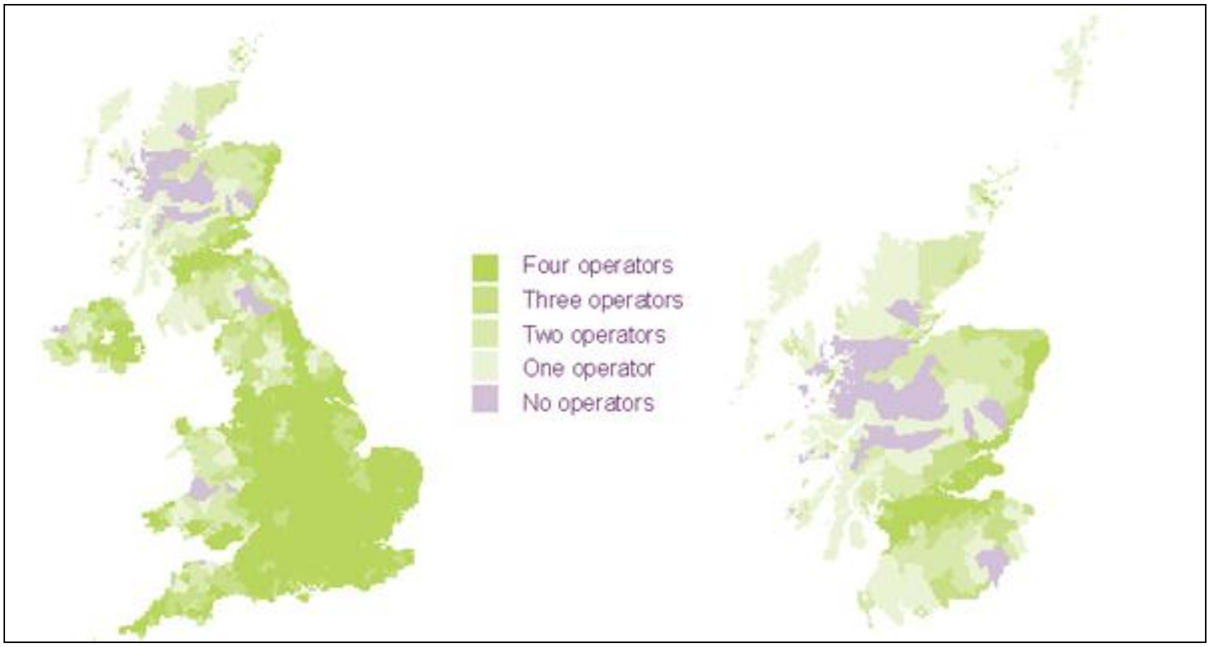
A memorandum of understanding has been in place since 2000 which describes the responsibilities of the parties and overall operation of the system. Since the SBD study report in 2006 there have been no significant developments of these arrangements. There have been hardware and software upgrades and fine-tuning of the protocols, but essentially the service is the same and, according to all parties involved, works well.

5.2.2.7 MNO and UK coverage

There are five principal MNO companies in the UK operating under Government licence, comprising: O2, Vodafone, Orange, T-Mobile and 3-UK. There are many other "virtual" operators such as Virgin, Ikea and Tesco that provide badged services through one of the principal five.

The five operators are differentiated by services offered, coverage of their network, number of subscribers, investment in technology and cost base. Significantly, the UK does not require cross-network emergency calling. So, a subscriber to Vodafone needs to be in a Vodafone coverage area to make a 999 call or an eCall even if there is service available from other operators. There are commercial issues why this is the case, but it reduces the overall completion rate of emergency calls from mobile telephones. Figure 2 below illustrates the UK coverage of 2^{nd} generation phones. For an operator to be counted as having coverage its network footprint in a particular area it has to cover 75% of that area, defined in terms of a postcode 'district'.

Figure 2: Number of 2G operators with at least 75% area coverage



Source: Ofcom / GSM Association / Europa Technologies

5.2.3 Approach to UK Study

5.2.3.1 Overall approach

Using the standard template, information was collected from stakeholders, national statistics, other studies and specific investigations tailored to the requirements of this study. As well as contributing to the European-level analysis the information was used within further detailed work comprising:

- a re-evaluation of the safety consequences of eCall based on case studies of fatal accidents
- modelling the traffic impacts of improving the emergency response time
- analysis of the implications of different roll-out options
- a critical examination of a previous UK study (the "SBD study")
- a UK principal factors cost benefit analysis and sensitivity study

The approach in each of these areas is described below.

5.2.3.2 Stakeholder engagement

The stakeholders contacted during the investigation are listed in **Table 6**.

Table 6: UK stakeholders involved

Organisation type	Organisation	Responsibility
Government	DfT	Transport policy
Government	DCLG	Emergency call centres, PSAP expert group
Government	BERR	Relationship mobile operators
Government	BERR	Technical telecomms issues
Government	BERR	Relationship with automotive industry
Road operator	Highways Agency	NTCC[3]
PSAP1	BT	
PSAP2 - Police	ACPO	999 calls eCalls
PSAP2 - Ambulance	Ambulance service (England)	999 protocols, PSAP expert group
Emergency medical response	London helicopter ambulance service	Trauma care
TRL	On the spot road accident investigation	Investigate the scene of road accidents immediately after they occur
Telecomms operator	O2	

[3] In addition, the results of discussions held with Regional Traffic Control Centres as part of a study on the impact of eCall on the Highways Agency, were also made available to the project.

Organisation type	Organisation	Responsibility
Technology strategy	InnovITS	
Private service provider	Trafficmaster	
Motor industry	SMMT	
Private "manual eCall" service provider	AA	Planning new eCall service

These discussions contributed to all areas of the analysis and the outcomes are included within the relevant sections presenting the results.

5.2.3.3 Case studies of fatal accidents

TRL maintains records of the police files which are generated in the case of fatal accidents. These include statements from witnesses, emergency service personnel, medical reports and post mortems. They are linked with the TRL copy of the road accident database for Great Britain (Stats19) so that it is possible to extract samples of files for particular types of accident. Files on a small sample of accidents were extracted and for those where there was enough information to identify the timing of the emergency response in detail and a description of the injuries, a detailed review was carried out on a case by case basis by a doctor specialising in emergency response in a helicopter ambulance service. In each case, an assessment was made of how much saving in response time would have been necessary in order to save the life of the casualties involved.

The cases were all accidents which did not involve heavy vehicles. The sample was designed to contain cases where eCall was considered in the SBD report to have a 'high', 'medium' and 'low' probability of improving the outcome. The three groups of cases were defined as follows:

- SBD assumed a 'high' potential eCall impact - single vehicle accidents in the dark on non built-up roads
- SBD assumed 'medium' potential eCall impact - single vehicle accidents in daylight on non built-up roads
- SBD assumed 'low' potential eCall impact - single vehicle accidents in the dark on motorways.

Together these three types of accident comprise a quarter of all vehicle user fatalities in Great Britain.

5.2.3.4 Modelling traffic impacts

To analyse the traffic impacts of eCall in the U.K. – specifically the benefits resulting from reductions in incident clearance times (and thus delays to passengers) – an analysis of the UK's Highways Agency (which manages the strategic road network in England on behalf of the Secretary of State for Transport) was carried out. This has then been used to approximate savings over the whole of the U.K.

Whilst this network represents only a small proportion of the national road estate and does not include Scotland, Wales or Northern Ireland, it has a far greater significance in terms of the extent to which it is used. Over 33% of all traffic in England is carried on the Highways Agency (HA) network and the proportion of HGV traffic carried is about 62% (by vehicle miles). This along with the highly detailed information about the HA network available provides a good basis for making traffic impact calculations.

It is anticipated that one of the main benefits to the HA will be reduced delay on the network due to quicker response to incidents and therefore earlier clearance. The methodology used to assess this is described below.

5.2.3.5 Methodology of Delay Benefit Calculations

The general approach was to analyse the impact of reducing delays in accidents on the network using Highways Agency data from HATRIS (HA Traffic Information System: a set of databases containing detailed HA traffic information).

The INCA (Incident Cost Benefit Analysis) software tool is designed for analysing the impact of schemes affecting the duration of incidents on motorways and inter-urban dual carriageways. It is owned by the UK Department for Transport (DfT) and its results and output are given credence by the HA. It uses a series of spreadsheets which are populated with standard values agreed with DfT and the HA and based on TRL research. It calculates monetary savings arising from time saved when incident durations are reduced, using standard values of time. These provided data which was fed into the cost benefit analysis. The types of incident in the model relevant to this assessment are: single lane accidents and multi-lane accidents. Input data includes definitions of sample sections of network with different characteristics (in terms of Average Annual Daily Traffic [AADT] and numbers of lanes, incident times etc.).

One can use INCA to effectively model single carriageway roads as one half of a dual carriageway. This is achieved simply by setting up a dual carriageway with twice the AADT of the single-carriageway road and then halving the benefits. This will underestimate delay as the modelled traffic is all moving in the same direction, which results in a greater capacity than the opposing streams of traffic which exist in reality. However, this may be a more robust approach to calculating an indicative benefit on single-carriageway roads.

The HA network can be categorised in terms of number of lanes as shown in

Table 7.

Table 7: Configuration of HA network

Type of Road	**Lanes**	**Length (km)**	**% of HA Network (nearest 1%)**	
Dual Carriageway				74
	2	4781	36	
	3	4639	35	
	>3	397	3	
Single Carriageway				26
	2	3475	26	
	3	16	0	
	>3	4	0	
Total		**13312**		100

5.2.3.6 Assumptions

It is assumed that when an e-Call is triggered, the response time, and therefore the total incident duration[4], is reduced by an amount R. The potential delay savings due to this reduction were assessed using the HA's standard INCA tool and data from the HATRIS database. Since INCA handles single and multi-lane accidents separately, two values of R were used: R_s and R_m for single- and multi-lane accidents respectively.

An automated process was developed whereby INCA could be run on all links on the HA network (not including single carriageways) and the benefits of reduced incident duration assessed. A number of values of R_s and R_m were used to produce a table of possible results (shown in Section 1.3.4.5). This makes it possible to assess the impact of different estimates of the savings in response time on savings in traffic delays.

5.2.3.7 Single carriageway roads

As INCA does not provide functionality for single carriageways, the benefits on these links had to be estimated. Two methods were considered:

1. Scaling up the benefits by an amount derived from the total traffic flow
2. Treat single carriageways as being equivalent to one carriageway of a dual carriageway.

It is likely that both methods, particularly the latter will result in a slight underestimation of delay and therefore an underestimation of benefits. The latter was adopted as it offered a more robust and reliable approach.

5.2.3.8 Uptake of e-Call

A base model for the composition of the eCall equipped fleet was set up as follows:

$$e_t = e_{t-1} + \eta_t - \varepsilon_t$$

$$\mu_t = \mu_{t-1} - \eta_t$$

Where:

e_t	is the number of equipped cars *t* years after the base year
μ_t	is the number of unequipped cars *t* years after the base year
ε_t	is the number of equipped cars scrapped in year *t*
η_t	is the number of unequipped cars scrapped in year *t*

The total number of cars in the system in year *t* is:

$$e_t + \mu_t \, .$$

[4] This assumes that initial response is on the critical path for incident clearance. It is not known whether this is the case.

Factors such as aftermarket uptake can be adapted fairly easily into the model and results pertaining to them will be illustrated in section 5.2.6.

5.2.3.9 Analysis of Reductions in Delay

A range of possible values of time savings were investigated as possible inputs, enabling the impacts of different reductions to be demonstrated. INCA outputs are shown in Section 5.2.5.

5.2.3.10 Roll-out options

The UK market comprised 32.4 million[5] licensed vehicles at the end of 2008, an increase of approximately 0.7% from the previous year. The average vehicle life is 7 years and new models are typically introduced every 5 years. To estimate the impact of eCall, a key factor is the number of equipped vehicles now and in the future. Essentially market penetration (or more correctly the penetration factored by mileage driven) is a proxy for the probability of vehicles involved in an accident being equipped with eCall.

eCall may be factory fitted at the time of manufacture (OEM fit), as an aftermarket professional fitment or (conceivably) in a self-fit or nomadic device. For factory fitted devices, eCall may be standard or customer-selected.

eCall may penetrate the market as a result of individual manufacturer initiative, industry-wide agreement or as a result of a Directive. If by Directive, eCall is likely to be mandated for all new type-approved vehicles from a future date and for all new vehicles from a second future date.

For OEM, aftermarket and self-fit routes, eCall could be "stand-alone" or provided as part of a "bundle" of services.

Market penetration will depend on the above options, as well as overall customer acceptance, and there will be different implications for equipment costs.

In order to model this situation, three illustrations have been developed:

a. Aftermarket only: Only as a high-end option fitted to 3% additional per year from 2010

b. New vehicle fit: All new type approved vehicles from 2014 and all new vehicles from 2017 (assuming random introduction of new types and each type having a 5 year duration)

c. New and Aftermarket: Option (b) + the 3% aftermarket additional to existing fleet.

It should be noted that the annual delay benefit figures to be presented in the cost benefit analysis assume full eCall implementation. While it is difficult to give a good numerical estimate for the possible cost reductions that might accrue to the EU, initial benefits are not likely to be significant. This will be largely due to the slow uptake of eCall. While the magnitude of these benefits will increase over time, it is expected that there will be diminishing returns eventually, for two reasons:

- An ongoing improvement in traffic regulations and conditions, reducing the added impact of eCall.

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5 http://www.dft.gov.uk/pgr/statistics/datatablespublications/vehicles/licensing/vehiclelicensingstatistics2008

- The installation of the eCall system in the customer pool which is most likely to benefit from the service (67% of accidents on the HA network occur during 7am to 7pm, when many other people are driving on the HA road network who could report incidents) will result in diminishing returns from eCall. Also, in the light of the above presented statistics, in real terms this leaves approximately 300 accident events per month for which eCall is most likely to provide a benefit (NTCC figures).

5.2.3.11 Proportion of Accidents Involving eCall

The benefits calculated using INCA are based on all accidents triggering an e-Call. In reality the take up of the technology will be gradual. This was modelled by using the predicted uptake of e-Call (as discussed in 5.2.3.8). It is assumed that the proportion of accidents triggering an e-Call (P_A) can be related to the proportion of vehicles equipped with e-Call (P_V) by the formula:

$$P_A = 1 - (1 - P_V)^N$$

Where N is the average number of vehicles involved in an accident, found to be approximately[6] 2, the benefits of e-Call for a given value of P_A are therefore:

$$B(P_A) = B(1)P_A$$

Where $B(1)$ is the theoretical benefit is all accidents triggered e-Call, as derived from INCA. Estimates using this method were used in the final cost-benefit study in section 5.2.3.13.

5.2.3.12 Re-examination of SBD study assumptions

The Department for Transport commissioned a study from SBD to investigate the case for eCall deployment in the UK, which reported in October 2006 (McClure and Graham 2006). This study focused on the viability of a public eCall service in the UK as envisaged by the European Commission. It is known as the 'SBD study'.

The approach adopted in this European project has been to carry out a critical review of the SBD study. This was done by examining the assumptions, data and information gathered previously, and identifying where these can now be improved on in the light of changes in circumstances, discussions with stakeholders and with the benefit of having resources available more detailed investigation of some of the elements of the eCall service chain.

As this study did not have access to the calculation framework of the SBD study, only qualitative discussion of the potential effects of refined assumptions are possible. However, a quantitative cost-benefit assessment of the principal cost and benefit factors is described below.

5.2.3.13 Cost benefit analysis

Although a Europe-wide cost-benefit study will be developed elsewhere in the project, it was thought helpful for UK stakeholders to have a much simpler analysis which identified the principal cost and benefit drivers and was attuned to UK conditions.

For this reason a simple spreadsheet implementation was developed with the following features and variables:

[6] STATS19 figures

COSTS: Two cost items are included:

1. The PSAP and infrastructure upgrade cost and maintenance cost specifically related to eCall. The upgrade cost is assumed to be absorbed over the next 20 years. The maintenance cost applies in all subsequent years.

2. The in-vehicle equipment cost. Costs are different for factory-fitted and aftermarket eCall. The cost in one year depends on the unit component cost and the number of vehicles equipped in that year. The unit cost has been assumed to decrease over time as volumes increase and technology matures. This number of equipped vehicles depends on the roll-out strategy as described above.

BENEFITS: Two benefit items are included:

1. In previous studies eCall has been assumed to reduce the number of fatalities involved in road accidents by reducing the time before emergency assistance is at the scene. For this calculation, the benefit is the monetary cost of a fixed proportion of accidents in which eCall equipment is available. Over time, as overall accident rates are predicted to decrease, the number of actual accidents which eCall helps will also decrease. As the proportion of the fleet equipped increases, the proportion of accidents in which eCall can potentially assist also increases. Strictly, this relationship would only be linear if all accidents involved just one vehicle, but a linear relationship has been assumed here.

2. eCall is also assumed to reduce the time until the incident is cleared and the road is flowing freely again. For this calculation, the benefit is the monetary cost of the congestion time saved using the same time interval saved as in (1) above. The congestion saved in this time depends on the number of vehicles affected and this can be estimated as described above.

DISCOUNTING: Having identified the costs and benefits in monetary terms arising in each future year these are then summed and discounted in the usual manner using a discount rate of 3%, which is that required to be used for UK investment decisions.

5.2.4 Analysing case studies of fatal accidents

A total of 30 cases of fatal accidents were examined in detail by a doctor specialising in emergency response. These comprised 10 cases each from three groups of accidents:

- SBD assumed a 'high' potential eCall impact - single vehicle accidents in the dark on non built-up roads
- SBD assumed 'medium' potential eCall impact - single vehicle accidents in daylight on non built-up roads
- SBD assumed 'low' potential eCall impact - single vehicle accidents in the dark on motorways.

There were three cases where there was not enough information for an assessment to be made on whether the outcome would have been different if the response time had been shorter. Of the remaining 27 cases, there was just one in which eCall *might* have shortened the response time enough for a fatality to have been avoided. This case was a single vehicle accident in the dark on a motorway (the group assumed to have low potential for eCall to have an impact on reducing fatalities); the injuries were not fatal at the point of impact, but the driver died at the scene as a result of the injuries sustained, about 20 minutes after the accident.

For 5 of the 27 accidents, death occurred at the time of impact. There were 3 cases where the casualty died in hospital and the rest died at the scene, generally a short time after the accident happened.

In a few cases, medical help was available immediately at the scene from passing medical personnel. In the cases where the time of arrival of the emergency medical care was known, one third arrived within 11 minutes of the accident, one third arrived within 12-20 minutes and one third arrived within 21 to 27 minutes. There was just one case where the accident went unnoticed and was found eight hours later following a police search.

While these cases are by no means representative of all road accident fatalities, the analysis has served to demonstrate that it is possible to use in-depth investigations of this nature to build up a picture of the timing and nature of the emergency response, and to make an assessment of the extent to which a shorter response time could have resulted in a different outcome.

5.2.5 Modelling traffic impacts

An analysis was carried out on all sections of the HA network (motorways and other major routes), which is defined in the HATRIS database in terms of 'links'. Comprising of over 2,500 links (links include single carriageways, dual carriageways and roundabouts) the database was used to obtain detailed network information which allowed the calculation of benefits that could be derived from reduced incident delay on each section of the road network.

These figures were then used to infer the values for the whole of the UK based on accident rates on HA and non-HA roads. This was done on the basis specified because it is an approach which can be assumed to reliably factor in the effects of road lengths and traffic flows.

Benefit figures resulting from reduced delay, for single-lane accidents and multi-lane accidents are presented below. The default duration of the former is taken to be 24.6 minutes and is 86.4 minutes for the latter.

Table 8: Savings in value of journey time (€) following faster response to accidents

Single Carriageway Benefits (€)

Incident Delay: Single-Lane Incidents (min)	Incident Delay: Multi-Lane Incidents (min)										
	86.4	86	85	84	83	82	81	80	79	78	77
24.6	-	1,871	7,516	14,547	22,968	32,780	43,987	56,594	70,603	86,018	102,844
24	183,731	185,601	191,247	198,278	206,698	216,510	227,718	240,324	254,333	269,749	286,575
23	486,212	488,083	493,728	500,759	509,180	518,992	530,199	542,806	556,815	572,230	589,056
22	783,764	785,635	791,280	798,312	806,732	816,544	827,752	840,358	854,367	869,782	886,609
21	1,076,070	1,077,940	1,083,586	1,090,617	1,099,037	1,108,850	1,120,057	1,132,663	1,146,672	1,162,088	1,178,914
20	1,362,789	1,364,659	1,370,305	1,377,336	1,385,756	1,395,568	1,406,776	1,419,382	1,433,391	1,448,807	1,465,633
19	1,643,557	1,645,427	1,651,073	1,658,104	1,666,524	1,676,336	1,687,544	1,700,150	1,714,159	1,729,575	1,746,401
18	1,917,981	1,919,852	1,925,497	1,932,529	1,940,949	1,950,761	1,961,969	1,974,575	1,988,584	2,003,999	2,020,826
17	2,185,639	2,187,510	2,193,155	2,200,186	2,208,606	2,218,419	2,229,626	2,242,233	2,256,241	2,271,657	2,288,483
16	2,446,070	2,447,940	2,453,586	2,460,617	2,469,037	2,478,850	2,490,057	2,502,663	2,516,672	2,532,088	2,548,914
15	2,698,774	2,700,644	2,706,290	2,713,321	2,721,741	2,731,553	2,742,761	2,755,367	2,769,376	2,784,792	2,801,618

Dual Carriageway Benefits (€)

Incident Delay: Single-Lane Incidents (min)	Incident Delay: Multi-Lane Incidents (min)										
	86.4	86	85	84	83	82	81	80	79	78	77
24.6	-	282,008	992,384	1,710,259	2,435,450	3,162,456	3,907,027	4,653,037	5,405,611	6,164,558	6,929,689
24	1,157,197	1,439,206	2,149,581	2,867,457	3,592,648	4,298,441	5,064,224	5,810,235	6,562,809	7,321,756	8,086,887
23	3,052,872	3,334,882	4,045,257	4,763,133	5,488,323	6,159,240	6,959,900	7,705,911	8,458,484	9,217,432	9,982,562
22	4,905,651	5,187,660	5,898,035	6,615,911	7,341,102	7,977,772	8,812,679	9,558,689	10,311,263	11,070,210	11,835,341
21	6,713,533	6,995,542	7,705,917	8,423,793	9,148,984	9,752,072	10,620,561	11,366,571	12,119,145	12,878,092	13,643,223
20	8,474,422	8,756,527	9,466,806	10,184,682	10,909,873	11,480,084	12,381,449	13,127,460	13,880,034	14,638,981	15,404,112
19	10,186,113	10,468,123	11,178,498	11,896,374	12,621,592	13,159,645	14,093,141	14,839,151	15,591,725	16,350,673	17,115,803
18	11,846,287	12,128,296	12,838,671	13,556,547	14,281,738	14,844,427	15,753,314	16,499,325	17,251,899	18,010,846	18,775,977
17	13,452,492	13,734,502	14,444,877	15,162,753	15,887,943	16,620,262	17,359,520	18,105,531	18,858,104	19,617,052	20,382,182
16	15,002,137	15,284,147	15,994,522	16,712,398	17,437,588	18,169,906	18,909,165	19,655,175	20,407,749	21,166,697	21,931,827
15	16,492,471	16,774,481	17,484,856	18,202,732	18,927,922	19,660,240	20,399,499	21,145,509	21,898,083	22,657,031	23,422,161

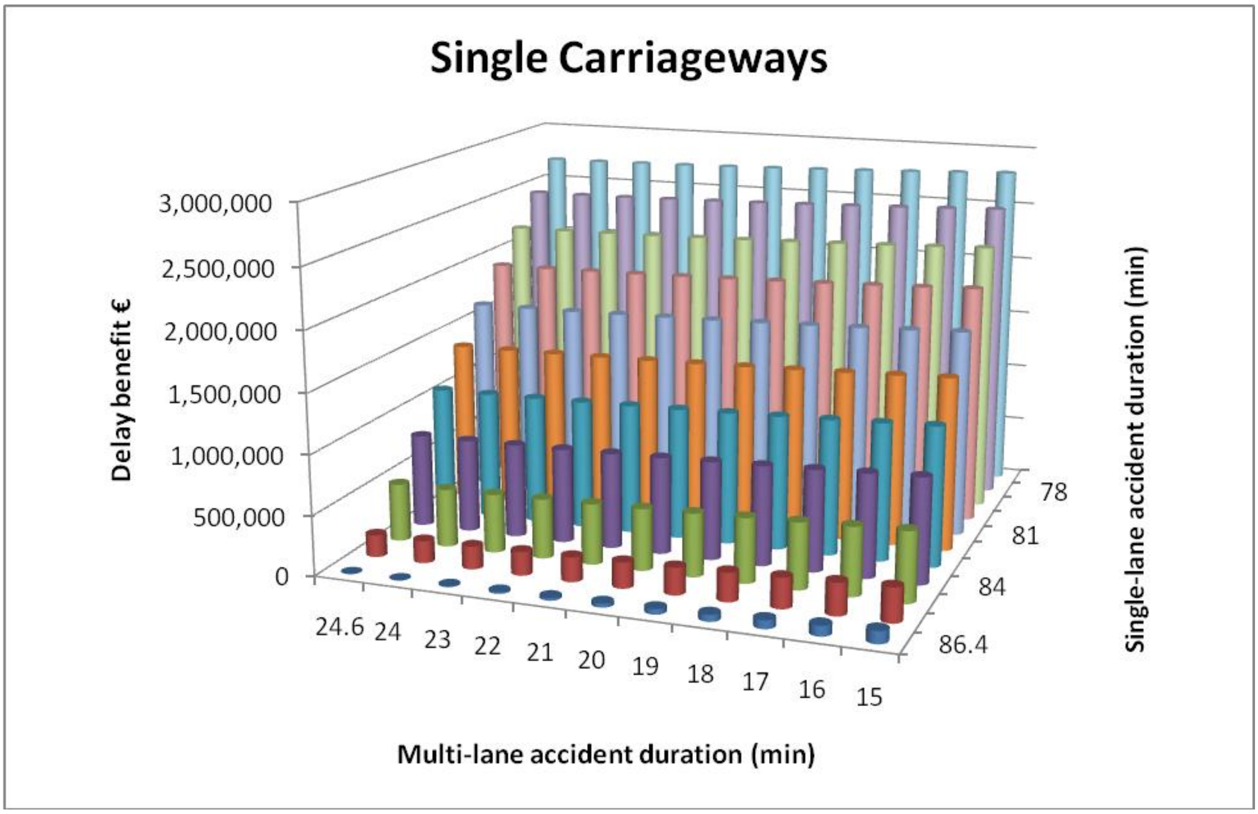


Figure 3: Benefits from delay reduction on UK single carriageways

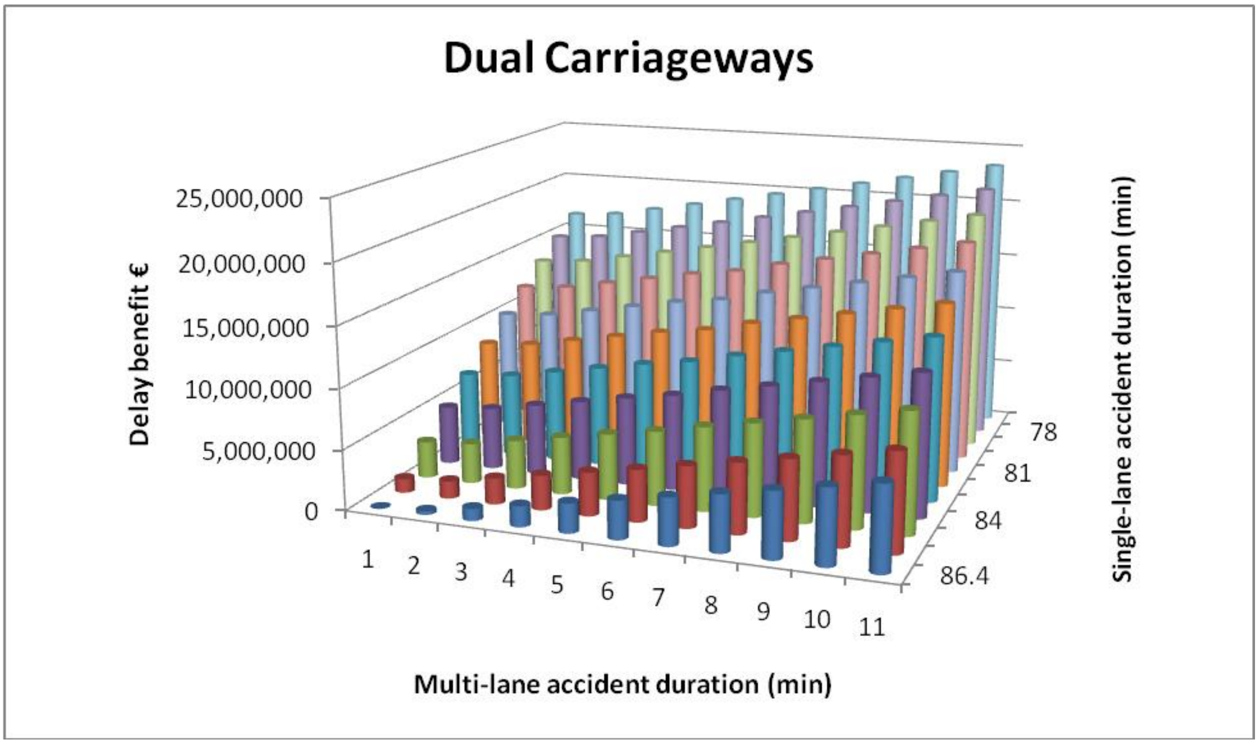
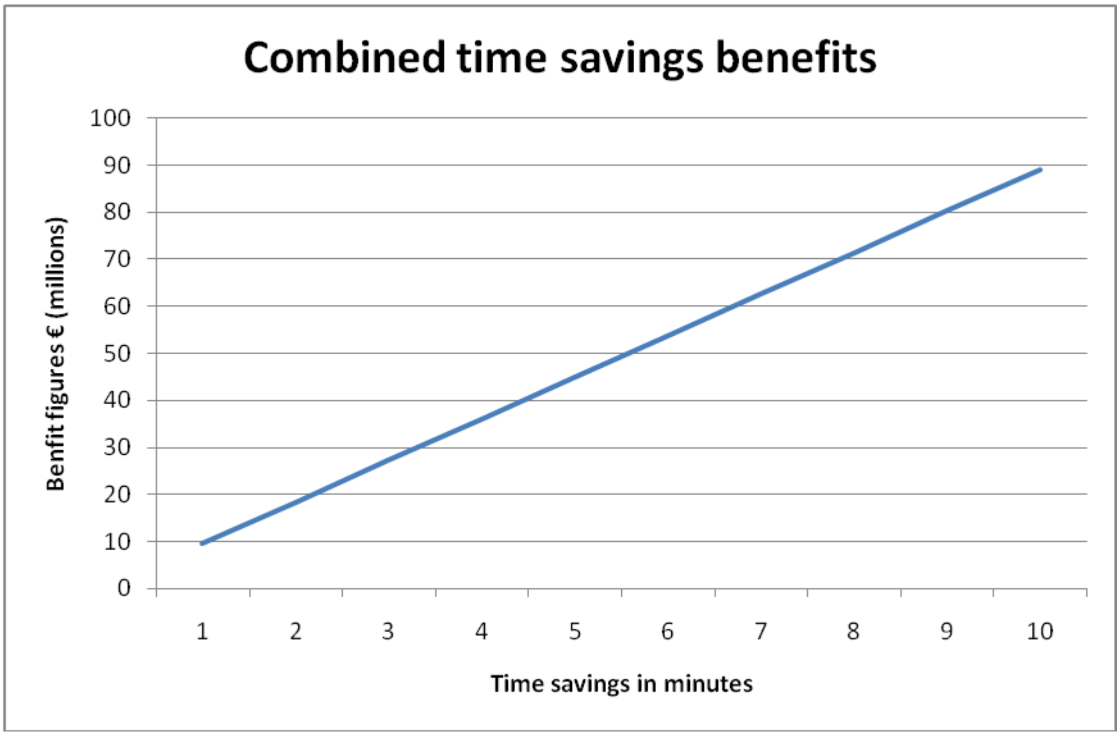


Figure 4: Benefits from delay reduction on UK dual carriageways

Linear regression has been used to obtain benefits for discrete minute savings and figures for both single and dual carriageways have been added to obtain aggregate figures.

This has then been scaled upwards on the basis of proportion of accident rates on the HA network and non-HA roads. This number has been calculated to be approximately 3.2[7]. HA benefits were multiplied by this figure to obtain aggregate benefit figures.

Figure 5: Association between saving in duration and journey time benefits



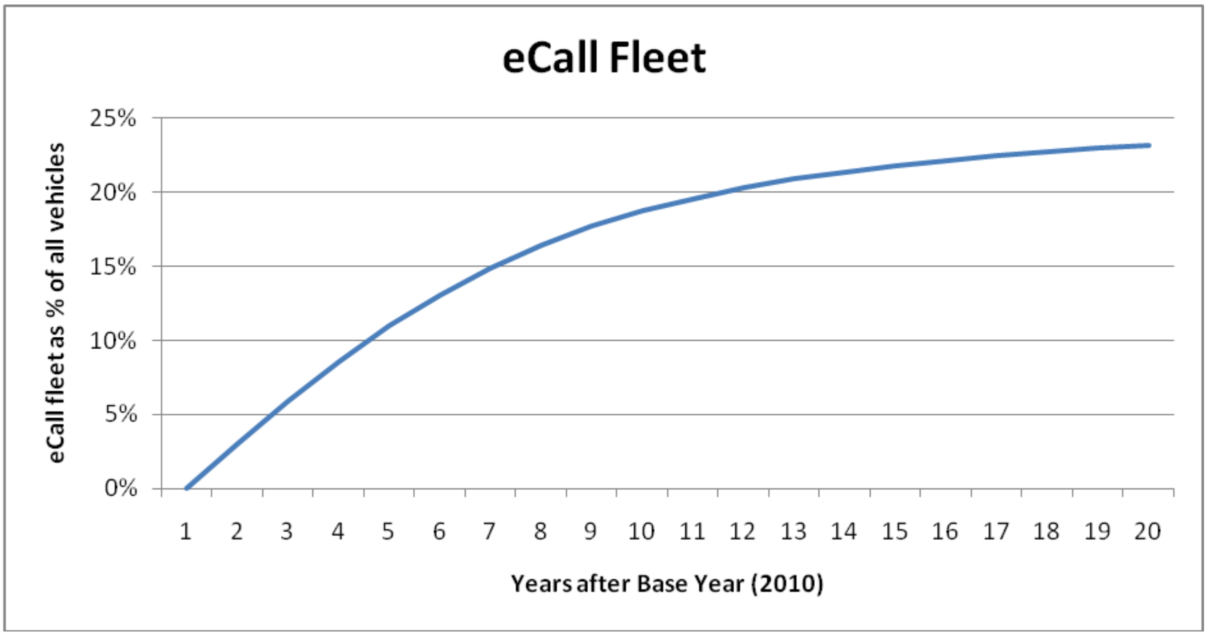
5.2.6 Investigating roll-out options

Based on the assumptions described above and in section 5.2.3.10, the three illustrative roll-out scenario results are presented below:

a) Aftermarket only: Only as a high-end option fitted to 3% additional per year from 2010.

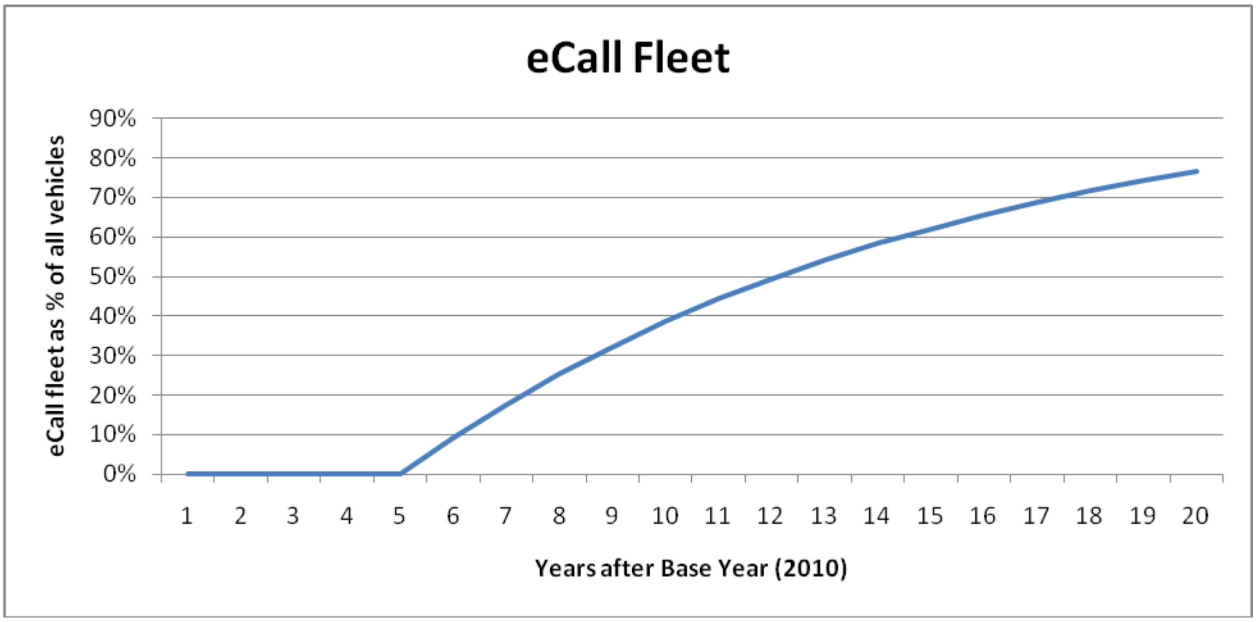
[7] Accidents on the trunk network 2006: http://www.highways.gov.uk/knowledge/17729.aspx
Transport Statistics GB:
http://www.dft.gov.uk/pgr/statistics/datatablespublications/tsgb/2008edition

Figure 6: Percentage (%) of fleet equipped under roll-out scenario a: aftermarket only



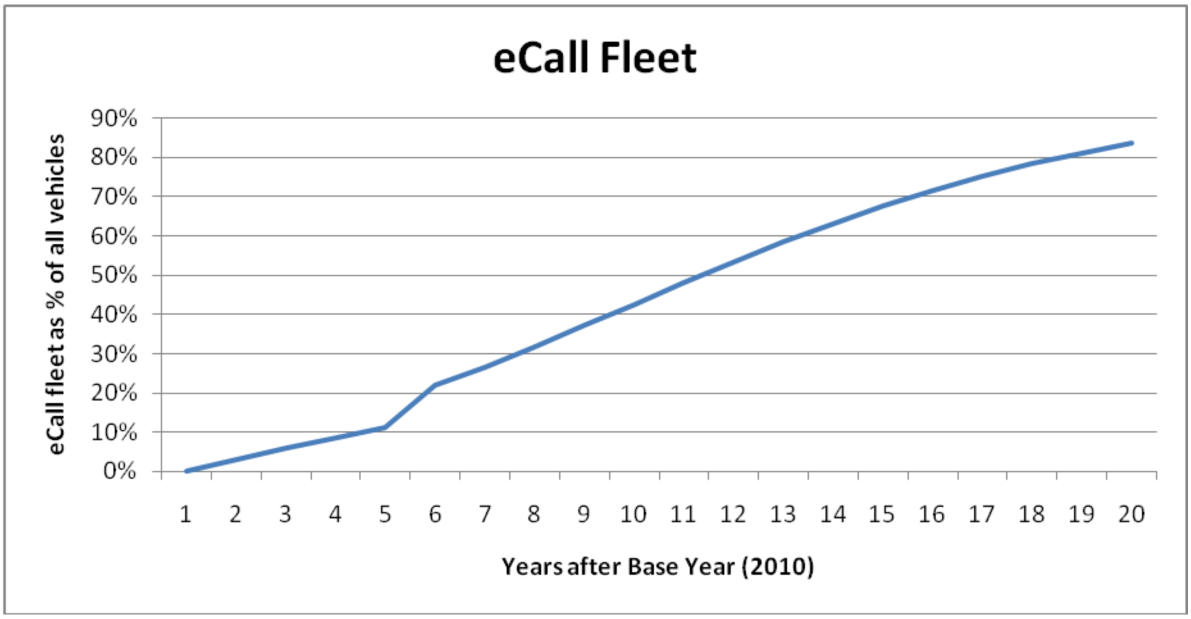
b) New vehicle fit: All new type approved vehicles from 2014 and all new vehicles from 2017 (assuming random introduction of new types and each type having 5 year duration).

Figure 7: Percentage (%) of fleet equipped under roll-out scenario b: new vehicle fit



c) New and Aftermarket: Option (b) + the 3% aftermarket additional to existing fleet.

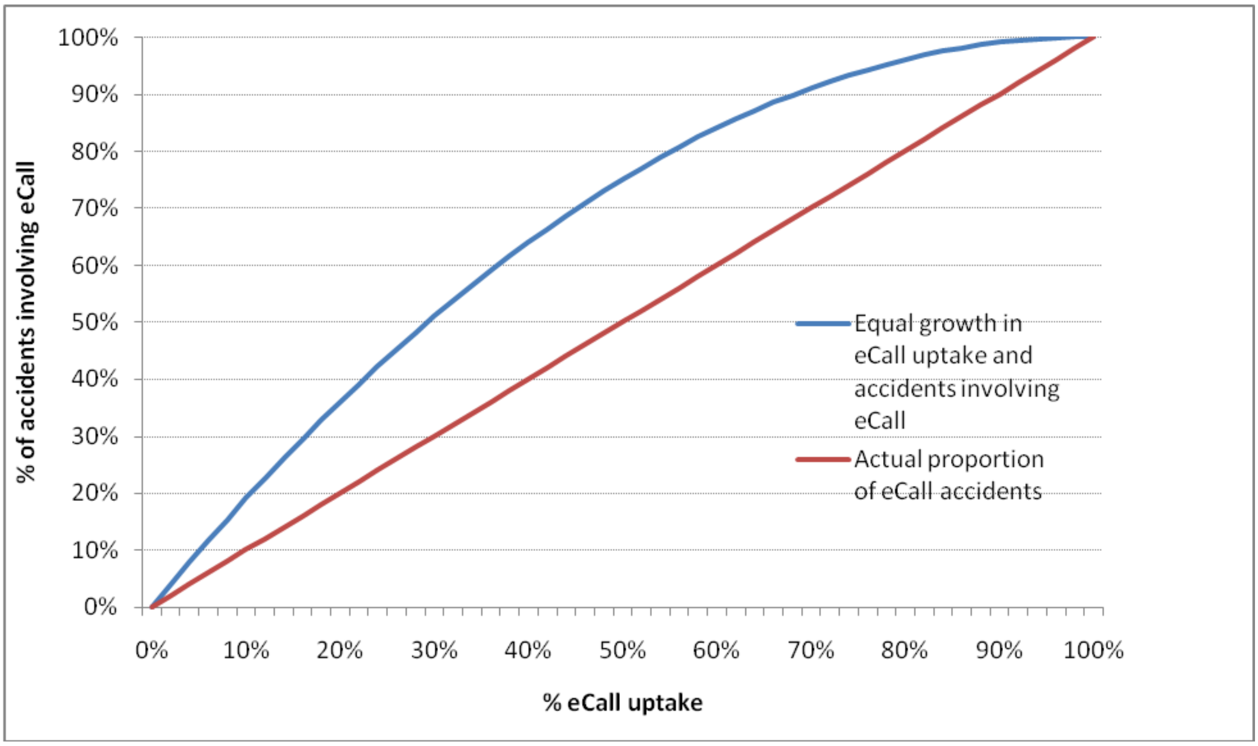
Figure 8: Percentage (%) of fleet equipped under roll-out scenario c: new and aftermarket fit



It should be noted that OEM standard fitment is likely to add the most vehicles to the eCall fleet; aftermarket fitment on its own cannot help achieve a significant uptake and may only be helpful as a supplementary scheme.

Additionally, achieving full market penetration may not be the most realistic objective. In fact the relationship between the proportion of accidents and percentage of vehicles equipped with eCall can be approximately shown as follows:

Figure 9: The diminishing rate of increase in eCall accident involvement with respect to uptake



The above fact has also been taken into account in the cost-benefit results presented in section 5.3.8.

5.2.7 Review of SBD study

This section presents the assumptions and results in the eCall study and then reviews them in the light of comments and information from stakeholders and the outcome of specific further investigations.

5.2.8 Accidents addressed by eCall

SBD assumptions and estimates

Most of the assumptions in the SBD study about the types of accident in which eCall would provide benefits were based on the likelihood of accidents being reported by the driver involved, the road operator or another 'observer'; 'high' benefits were assumed in cases where there is the greatest probability that eCall will reduce the time elapsed between the accident occurring and the emergency services being notified. The evidence on which these assumptions were made is not provided in the study report.

The following assumptions were made:

1. eCall is not likely to benefit pedestrian accidents
2. Motorcycle accidents were excluded because the benefits have not yet been researched.
3. A 'high' level of benefit was assumed for single vehicle accidents on non built up roads (non-motorway) at night
4. A 'medium' level of benefit was assumed for:
    a. Multiple vehicle accidents at night on non built-up roads
    b. Single vehicle accidents in daytime on non built up roads
    c. Single vehicle accidents at night on built up roads
5. A 'low' level of benefit was assumed for:
    a. Multiple vehicle accidents in daytime on non built up roads
    d. Multiple vehicle accidents at night on built up roads
    e. Single vehicle accidents in daytime on built up roads
    f. Single vehicle accidents at night on motorways
6. It was assumed that there would be no benefit in the case of:
    a. Multiple vehicle accidents in daytime on built up roads
    b. Multiple vehicle accidents at night on motorways
    c. Single vehicle accidents in daytime on motorways
    d. Multiple vehicle accidents in daytime on motorways

The high level of traffic on motorways and the availability of roadside emergency phones and technologies for detecting incidents were the justification for the assumption that there would be no safety benefits in the case of motorway accidents.

Using the published accident statistics for Great Britain for 2004[8], the number of fatalities and the number of serious injuries in each type of accident (categorised by day or night

[8] Data for Northern Ireland were not available, so the estimates cover Great Britain rather than the United Kingdom

time, motorway, built up or non built up road and single or multiple vehicles involved) was used to identify the proportion of all vehicle user fatalities and serious injuries who were in accidents where the benefits of eCall were assumed to be 'high', 'medium' and 'low'.

The resulting estimates were that eCall could provide 'high' or 'medium' benefits for 48% of fatalities and 35% of serious injuries. The types of accident where it was assumed that eCall would provide no benefit accounted for 12% of vehicle user fatalities and 23% of serious injuries.

Table 9: SBD assessment of potential accident population for eCall

Road Type	Time of day	Number of vehicles involved	Percentage of all vehicle user fatalities in 2004	Percentage of all vehicle user serious injuries in 2004	Estimate of likely benefits
Non built-up roads	Night	1	14.3%	8.9%	High
		>1	17.1%	10.5%	Medium
	Day	1	8.0%	7.9%	Medium
		>1	27.2%	23.6%	Low
Built-up roads	Night	1	8.3%	7.2%	Medium
		>1	7.4%	12.0%	Low
	Day	1	3.4%	5.4%	Low
		>1	7.2%	18.0%	None
Motorways	Night	1	1.6%	1.0%	Low
		>1	2.3%	1.6%	None
	Day	1	1.4%	1.2%	None
		>1	1.8%	2.7%	None

Source: McLure and Graham 2006.

Comments from stakeholders and project team and further evidence

Stakeholders confirmed that the highest level of benefits would be seen in rural areas, because in urban areas a phone call from a witness would be likely to be made almost immediately in most cases. There was a general feeling that it is very rare for accidents to go unnoticed for any length of time. However, no views were expressed on the more detailed assumptions made by SBD.

A pro-safety approach, providing eCall for motorcycles and lorries as well as cars was advocated by one stakeholder.

The medical assessment of 30 case studies of fatal accidents was not sufficiently large in scale to provide evidence to either support or refute the assumptions made by SBD.

Revised assumptions and estimates

Due to the lack of further evidence the specific types of accident where eCall would be most likely to provide benefits, an overall estimate was made of the proportion of all fatalities and serious injuries likely to benefit from eCall. This is described in section 5.2.8.1.

5.2.8.1 Saving in response time and effect on fatalities and casualties

SBD assumptions and estimates

The SBD assumptions on saving in response time were derived from previous research and statistics from the emergency services on the chain of response. The German 'STORM' project results which estimated a 10 minute reduction in response times in rural areas and a 5 minute reduction in urban areas were discussed with UK emergency service practitioners and a decision was taken to base the benefit calculations on a 10 minute improvement in response time.

The benefits of reducing response times were estimated on the basis of a European study[9] which found that 30% of road accident fatalities occur within minutes, and 50% occur before reaching hospital, generally within 20 minutes following heart or respiratory failure. The cause of death for the other 50% of fatalities is massive bleeding, generally 10 – 60 minutes after the accident. Data on ambulance response times for the UK show that most ambulance services in the UK attend more than 75% of category A (critical) calls within the target time of 8 minutes from receiving the call, but that the time between the accident and the emergency call being made is not known. Data from the German STORM project and a study in Sweden showed a reduction of 10% of serious injuries as they became slight injuries.

On the basis of all this information, the following assumptions were made:

1. There would on average be a 5 minute saving in response time as a result of the automated call being made immediately after the accident.
2. There would on average be a 5 minute saving in finding incidents due to the improvement in location information.
3. Emergency services are unlikely to be able to attend accidents within 20 minutes even with eCall and 50% of fatalities (those with heart or respiratory failure) would die, with or without eCall.
4. 50% of fatalities occur through massive bleeding between 10 and 60 minutes after the accident, and for these, every minute of response time saved would save 2% of fatalities in the 'medium' benefits scenario, with these casualties becoming serious injuries instead of fatalities.
5. 10% of serious injuries would be reduced to slight injuries.

Thus a 10 minute saving in response time would reduce 20% of the fatalities which occur following massive bleeding, to serious injuries; these represent 10% of all fatalities.

The estimates of 10% fatalities reduced to serious injuries and 10% serious injuries reduced to slight injuries were treated as an 'average benchmark' figure. The assessment carried out by SBD tested reductions in fatalities and serious injuries that were 5% greater and 5% less than this to provide a range of benefits for a 'mean' scenario. To reflect uncertainty in the extent to which notification times and emergency response times would improve, 'optimistic' and 'pessimistic' scenarios were tested, involving increasing and reducing benefits by half compared with the 'mean' scenario. This provided a range of estimates of accident severity change ranging from 22.5% in the case of the optimistic scenario for accidents with a high probability of eCall benefits, through 2.5% in the case of the pessimistic scenario for accidents with a low probability of eCall benefits to 0% in the case of the types of accident where it was assumed that eCall would produce no benefits.

[9] E-112 Issues and answers recommendations and insight for the optimal planning and implementation of E-112, Emergency Wireless Location for the European Union, 2004. www.trueposition.com/e112_issues_and_answers.pdf)

Comments from stakeholders and project team and further evidence

Timing in the emergency response 'chain'

The police PSAP representative estimated that on average, 2 minutes elapse between an accident occurring and an emergency call being made, if there is someone at the scene who is conscious. If none of those involved in the accident is conscious, then the average delay was estimated at 10 minutes.

Once an emergency call has been made, the average time for the PSAP1 to answer the call is less than 5 seconds. The average time between the call being answered and passed on to appropriate PSAP2s is 7 seconds. Ambulance PSAP2s answer the call from the PSAP1 within 5 seconds in 95% of cases, while Police and Fire and Rescue PSAP2s answer within 10 seconds in 90% of cases. The current E112 service is connected within 5 seconds.

The cell ID and zone code are processed to provide the PSAPs with latitude and longitude information, but the accuracy of this information varies from 100m in urban areas to 20km in rural locations.

Ambulances or other medical response (depending on the nature of the incident) are despatched to the postcode area or mobile phone cell from which the call was made within a further 30 seconds (i.e. 1 minute 5 seconds from the time when the call was received). The national targets set for the ambulance service are that a response should reach the scene of a life threatening incident within 8 minutes in 75% of cases, and within 19 minutes in 95% of cases. These targets are usually met.

The police expect to be able to despatch a vehicle to an incident within 1-3 minutes for an automatic eCall; a manual eCall is scheduled in the same was as responses to other calls. A police vehicle would be expected to arrive at the scene of an accident within 5-10 minutes in urban areas and 20-30 minutes in rural areas, in the cases of 'medium' severity. There are some cases where delays occur because the location information is not sufficiently accurate or detailed. For the police service this would typically result in an additional 5-10 minutes searching for the incident. Ambulances and Fire and Rescue service vehicles are equipped with satellite navigation equipment and lose less time than this while searching for incidents. The ambulance service estimate that by the time a vehicle reaches the scene, the location has been identified correctly in most cases; delays in finding the location occur in less than 1% of cases on average, but the proportion is higher on motorways. If the ambulance service is unable to find the incident, the PSAP2 phones the caller to clarify the location details; the extra response time is on average less than 4 minutes in such cases.

One further factor to be considered is how 'silent' calls are dealt with. Currently, silent 999 calls are held open for 3 minutes. This could be extended to 5 minutes for eCall to cater for situations where the occupants leave the vehicle after the accident and the voice call is left open. This would not affect response times, but could have an impact on PSAP resources required to handle calls.

The final part of the incident response chain is incident clearance. The first priority is accident investigation and protecting the scene in cases of fatalities or criminal investigations. Recovery vehicles are not called to accidents on motorways and trunk roads until the incident has been assessed and the requirements for recovery vehicles have been identified. Thus eCall could provide small additional benefit in this part of the response chain and this is included in the congestion benefit calculations.

The Highways Agency analyse historic data on the duration of incidents so that delays can be predicted at the start of incidents and traffic management strategies can be put in place and information can be provided to road users. In the case of fatal accidents on motorways, the delay before the scene is cleared is 6 hours on average. By comparison, for incidents involving heavy goods vehicles the average duration is 2 hours, or 4 hours if the lorry has overturned.

Estimates of potential response time savings

Experience of current private eCall services shows that the emergency response time is shorter because the location information is more accurate; a delayed call with good location information can be reached more rapidly than an immediate call which only provides vague information about the location. This suggests that eCall would result in efficiency savings for PSAPs.

The ambulance service representative reported that the eCall would improve the efficiency with which the PSAP is able to determine the precise location of incidents, affecting around 80-90% of accidents on motorways and 30-40% of other cases. However it would only be in rare cases that eCall would improve the response time for medical services reaching incidents. This is because the ambulance which is nearest to the accident scene is dispatched immediately even if the exact location is not known at the time. The full details of the location are then transmitted to the ambulance while it is on the way to the scene.

The Highway Agency Regional Traffic Control Centres (which are responsible for traffic information and management on motorways and trunk roads) estimate that eCall could save a maximum of 4 minutes in 'desk time', during which staff in the traffic control centre are determining the precise location of accidents by talking to those involved and checking the results of monitoring systems, before a Traffic Officer is despatched to assess the accident scene and provide traffic management and other services there. Given that this 4 minute is a maximum saving, it could be assumed that on average, a saving of 2 minutes would be seen. While this saving in response time would not have an impact on the despatch of emergency medical care, it does have implications for the traffic impacts of accidents on motorways and other major routes, as outlined in Section 5.2.3.13.

Stakeholders in telecommunications who have analysed the end-to-end system claim that the saving in response time would be far less than the 5 minutes estimated in the SBD study; it seems likely that mobile phone calls from passers-by would be made almost as soon as an eCall. However other stakeholders pointed out that the location of a passer-by using a mobile phone may be different from the location of the accident, so the eCall will provide more accurate location information.

The SBD estimates of 5 minute saving in response due to the automatic call and 5 minutes saving from improved location information were also considered to be too optimistic by the police representative.

Impact on numbers of fatalities and casualties

There are no agreed figures on how the rate of survival from serious trauma is associated with response times. The air ambulance doctor provided an indication of survival times for casualties who suffer major trauma (ISS of 15 or over):

- One third die at the scene
- One third die while in the care of the Accident and Emergency service (half these die before reaching hospital and half in hospital)
- One third survive.

Research on fatal injuries to car occupants found that 80% of deaths occur either at the scene or before admission to hospital (this includes deaths in the emergency department or operating theatre) (Ward et al 2007). This study recorded an average time between the casualty leaving the accident scene and reaching the hospital of 19 minutes.

The ambulance service representative estimated that eCall would only improve the response time in the case of less than 0.5% of accidents.

The air ambulance doctor noted that the nature of the medical response is a more significant factor in survival rates following major trauma, than the speed of medical response. Currently, 80% of accidents are attended by paramedics with just 8 weeks training, with trauma care specialists attending the remaining 20%. There are plans to provide trauma care at the scene of 80% of incidents by the end of 2010, and this would have a far more dramatic effect on reducing fatalities and the long term consequences of injuries than reducing medical response times. He considered that the SBD assumption of 10% of fatalities being reduced to serious injuries is far too high. He also considered that the SBD assumption that 10% of serious injuries would become slight was also too high.

The police representative noted that it is extremely rare to encounter an accident in which lives would have been saved if the emergency services had reached the scene sooner, and felt that in the UK the reduction in fatalities as a result of eCall would be significantly less than 5-10%.

Those involved in attending the scene of accidents noted that there is no readily available source of information on the most extreme cases where eCall would provide benefits, namely those accidents which are not found for some time after the event. However the impression gained is that these are very rare even if they are of sensational interest in newspapers.

The issue of extreme time delays, even if these are rare events, raises the question concerning the distribution of times before which an accident is notified. In the UK analysis, and in broader European work, average values of time saving are estimated and used in calculations. However, averages are really only appropriate when a distribution is normal. In the case of accident notification times, the distribution will not be exactly normal because of the extreme events and, perhaps, a log-normal distribution should be considered where the effect would be to disperse the mean, mode and median of the distribution.

Whether a mean value or some other representation of the time distribution is appropriate depends on the value and frequency of extremely long accident notification delays. Some data can be found in the Hungarian study (e.g. <1% have notification beyond one hour) but no equivalent data is readily available for the UK. A future research project could be envisaged to address this consisting of analysis of emergency services internal data and, perhaps, an electronic search of local papers to identify and catalogue accidents where there has been a long notification delay. Without such quantitative data, it is necessary to rely on professional experience and the impression from professionals involved in the incident rescue chain (even though these people might be considered to have a vested interest) is that such long notification delays are very rare events.

The responses from the various stakeholders are summarised in Table 10 below.

Table 10: Summary of estimates of effect of eCall on medical response time

Reducing fatalities to serious injuries	
Ambulance service	< 0.5%
Air ambulance service	Much less than 10%
Police	Much less than 5-10%
Reducing serious injuries to slight	
Air ambulance	Much less than 10%

Revised assumptions and estimates

On the basis of the outcome of these discussions with stakeholders, including consideration of their response to figures already published, the research team estimated the following impacts of eCall on road accident casualties (assuming full uptake):

- 1% of fatalities estimated to be saved, and reduced to serious injuries (equivalent to €48mn p.a.)
- 0.5% of serious injuries estimated to be reduced to slight injuries (equivalent to €26.5mn p.a.)

The potential for injuries classified as 'serious' to be reduced to 'slight' arises in part from the way in which the severity of road accident injuries is categorised in the UK. Injury severity is defined on the basis of the nature of the injuries and whether or not they resulted in an overnight stay in hospital: a 'serious' injury is either one which requires an overnight stay in hospital or any of a number of specific injuries, or one which results in death more than 30 days after the accident. In the case of a casualty with injuries which are not automatically classified as 'serious' but which result in an overnight stay in hospital, an improved response time may in some instances reduce the impact of the injuries to the extent that they can be treated without an overnight stay in hospital; such cases would then be categorised as 'slight'. In some countries (such as Hungary) the severity of injuries is recorded on the basis only of information at the scene of the accident; in these cases, there is no potential for a reduction in response time to reduce the number of casualties recorded as having serious injuries.

In addition to the reduction of some serious injuries to 'slight', it is likely that there would be a reduction of injury severity within the 'serious' category, which covers a wide range of injuries from those resulting in severe permanent disability to those with concussion who are detained in hospital overnight for observation. However in cost benefit terms, this would not provide a quantifiable benefit because an average value is used for preventing all serious injuries.

The reduction in secondary accidents arising from eCall was estimated at less than 0.5%. This is because any secondary accidents are likely to occur during the time when the call is being dealt with by PSAPs or the incident details are being verified by traffic centres before warning messages can be broadcast.

5.2.8.2 Other benefits

SBD assumptions and estimates

In addition to the benefits arising from the saving in response time, the SBD study identified a range of other benefits, which are summarised in Table 11.

Table 11: Summary of other benefits

Other benefits	SBD assumptions and estimates
Other accidents and incidents (non-road accidents, crime, manual eCall for medical emergencies in vehicles)	Not estimated
Resource savings in incident response (arising from improved information in eCall)	The improved accuracy of location information in mobile phone calls was assumed to reduce the resources needed to respond to incidents but this benefit was not quantified.
More appropriate emergency response arising from improved information in eCall	The vehicle details and data about the impact would help emergency services to respond more quickly and with resources that are better targeted to the incident, but this was not quantified in the assessment.
Reduced traffic delay	It was assumed that most of the benefit would be on roads with light traffic so savings in journey time as a result of

Other benefits	SBD assumptions and estimates
	reduced congestion were not included in the assessment.
Reduced variability in travel time	Again, it was assumed that most benefits would occur on uncongested roads so this was not included in the assessment.
Environmental impacts	Not estimated
Wider benefits: • additional data on accidents that would not normally be reported • improved accident location for analysis of clusters • security of vulnerable drivers and lone workers • cross border travel	These benefits were identified but not quantified

Comments from stakeholders and project team and further evidence

Other accidents and incidents

There was concern that some non-emergency use of eCall would occur, or that the manual eCall button may be used in cases where no accident has occurred. Some of these, such as vehicle breakdowns where the vehicle is not obstructing the traffic, would result in additional costs in processing the call which would not be offset by any saving in lives or reducing injury severity.

Resource savings in incident response

Information from some of the Regional Control Centres which are responsible for incident response and tactical traffic management on the Highways Agency network (motorways and other major routes) was used to assess resource savings.

One of the Regional Control Centres reported that they expect that the improvement in the quality of information received could reduce the number of staff carrying out incident response duties in the control room by one, with staff being redeployed elsewhere. They do not expect that the detailed information contained in the eCall message will change the way in which incidents are responded to (because the first response would still be to send a Traffic Officer to assess the incident), although there may be a possibility of saving on Traffic Officers patrolling the network, at least in some areas.

Discussions were also held with other RCCs

The National Traffic Control Centre (which is responsible for providing information to drivers) expect that if eCalls are filtered at the PSAP1 stage so that only real emergencies are passed on to PSAP2s, then eCall could remove the need for validation via traffic monitoring or contact with the police before warning messages are broadcast to drivers via Variable Message Signs and other traffic information services (for example to neighbouring road authorities in urban areas). Thus there could be a resource saving and an improvement in the speed of informing road users.

The police representative also envisaged a reduction in the effort required in police control centres following the introduction of eCall, but did not provide an estimate of the extent of the reduction.

On the basis of these discussions, an overall maximum saving in the time which Regional Control Centres spend in locating incidents before starting to respond to them was estimated at a maximum of 4 minutes per eCall incident, which implies an average of 2 minutes per incident. This can be translated into an efficiency saving in control centre staff which amounts to €1.1mn per year, based on full eCall uptake. In addition, there would be a similar saving in time spent by traffic officers locating incidents (two traffic officers per vehicle) resulting in saving of a further €2.4mn per year.

More appropriate emergency response

Stakeholders commented that the vehicle information transmitted in the eCall message may enable appropriate equipment to be sent to the scene in a shorter timescale. In the case of the fire and rescue service, it may enable them to plan any extraction of vehicle occupants more effectively while travelling to the scene.

Reduced traffic delay

The estimated reductions in traffic delays were presented in Section 5.2.5. On the basis of an average saving of 2 minutes in the time spent processing incidents at the Traffic Control Centres, the results showed an estimated reduction in traffic delay of 2.26mn vehicle hours (approximately 0.07% of total hours spent in congestion or 3% of the congestion related to accidents). This is equivalent to approximately €19.5mn (see Figure 5) – using the average value of an hour of time to be €8.6 – of which €6.1m are on the motorways and trunk roads.

Environmental impacts

The environmental impacts of eCall arise from the reduction in congestion following improvement in incident response times. Percentage reductions in Nitrogen Oxide, CO_2 and Particulate Matter emissions are negligible (all reductions less than 0.0002%). Reductions in fuel consumption are also negligible.

Wider benefits

Some of the wider benefits noted by SBD were also raised by stakeholders:

- Vehicle occupants who do not speak the local language (whether or not they are involved in cross border journeys) would benefit from the automatic element of the eCall service.

Some of the stakeholders noted further additional benefits which are 'spin-offs' of the eCall service and which are difficult to quantify:

- All of the Mobile Network Operators seem to be favourably disposed towards eCall and see it as a business opportunity for getting networks into vehicles. There could therefore be further benefits for users and for service providers
- There could be additional jobs created in setting up systems and services for eCall. On the other hand there could be fewer 999 calls, which may reduce the number of people employed in PSAPs
- There are potential benefits for improving the efficiency of commercial services if they are able to receive immediate information relating to accidents: for example insurance companies arranging budget replacement car rental or supply of breakdown and vehicle repair services

Benefits from an 'enhanced' eCall service

Some stakeholders noted that an 'enhanced' eCall service would provide additional benefits:

- Information on the 'g' forces involved in the impact, combined with information on the type of vehicle, would help the medical services to plan the staff and equipment deployed to the scene
- Medical information on vehicle occupants would enable the most appropriate emergency response to be despatched more rapidly
- A picture channel would help to deal with the issue of silent calls
- A pre-accident black box would be beneficial for providing information about the circumstances leading up to the collision.

Revised assumptions and estimates

The benefits estimated in this study that were not quantified in the SBD study can be summarised as follows:

- An average saving of 2 minutes (maximum 4 minutes) in Traffic Centres resulting in savings of €1.1mn in control centre staff resources and €2.4mn in efficiency savings by traffic officers, assuming full eCall uptake.
- An average saving in delays on the road network arising from saving time in Traffic Centres which is estimated at 2.26mn vehicle hours per year, equivalent to €19.5mn of which €6.1mn is on the motorways and trunk roads
- Environmental impacts are negligible.

The estimates of journey time savings have been included in the cost benefit analysis described in Section 5.3.8

5.3 Costs of eCall

5.3.1 In-vehicle costs

SBD assumptions and estimates

The in-vehicle costs were assessed by taking account of the costs of the bought-in parts for a basic eCall system produced in large volumes, and the vehicle manufacturers' additional costs for development, production, distribution, after sales service and profit. The costs included fitting the unit, maintaining it during vehicle warranty, communications costs (embedded SIM card), training and supporting dealers and educating users. Information on costs of the bought-in parts was provided by two automotive suppliers, with the cost of an embedded SIM card based on information from a mobile network operator supporting pan-European eCall. The vehicle manufacturers' associated costs were estimated on the basis of a rule of thumb that doubling the purchase price of the bought-in parts provides an approximation to the retail price to the customer.

The total whole-life cost of the in-vehicle system to the user was estimated on this basis to be €360 (then £250), (€180 for bought-in parts and €180 for the costs of vehicle manufacturers' associated activities).

A wide variation between previous studies in estimates of the cost of eCall systems was identified. The assessment therefore included a 'pessimistic' case based on the costs quoted by manufacturers through ACEA, which was equivalent to €580[10] and a low cost equivalent to €150 as a sensitivity test.

[10] The SBD report quoted the pessimistic and low costs in £; for the purpose of this report these have been converted to Euros using the conversion rate applicable at the time of the study.

The benefit cost calculations included different scenarios for who bears the in-vehicle costs: users and the government.

Comments from stakeholders and project team and further evidence

Stakeholders note that as with other new technologies, the costs are reducing over time. A rule of thumb is that the cost of a system when first envisaged is about four times higher than when it is eventually deployed. Costs will be lower if eCall is implemented voluntarily than if is mandatory, because manufacturers will be able to manage the costs to their best advantage if they are driving the deployment.

Other costs which may need to be considered are:

- whether the system would need to be tested during the annual vehicle roadworthiness check
- whether the vehicle would need to include any built in diagnostic testing of the eCall system

Several pointed out that bundling eCall with other services seems to be the only practical way forward, and that this would reduce the costs significantly because the incremental cost of eCall would essentially be additional software.

The estimates of costs provided by stakeholders are summarised in Table 12.

Table 12: Costs of in-vehicle equipment estimated by stakeholders

Cost	Description	Other information	Source
Under €55	In-vehicle equipment components once volume production begins	Current cost under £100	Private eCall service provider
€55	GSM/ GPS based equipment cost (excluding installation)	Installation costs could be considerable but less if bundled with other services Who supplies the SIMs and who bears the cost of these? What about the cost of the signal overhead?	Mobile Network Operator
€10 – 50 €200-250	In mass production by 2020 In 2013	Vehicles coming onto the market now have some of the components for eCall. Maintenance costs are not likely to be significant	Member State
€80-90		Based on cost of mobile phone	Member State
€22-33 €80-100	Manually triggered system or OEM fit full system Aftermarket fit of automatic system	Following detailed investigation of costs	Private eCall service provider

At some point in the future, 2G services might be switched off, which might lead to upgrade costs for eCall and issues with continuity of service.

Revised assumptions and estimates

Taking into account the estimates provided by stakeholders, the following estimates were made:

- €150 per unit for an OEM device in 2014
- €50 per unit for an OEM device in 2020
- €200 per unit for an aftermarket (retrofit) device, including installation costs
- €50 per unit for a nomadic device, including installation by the user.

These costs were used in the UK cost benefit analysis presented in Section 5.3.8.

5.3.2 Telecommunications costs

SBD assumptions and estimates

Telecommunications costs depend on issues such as who pays for the call charges and whether there will be a requirement to continuously monitor the location of vehicles. Currently mobile network operators in the UK pay £0.60 to PSAP1s for every 112 call that they connect so that the calls are free at the point of use.

An estimate of £500,000 per year was made (€720,000 then), based on predicted call volumes. On the basis of the operation of the Volvo eCall service in Sweden, it was assumed that mobile operators would cover these costs by a one-off charge for the SIM embedded in the vehicles; this amount was included in the cost of equipping vehicles.

Comments from stakeholders and project team and further evidence

The cost paid by mobile network operators to PSAP1s remains at £0.60 (€0.67) per 3 minute 112 call connected. The cost of eCalls was estimated by telecommunications stakeholders as between £1.50 and £2.50 (€1.67 – €2.78) per call.

Emergency calls have a 'flag' which enables them to have priority in processing, even if the load on the network at the time is high. The cost for mobile network operators in implementing eCall 'flags' could be substantial for some companies, but others will already have the necessary equipment and will not incur significant additional charges.

Mobile Network Operators confirmed that the additional number of SIMs in circulation and the increase in signals and transmissions arising from eCall might mean that mobile network operators may need to purchase additional equipment but no estimates of cost were provided. This comment was made before the issue of dormant SIMs was understood. No additional revenue is expected.

If eCall SIMs are dormant, then there will be a delay of 3-4 seconds while a connection with the PSAP1 is established. The benefit for mobile network operators would be less load on the network, but it may be possible for this additional capacity to be built into future plans for expansion without significant additional cost.

Revised assumptions and estimates

In the light of this information, no revisions were made to the estimates made by SBD.

The telecommunications costs were not included in the UK principal factors cost benefit analysis presented in Section 5.3.8.

5.3.3 PSAP costs

SBD assumptions and estimates

At the time of the study, the PSAP1s and many of the PSAP2s were equipped to handle private eCalls. Additional costs would be incurred for a public service.

Discussions with emergency services led to the following "conservative" estimates:

- Start up costs for PSAP2s: £4m (then €5.76m) to cover additional upgrades, training additional staff and transferring eCalls to other services
- Operational costs for PSAP2s: £3.5m per year (then €5.04m).

Comments from stakeholders and project team and further evidence

The PSAP start up costs were not thought likely to be as high as £4m, because it is a similar call, just with better information, and costs would therefore be relatively minor.

PSAP2s could receive multiple calls from incidents (either passersby or multi-vehicle accidents) which could increase the resources devoted to dealing with these incidents. Screening out multiple calls could also result in secondary accidents being overlooked.

PSAPs would need to have a system for filtering out non-emergency calls. One of the current manual eCall services receives a large proportion (80%) of calls which are not emergencies.

Revised assumptions and estimates

Taking into account the estimates provided by stakeholders, the following estimates were made:

- €220,000 investment in the PSAP1 system
- €110,000 per year in operating the upgraded PSAP system
- No additional costs are likely to arise in the PSAP2 systems; these are likely to be absorbed in periodic upgrades.

These costs were included in the UK principal factors cost benefit analysis presented in Section 5.3.8

5.3.4 Cost of driver education and publicity

SBD assumptions and estimates

The initial deployment of private eCall services in the UK has shown that driver education is important, both for maximising benefits when accidents occur and minimising inappropriate use of the service at other times. This is a cost that would be expected to be borne by the National or European government.

An estimate of £2 per new vehicle per year was made, which amounts to £4m per year (then €5.76m). This was equivalent to about a third of the government road safety advertising budget at the time.

Comments from stakeholders and project team and further evidence

One of the government stakeholders agreed that a government publicity campaign would be expected in this type of initiative, but no information on costs was provided. One of the private service providers noted that people do not understand the benefits of eCall, so an information campaign would be an important element in eCall deployment.

Revised assumptions and estimates

No evidence has been obtained which would support a change in the SBD estimate.

5.3.5 Timescales for eCall deployment

5.3.5.1 Roll-out of newly type approved vehicles into the market

SBD assumptions and estimates

The SBD study looked at three scenarios for the take up of eCall.

The "all vehicles" scenario assumed that if eCall were fitted in all new vehicles from 2010, then 2 million new vehicles would be sold in the UK each year in which eCall could be fitted, this it would take more than 10 years for the majority of the UK fleet to be fitted. This was simplified into an assumption that 10% of the fleet would be equipped each year. In this scenario, 10% of all vehicles would be equipped by 2014, and 30% by 2020.

The "type approval" scenario involved restricting eCall to newly type approved vehicles. It was assumed that it would take 7 years for all new vehicles to be type approved and that all new vehicles would therefore be fitted from 2017. In this scenario, about 4% of vehicles would be equipped by 2014, and about 21% by 2020.

The "market led" scenario assumed that there would be low initial take up but that as all new vehicles were fitted it would become uneconomic not to fit eCall units. In this scenario, about 2% of vehicles would be equipped by 2014, and about 18% by 2020.

Comments from stakeholders and project team and further evidence

Stakeholders commented that linking eCall deployment to type approval means that roll out is linked to the introduction of new models of vehicle. Information on manufacturers' intentions in this respect is commercially sensitive and difficult to predict. On average the production life of a specific model of car is about 5 years.

Under a voluntary agreement, manufacturers would be expected to introduce eCall on top-of-the range models first (about 6-7% of all vehicles), spreading to the rest of the range as the market develops in subsequent years. The speed with which eCall spread through the range of vehicles would depend on other features that could be added to increase its attractiveness to consumers, or on finding ways to recover some of the additional cost to make the price more attractive.

If systems are mandatory, market penetration would be expected to take place more quickly. Manufacturers would be expected to make the service available in all new vehicles about three years after the introduction in newly type-approved vehicles – say by 2018.

Another option suggested was that industry could develop a voluntary 'standard' by agreeing on one solution and fitting it. However manufacturers would be more likely to focus attention of systems that prevent accidents from happening in the first place, than on developing a standard eCall solution.

Revised assumptions and estimates

The roll-out options investigated in this study were discussed in Section 5.2.6. Three scenarios were included in the UK principal factors cost benefit analysis summarised in Section 5.3.8: aftermarket fit only, newly type approved vehicles from 2014 and all new vehicles from 2017 and a third scenario in which 3% of the existing fleet has an aftermarket fit in addition to the newly type approved vehicles.

5.3.6 Performance of eCall

5.3.6.1 Likelihood of eCall system operating after an accident

SBD assumptions and estimates

SBD assumed that the success rate for eCall would be 90% in 2010 and 98% in 2020. These estimates combined the effects of gaps in network coverage and failure of eCall equipment as a result of the accident.

Comments from stakeholders and project team and further evidence

Stakeholders noted that to avoid system failure, industry will need do their utmost to make sure that the eCall unit is robust enough to work even after a severe crash or under extreme temperatures. If good hardware standards are set and are implemented, it is very likely that the in-vehicle unit will remain functional in between 95 and 98% of incidents.

Revised assumptions and estimates

Taking into account comments from stakeholders, it was assumed that the likelihood of eCall operating successfully after an accident would be between 95% and 98%.

5.3.6.2 Network coverage

SBD assumptions and estimates

SBD assumed that the success rate for eCall would be 90% in 2010 and 98% in 2020. These estimates combined the effects of gaps in network coverage and failure of eCall equipment as a result of the accident.

Comments from stakeholders and project team and further evidence

Mobile phone coverage in the UK is still not 100%, and is generally worst in remote rural areas where eCall would provide the most benefit. The probability of obtaining a signal in urban built-up areas is probably very good, but factoring in the gaps in more rural areas the overall coverage can be considered to be slightly above 90%.

Revised assumptions and estimates

An overall average figure for coverage was estimated at slightly above 90%.

5.3.6.3 Accuracy of location information

SBD assumptions and estimates

SBD did not make any specific estimates about the accuracy of location information, but recognised that there would be a benefit.

Comments from stakeholders and project team and further evidence

Stakeholder comments on location information have been included in the discussion on response times in Section 5.2.8.1.

Revised assumptions and estimates

The estimates of the benefit of improved location information have been included within the saving in response times in this study.

5.3.7 Overall assessment of costs and benefits

SBD estimates

SBD presented two scenarios for the overall summary of the cost benefit analysis. The overall benefit cost ratio for the UK was estimated to range between 0.1 and 0.7. An alternative scenario in which the vehicle costs were excluded resulted in a benefit cost ratio ranging from 7.3 to 44.0.

Revised assumptions and estimates

The results of the overall assessment of the UK principal factors involved in the cost benefit analysis are shown in Section 5.3.8.

5.3.7.1 Issues and barriers to deployment

SBD information

The issues identified by the SBD study included the following:

Realising the potential benefits of eCall in practice depends on several other elements of the emergency service chain: PSAP2s and emergency services need to be able to process the information effectively, medical responses need to be available, false alarms and inappropriate calls need to be minimised, eCall needs to work in the vehicle and to operate even after a severe crash.

Consumers

Consumers may prefer to invest in other in-vehicle technologies, whether safety features (such as electronic stability control, which has high benefits and relatively low cost) or non-safety features. The value of eCall needs to be demonstrated. It was suggested that one way of doing this would be to include it within the Euro NCAP safety assessment rating for vehicles.

Protection of personal data is an issue for consumers, and education and publicity will need to address these concerns.

Emergency services

Vehicle Identification Number details for both national vehicles and those from other countries need to be available to the emergency services in real time if they are to make the most effective use of the data in the eCall message.

Inappropriate calls are a major concern, with 70% of calls to PSAP1s being non-emergency calls. The design of the eCall equipment and driver education is seen as key to minimising non-emergency manual calls.

Performance and communications issues included: equipping PSAP1s with in-band modem receivers, processing raw GPS data on location, silent call handling if systems are not fitted with SIM cards, a preference for a SIM solution so that PSAPs can call vehicle occupants back, a small delay in receiving calls if dormant SIMs are used.

Reliability of nomadic devices as alternatives to embedded eCall is also a concern, but these devices were seen as offering benefits to drivers in older vehicles.

Vehicle manufacturers

The additional cost of eCall equipment is a significant factor in a low cost mass-market vehicle. Various solutions were identified, including government incentives, education, publicity and including in Euro NCAP assessment and bundling eCall with other services.

Current private services should continue to be supported as legacy systems in parallel with the public eCall service.

Mobile Network Operators

The cost of managing the additional subscribers was reported as a major issue. Issues over costs and charging arrangements were also identified associated with whether eCall involves a SIM in each vehicle, and if so, whether or not it is dormant. Duration of GSM licences and long term support were also concerns. Clarification of liability (or absence of liability) of the various parties each element in the eCall delivery chain is also needed.

Government

In addition to concerns over the business case for eCall, the question of how a manual eCall from a moving vehicle should be treated in the context of legislation on the use of communication devices while driving was identified as an issue for governments to resolve.

5.3.8 Cost benefit analysis

The opinion that both costs and benefits have been overstated was expressed by a number of stakeholders. A number of possible scenarios are considered below (the maximum value of the vertical axis has been kept constant at 2.5 for ease of cross comparison).

5.3.9 Results of scenarios

In order to arrive at a strategy which theoretically stands a better chance of improving the overall socio-economic context in which eCall is expected to operate, a clearer picture of the relativity between costs and benefits of eCall can be presented by the analysis presented in this section. This involves consolidating all eCall specific variables and then weighing their advantages and disadvantages against each other.

Examples of economic variables that have been considered are cost of in-vehicle eCall units (IVU costs), costs of operating eCall specific services at centralised Traffic Centres (operational costs) and costs of purchasing and installing eCall specific equipment and services (initial infrastructure cost). At the same time, other variables have been considered whose valuation involves a subjective assessment of their merits (or demerits). Variables that fall into this group include the monetary benefit that might accrue to UK society or economy from the prevention of a fatality or, separately, a serious injury. Another factor could be the reduction in congestion which may result from accident scenes being cleared more quickly as a result of eCall.

Some of the variables listed above will vary depending on the number of vehicles in the UK that are equipped with eCall, such as IVU costs and congestion benefits; while others such as fatality/injury prevention have been elicited during comprehensive discussions with stakeholders from industry, emergency services and police.

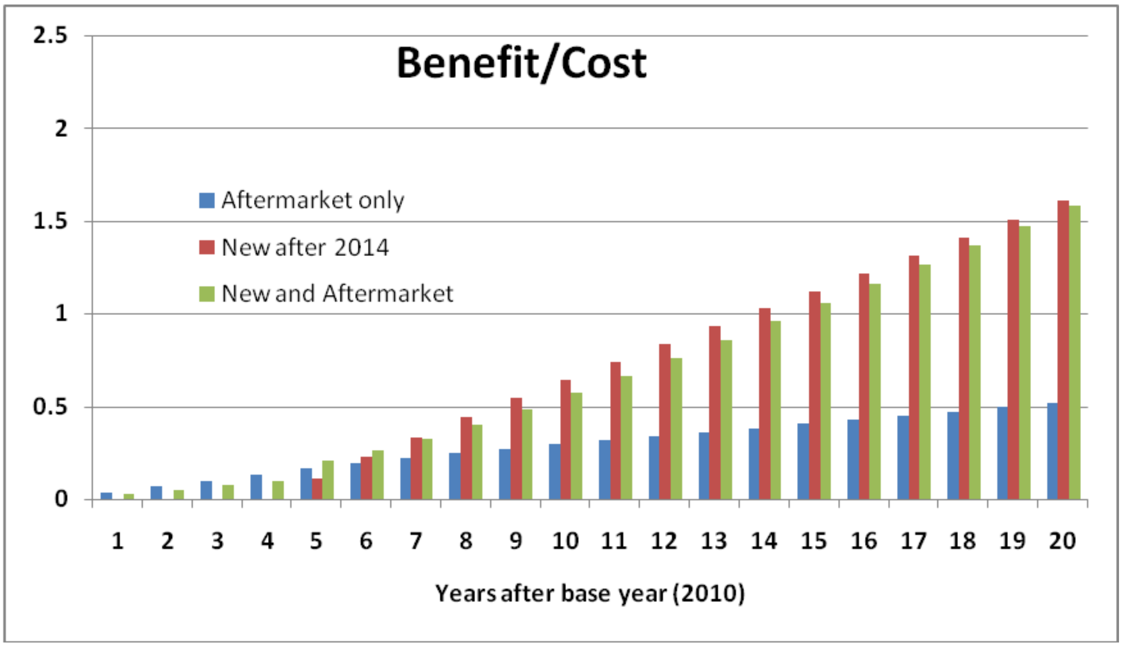
Due to the uncertainty and volatility of overall costs and benefits with respect to the strategy adopted by the EU (specifically the rollout option) and the variables mentioned, a number of scenarios have been developed to highlight the effects their possibilities may have on the overall picture should they materialise.

A selection of scenarios together with their Benefit/Cost ratios is presented below, including one which brings together the best estimates derived in this study (scenario 4). A discussion of the scenarios follows immediately after the graphical summaries.

Summary of Scenario 1: SBD mean figures

FATALITIES	
Fatalities prevented (% of fatalities/yr)	**10.0**
Serious injuries prevented (% of serious inj./yr)	**10.0**
AFTER MARKET TAKE-UP RATE	**3.00%**

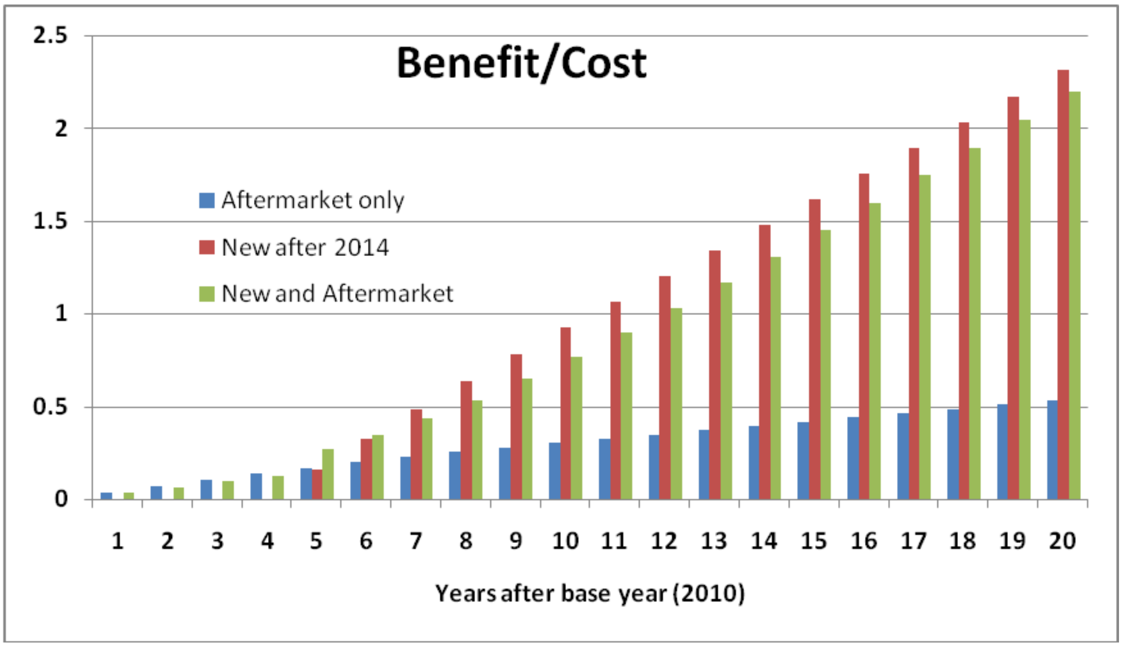
COSTS	
Reduction in IVU / yr (%)	**5**
Initial IVU (€) (OEM, Aftermarket)	**360, 360**
Operational cost (€ mn) /yr	**5**
Driver education costs (€ mn) /yr	**5.76**
Initial Infrastructure Cost (€ mn)	**5.76**



Summary of Scenario 2:
High Operational Cost, High Benefit, High IVU Cost

FATALITIES	
Fatalities prevented (% of fatalities/yr)	**10.0**
Serious injuries prevented (% of serious inj./yr)	**10.0**
AFTER MARKET TAKE-UP RATE	**3.00%**

COSTS	
Reduction in IVU / yr (%)	**5**
Initial IVU (€) (OEM, Aftermarket)	**250, 350**
Operational/Education costs (€ mn) /yr	**1**
Initial Infrastructure Cost (€ mn)	**0.5**

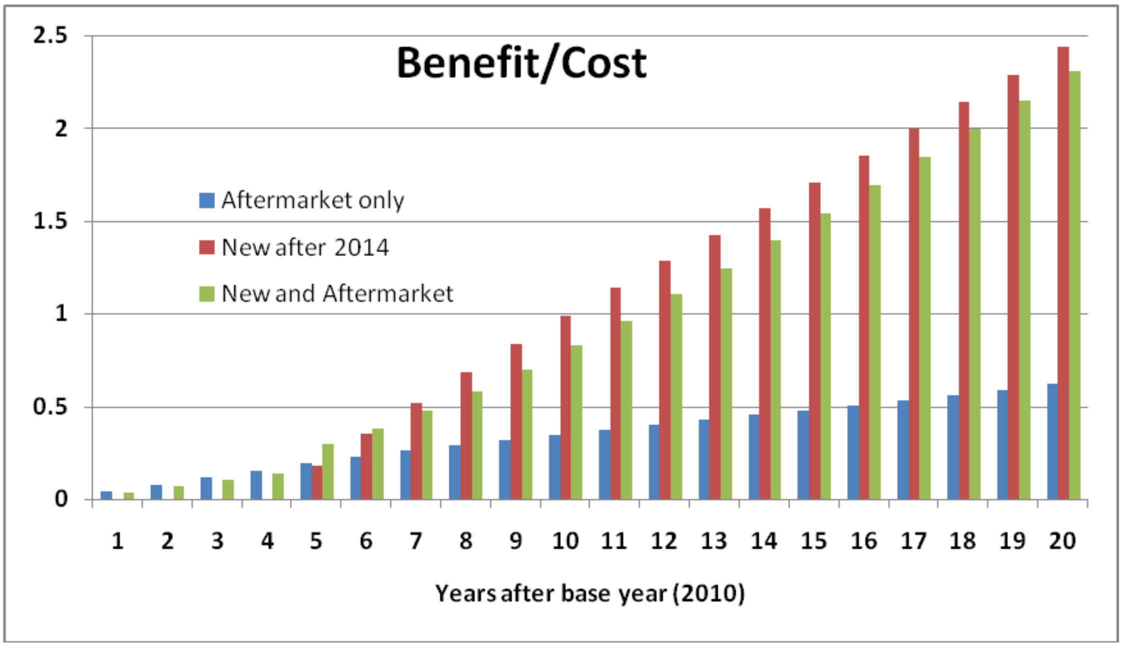


<u>Summary of Scenario 3:</u>
Medium Operational Cost, Medium IVU Cost

FATALITIES	
Fatalities prevented (% of fatalities/yr)	**4.0**
Serious injuries prevented (% of serious inj./yr)	**7.0**
AFTER MARKET TAKE-UP RATE	**3.00%**

COSTS	
Reduction in IVU / yr (%)	**5**
Initial IVU (€) (OEM, Aftermarket)	**150, 200**
Operational cost (€ mn)	**0.11**
Initial Infrastructure Cost (€ mn)	**0.22**

Medium-High Benefit

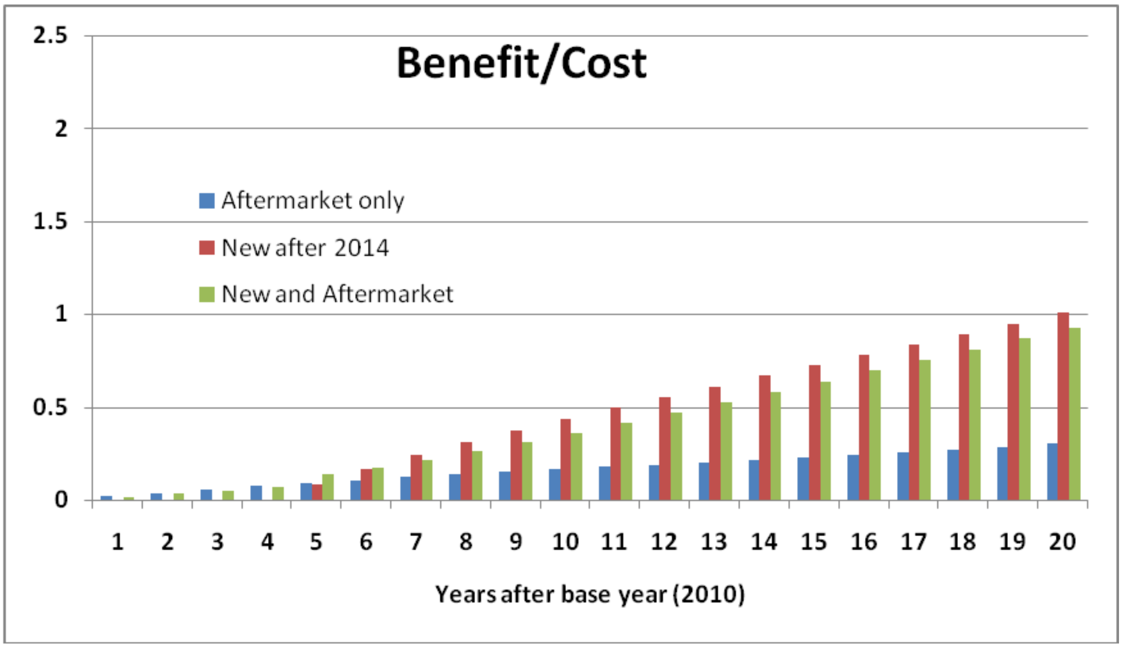


Summary of Scenario 4:
Medium Operational Cost, Medium IVU Cost

FATALITIES	
Fatalities prevented (% of fatalities/yr)	**1.0**
Serious injuries prevented (% of serious inj./yr)	**0.5**

Medium Benefit

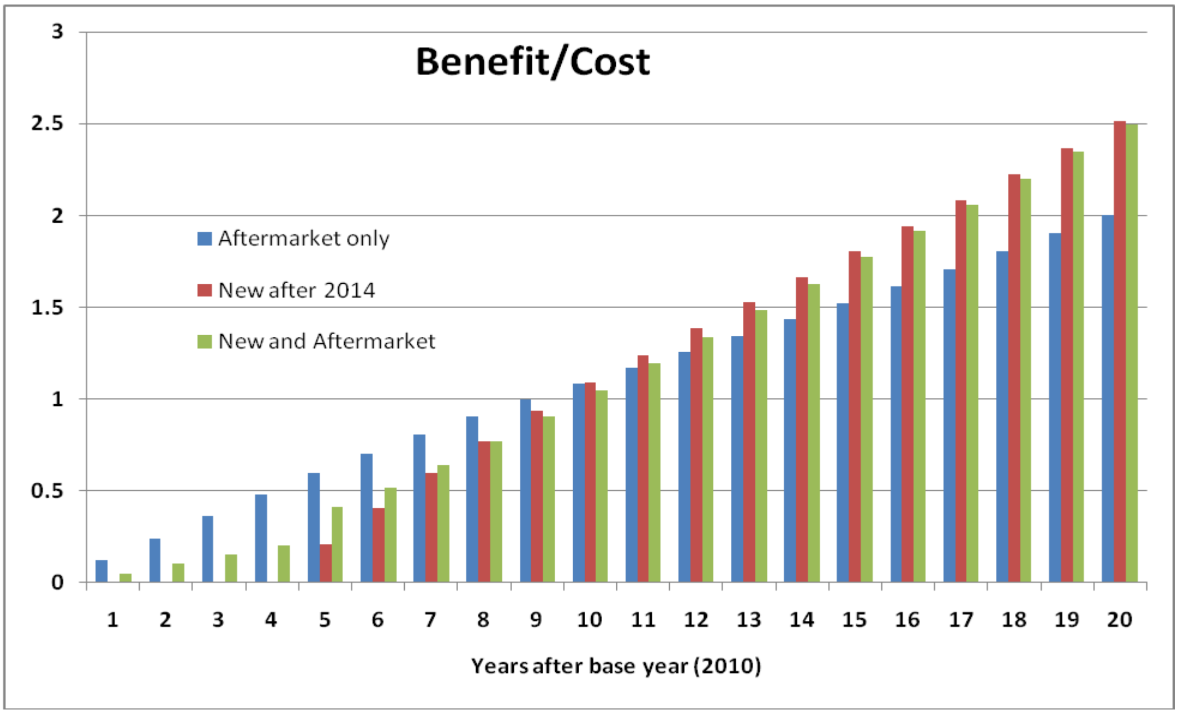
COSTS	
Reduction in IVU / yr (%)	**5**
Initial IVU (€) (OEM, Aftermarket)	**150, 200**
Operational cost (€ mn)	**0.11**
Initial Infrastructure Cost (€ mn)	**0.22**
AFTER MARKET TAKE-UP RATE	**3.00%**



Summary of Scenario 5:
Medium Operational Cost, Low IVU Cost, Medium Benefit

COSTS	
Reduction in IVU / yr (%)	**5**
Initial IVU (€) (OEM, Aftermarket)	**60, 30**
Operational cost (€ mn)	**0.11**
Initial Infrastructure Cost (€ mn)	**0.22**
AFTER MARKET TAKE-UP RATE	**3.00%**

FATALITIES	
Fatalities prevented (% of fatalities/yr)	**1.0**
Serious injuries prevented (% of serious inj./yr)	**0.5**



5.3.9.1 Discussion of results

These results have been generated using a conventional discounting approach as that is the standard approach used in the UK for investment decisions. Note, that a different approach is used for the Europe-wide analysis as explained in a later chapter. The "best" Cost:Benefit (C/B) ratio is provided by the "New after 2014" scenario which assumes that either through mandating or by industry agreement all new type-approved vehicles are factory-fitted with eCall after this date.

All graphs show an upward trend of benefit with time. This arises from the relatively low initial and annual infrastructure cost and the reduction in cost of the IVU equipment with time. It is assumed that IVU costs will decrease in real terms as volumes increase and system integration increases. Indeed, it can be foreseen that some equipment costs (e.g. GPS) could be shared amongst different functions thus reducing the cost attributable to eCall although this has not explicitely been taken into account. A 5% cost reduction per annum is assumed and this has the effect of reducing a €150 price to a €90 price in 10 years (at today's costs). This 5% reduction more than offsets the discounting rate and the assumed accident reduction in time and therefore leads to an increasing B/C ratio over time.

It can also be seen in all scenarios that the B/C ratio of the new vehicle fit is better than when aftermarket fit is also considered despite higher eCall fleet numbers with aftermarket fitment also. This is because the assumed IVU cost of aftermarket is higher than that of new fit.

From Scenario 1, using SBD mean figures, it is quite clear that aftermarket fitment alone will not be able to produce high benefit figures. If all new type approved vehicles are fitted with eCall after 2014 the situation improves with benefit-cost ratios (B/C ratios) exceeding 1.5 at the end of the period.

Scenario 2 shows that with lower IVU costs, it is possible to achieve higher B/C ratios. This highlights that IVU cost is a sensitive parameter in the analysis (further investigation reveals that this is much more important than initial investment and operational costs).

Scenario 3 moves a bit further towards the situation now considered realistic for the UK. Fatality reduction is however still much higher than expected figures. With this optimistic assumption a B/C ratio of almost 2.5 can be obtained. It also illustrates that alongside IVU cost, fatality/injury prevention is a most sensitive parameter.

Scenario 4 uses the figures considered most realistic for the UK with a maximum C/B ratio of about 1 being obtained from option b) of new vehicles installed from 2014.

Finally, Scenario 5 shows the more optimistic picture where the parameters of Scenario 4 are used but with the IVU costs assumed in the European level analysis. In fact this shows eCall as more beneficial than the European level analysis because of the 5% IVU cost reduction per year.

5.3.9.2 UK perspective on implementation issues

This section summarises the key issues arising from discussion with the many stakeholders consulted in the course of the UK work. As described above, the UK already implements a form of eCall and has an efficient but still developing rescue-management chain. This context obviously influences the perspectives expressed which, for reference, have been summarised within three main headings.

5.3.9.3 Legal and Liability issues

The legal issues raised by eCall fall mostly on the in-vehicle equipment and service suppliers. For other elements of the rescue chain, eCall is seen as requiring only simple extensions to existing procedures and practices and hence legal issues are not radically different or of particular concern.

Clearly there are potential liability issues if in-vehicle equipment fails to operate as expected but such risks are well understood, accepted as part of doing business, and are managed using standard approaches. For the Mobile Network Operator, coverage or system failure similarly raises issues. There is also a concern that the expectations of automatic electronic systems are higher than those of human manual systems. Similarly, a network coverage failure for a handset may be accepted more than the same failure of an eCall message.

Overall, liability issues are not seen as a barrier to implementation because good systems and clear contracts are expected to be available to deal with any issues in a business-like way. No issues have come to light in the current UK implementations.

In terms of privacy, some small concerns were raised. Dormant SIMs may allay concerns about privacy because they are not traceable while dormant. If SIMs are active, there may be an issue that the system would need to have an off-switch. In the current UK implementation, where eCall is part of a subscription service with other functions, privacy has not been an issue.

Overall, privacy issues were also not regarded as a barrier to implementation by any Stakeholder consulted.

Further issues may arise when the fuller details from the emerging standards are known, but, overall, the legal and liability issues do not appear insurmountable and there is interest from private suppliers in being involved in eCall service provision.

5.3.9.4 Moral and Economic issues

Although the moral and economic issues were raised for discussion with all of the stakeholders, we were unable to find anyone to meaningfully engage in moral debate.

In terms of economic issues, different calculations are performed (explicitly or implicitly) by different stakeholders. All stakeholders think that eCall is beneficial and will lead to saved lives and reduced injuries. However, the debate concerns the costs of eCall and who bears those costs.

For commercial organisations providing eCall services, the economic calculation is one of business case. For Mobile Network Operators there are some costs but there may also be future service and customer relationship benefits. For stakeholders further along the rescue chain, the costs are relatively small.

Two discussions and email correspondence with government economists helped to clarify the social cost-benefit situation. The conversations were useful in verifying technical aspects of current approved cost-benefit and economic valuation techniques. Some points raised were:

- It is not easy to calculate employment benefit and these should probably be excluded
- Ideally foreign visitors should be excluded but foreign travellers included and, to a first approximation, these balance
- Costs should include full installed equipment cost to the driver (not component costs)

The framework for such government calculations is relatively prescribed and do not extend much beyond purely economic considerations. However, cost-benefit calculations are just one input to wider policy consideration for decision-making.

5.3.9.5 Roles and responsibilities

No "**customers**" of eCall were consulted during this study, but several stakeholders expressed opinions concerning them. The consensus was that individual drivers do not, in general, understand, appreciate or want eCall. They do not believe they will crash and, if anything, might be persuaded to spend money on pre-crash assistance before post-crash technology. The implication from this is that eCall, if offered on its own, would fail and so either needs to become standard equipment or a service needs to be included in combination with other services that customers do appreciate.

From the stakeholders consulted there was a general impression of lack of clarity from the **European Commission** (perhaps based on dated information?) and some unresolved issues – e.g. eCall flag and dormant SIMS. It was also noted that progress on standardisation has been slower than the initial timetable and that the commission timetable is optimistic/unrealisable.

When the actual recent situation was described to the stakeholders they were more positive about the prospects for eCall. The implementation platform was particularly welcomed and was expected to greatly assist implementation.

All the stakeholders including the **UK government** have the perception that the investment involved for eCall is higher than the expected safety benefit for the UK in purely social cost-benefit terms. The government's position is therefore to ensure that the emergency rescue chain can service eCall and it supports the private provision of eCall service where the equipment cost is borne at their choice by individual motorists. The UK government also want to ensure that the eCall service and surrounding issues are well managed to avoid adverse publicity for those involved.

There was a very clear and loud statement from **Equipment and Service Suppliers** concerning roles and implementation. Essentially three points were made:

1. That the existing UK systems should continue to work during any future implementation of eCall

2. Third party eCall services should be supported. There was little enthusiasm for the pan-European eCall and some thought it would impede implementation

3. eCall can only work as part of a bundle of services. There is cautious enthusiasm to offer eCall as one of a number of services that use the same equipment. The service providers believe in the benefit of eCall (even if the Customer appreciates it little) and it provides an additional feature essentially for free.

Some (but not all) of the service providers supported the idea of aftermarket solutions, for example based on automatic notification from a connection with the CAN bus or accelerometer sensing. They argue that this would shorten the time before the full benefits of investment in eCall are realised.

Some of the service stakeholders raised the issue of overall responsibility for the quality of the end-to-end service. There is a possible danger that despite contracts one stakeholder might be "blamed" for another's fault or that the whole service receives poor publicity. However, no solution was offered.

The **Mobile Network Operators** are generally positive about eCall and some are already involved in UK eCall provision. It is a requirement of their operating licence that they handle emergency calls and give them network priority. eCall has costs in terms of implementation but also offers future new business opportunities.

A key issue for them is network coverage (as explained above). There is an on-going UK project on cross-network connectivity for emergency calls. Cross-operator 999/112 calls are not currently mandated in the UK although this would provide benefits for consumers and increase eCall coverage. However, some MNOs are reluctant to allow 'roaming' (i.e.

cross-operator coverage) even for 999 calls, since service operators recoup these costs on service contracts and operators with good coverage would not wish to subsidise cheaper operations.

Another issue concerns spectrum space. Further spectrum space will be available after 2012 when the switch-over to digital TV should have been completed in the UK. This may prompt other changes. Further ahead there is concern about the transition to 3G when 2G services are switched off. Therefore there may be an issue of some eCall implementation becoming obsolete.

The **PSAP**s in the UK are generally positive about eCall and see it as another development to assist the rescue chain. Given the relative sophistication of the UK PSAPs and their state of readiness for eCall, and with some services currently operating, they do not foresee any insurmountable problems. eCall may also be a stimulus to further improve the information technology further along the rescue chain as, of the 220 PSAP2s, only half fully use full digital data and mapping. eCall may have an effect on false alarms but it is unclear if the numbers will go up or down.

The **Emergency Services** (PSAP2s) are relatively sceptical about the benefits of eCall. Their focus is on the casualties at the roadside. Their priority in terms of use of any financial resources would be to support their development plans including increased provision of air-ambulances and more trained trauma personnel who can offer more effective assistance at the roadside and during the journey to hospital.

5.3.9.6 Summary of re-evaluation of eCall impacts, costs and benefits

The table below summarises the estimates of the costs and benefits for eCall in the UK which have been presented in Section 5.2.7. Section 5.3.8 has analysed the benefit cost ratios of the principal factors for four scenarios. One of the scenarios used the values of the benefits and costs shown in this table and estimated that a benefit cost ratio of 0.75 could be achieved by 2020 if all new vehicles were equipped from 2014, with the benefits exceeding the costs under this scenario in 2023.

Table 13: Summary of costs and benefit estimates for eCall in UK

Benefit	Saving	Value per year
Reduction in response time	2 minutes per accident	Results in savings as set out below:
Reduction in journey time delays (full uptake only)	2 minutes per accident	€19.5mn
Reduction in fatalities	1% - i.e. 29/ year	€48m
Reduction in serious injuries	0.5% - i.e. 67/ year	€106m
Improved efficiency of traffic centre staffing*	2 minutes (1 minute in call out and 1 minute in location)	€1.1mn
Improved efficiency of traffic officer service*	2 minutes (1 minute in call out and 1 minute in location)	€2.4mn
Reduction in emissions arising from reduction in congestion*	Less than 0.0002%	
Reduction in fuel consumption arising from reduction in congestion*		
Cost		**Cost**
In-vehicle unit (OEM)	€150 per unit in 2014 €50 per unit in 2020	
In-vehicle unit (aftermarket)	€200 per unit	
In-vehicle unit (nomadic)	€50 per unit	
PSAP1 initial investment	€222,000	
PSAP1 operational cost		€0.11mn per year
Government publicity*	€2.22 per new vehicle per year	€5.76m

* Elements not included in principal factors cost benefit analysis

5.3.9.7 Conclusions from the UK case study

The UK has a well developed and efficient emergency service chain. It is essentially “eCall-ready” and supports a number of private eCall services. The conclusions from the UK case study can be summarised as follows:

5.3.9.8 Impacts

eCall is expected to be beneficial in terms of fatalities saved and injuries rendered less severe because of time saved as a result of increased efficiency of the rescue service chain. However, evidence for time saving, and casualty saving, is scarce.

This study has undertaken a medical examination of 30 specific cases of fatal accidents. Whilst providing a small amount of evidence, and facilitating broader discussions with emergency service personnel, the scale of the work has been insufficient to develop robust conclusions about casualty savings. Further work to refine the methodology, perhaps including a panel of assessors, and extending the study to hundreds of cases, would be worthwhile.

eCall is expected to make a small contribution to reduction of congestion through swifter call-out and management of incidents resulting from vehicle crashes. This study has modelled the situation on UK roads, which are relatively congested in European terms.

In terms of eCall costs, our research has indicated that the additional cost for the PSAPs is small and the costs for Mobile Network Operators are probably modest.

The in-vehicle unit costs are the most significant and sensitive cost factor and, whilst cost figures are commercially sensitive and depend on volume, our best estimate is lower than has been assumed in previous studies. We estimate that the fitted cost to the driver is approximately €150 and will decrease in time.

This study has made a re-assessment of the previous UK report – known as the SBD study. A detailed criticism is included in this report, but the main points are:

> We have taken the approach of supplementing the desk-based SBD study with specific case-based medical material. However, and rather as expected, the scale of the new study has not yielded sufficient data to validate, or otherwise, the overall SBD methodology.
>
> We found the SBD study to have over-estimated eCall time saving and casualty reduction. However, we also found it to have over-estimated equipment cost.
>
> Two areas of benefit that were not included in the SBD study, but worthy of consideration, are inclusion of all road vehicle types (the technology for powered two-wheelers is being developed) and inclusion of the benefits of congestion reduction.

Comparing benefits and costs we find that, whilst no-one denies that eCall is beneficial; the case in social cost-benefit terms still appears weak.

5.3.9.9 Implementation issues

Legal issues do not appear to be a barrier to implementation. Liability and privacy issues are appreciated and are expected to be addressed in service development and be successfully managed. Commercial contractual issues are also expected to be solvable.

There is a general impression of lack of clarity from the EC (perhaps based on dated information?) and some issues to be resolved – e.g. eCall flag and dormant SIMs - but the implementation platform and development of standards is expected to greatly assist.

Some development of the emergency rescue chain is foreseen which would benefit both eCall and non-eCall services. The UK has mobile network coverage gaps which reduces the efficiency of both eCall and mobile 999 calls. Cross Network emergency calling would benefit consumers. More PSAP2 investment in mapping may be needed and the emergency service provision is also expected to develop further.

The business case for eCall as a stand-alone service is weak. There is a strong demand from service providers and MNOs for “bundling” of eCall with other services and for TPS eCall and legacy systems.

In conclusion, the UK is already very well placed in terms of eCall infrastructure and there is cautious private sector enthusiasm for providing eCall as part of a service package.

5.4 References

McLure D and Graham A (2006). eCall – The Case for Deployment in the UK Final Report to Department for Transport.

Ward H, Lyons L, Christie N, Thoreau R and Macey S (2007). Fatal injuries to car occupants: analysis of health and population date. Road Safety Research Report 77. Department for Transport, London.

5.5 NL Approach and Results

5.5.1 Approach and methods used

For the NL situation the proposed steps are executed as follows:

1. Description of the current incident management and the proposed way of implementing eCall in The Netherlands. Previous studies will serve as input for this. This enables a first analysis on where the expected benefits of eCall may be in the emergency chain. The result of this can then be further analysed the following steps.
2. Optimisation of intervention resources / reducing costs in the value chain / added value of eCall to the value chain. This will be done by a workshop with the relevant stakeholders. The group of stakeholders will consist of representatives assigned by the Landelijk Platform Incident Management (National Platform Incident management, a national multi-stakeholder program to address incident management with members from government, road operators, emergency services and national and local police), supplemented by Mobile Network Operator(s). This workshop will have multiple purposes:
    - get a clear view on the (stakeholders point of view on the) responsibilities for each stakeholder
    - discuss and estimate the benefits and costs of eCall for each stakeholder
    - discuss differences between cost and benefits between stakeholders (unbalanced business case)
    - discuss on the potential of eCall in saving time in the emergency call chain (see Figure 10)

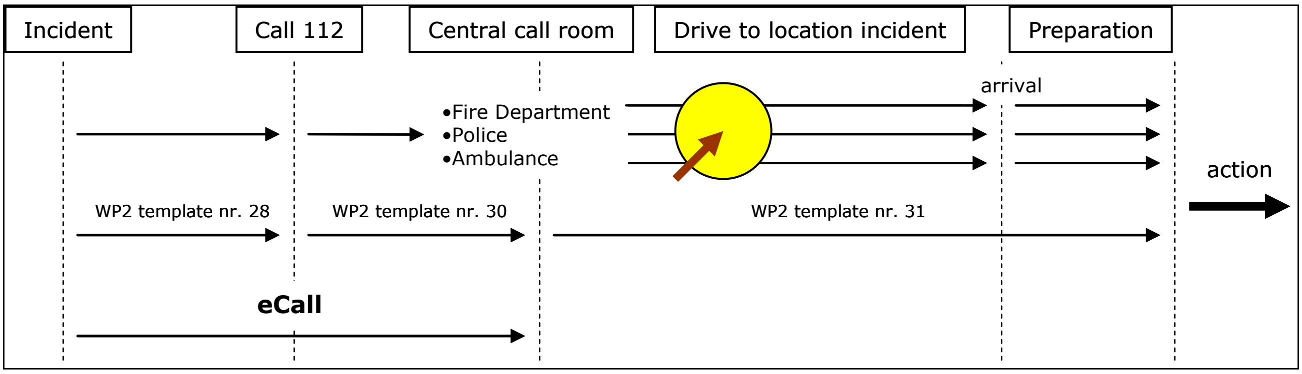


Figure 10: Incident Management & eCall

When indicating the places where eCall may have the potential in saving time, the first part if that of the calling process. eCall may also indirectly save time when looking at the approaching phase of the emergency services. Four potential saving areas come to mind:

- Immediate call to rescue services when the accident happens in a remote area, in darkness and or when it is a single vehicle accident;
- Precise location indication of the incident through eCall;

- eCall can give indication which and how many emergency services are needed at the incident (more effective response)). This is especially beneficial for complex incidents where multiple vehicles are involved;
- Preparation during approach instead of at the scene thanks to precise more information on incident (e.g. car type).

To be able to estimate the total time savings because of these three things, one must know how often these savings occur, and how much time is saved on average.

3. Review and validation of the assessment of the number of fatalities and severely injured avoided over a period of a year. This will be done through contact with the emergency / incident room in the workshop. A determination of call delays before arrival at the emergency room, and that could have been helped by eCall will be made. Refinements of the estimates will be made. The Golden Hour principle could play an important role in this.
4. Determination of the reduction of traffic congestion. This will be done by the TNO Quick Scan model. This model can provide estimates of the reduction in congestion as a result of eCall. This information can be used to determine how many secondary accidents can be avoided.
5. Determination of the reduction of congestion by providing information to drivers via Variable Message signs and via Navigation Systems services (e.g. TomTom)

Using the standard template background information for the analyses was collected from national and international statistics, stakeholders, other studies and specific investigations tailored to the requirements of this study.

5.5.2 The current Emergency service situation in The Netherlands

Introduction

The current incident management procedure in the Netherlands can be described using four phases:

- Initializing- and calling phase
- Approaching phase;
- Handling phase;
- Normalization phase.

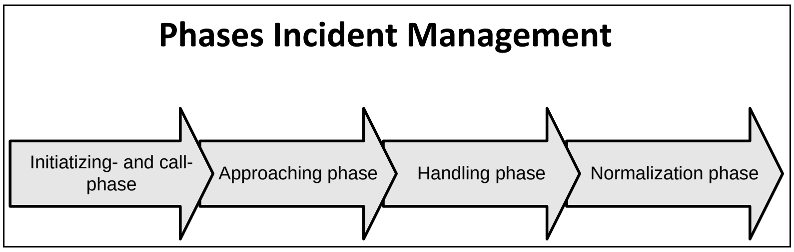


Figure 11: Phases of incident management

Each of these phases is discussed in more detail below.

Initializing- and calling phase

Sources of incident detection

Incidents can be detected and reported by various sources, which determines in what way the further procedures will be:

- Mobile phone calls of the involved or observing road users (via the Dutch emergency number 112) come in at the call room of the Korps Landelijke Politie Dienten (KLPD, police department on country level) and will, after a checklist has been filled in, be shared with the call room of the Regional executing call room.
- Calls coming from surveillance cars of the KLPD come in at the call room of the KLPD.
- Calls coming from surveillance cars of the Regiopolitie come in at the call room of the Regiopolitie and will, after a checklist has been executed, be shared with the call room of the KLPD.
- Other 112 calls come in directly at the Regiopolitie and will after a checklist has been filled in, be shared with the call room of the KLPD.
- Calls coming from road side phones and surveillance cars of the ANWB come in at the call room of the ANWB, which forwards the call to the police.
- Incidents detected by the Rijkswaterstaat (RWS, Dutch road operator) surveillance cars or with help of their Incident Management Detection Systems (i.e. cameras, induction loops). In these cases, the RWS takes action to notify the police as well as the Centraal Meldpunt Incidenten (CMI, Centre Call room for Incidents).

Often a single incident is reported by more than one source, in which case this should be pointed out as soon as possible and the information from the various sources needs to be integrated.

Incident Management report process

Speed and correctness of information are essential within the process of an incoming call. The current procedure can be described by the following diagram:

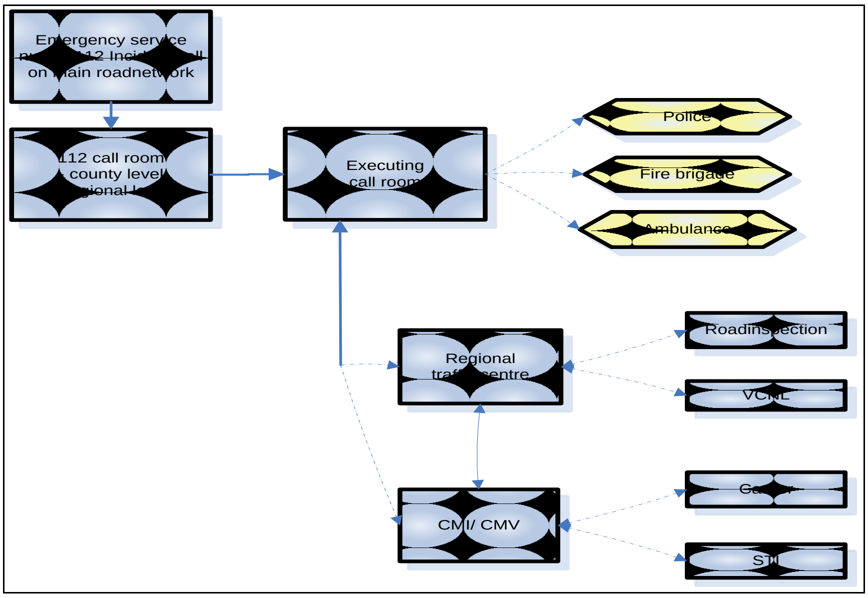


Figure 12: Procedure of incoming emergency call

The calls can come in at the call room of the Korps Landelijke Politie Dienten (KLPD, police department on country level) or at the Regiopolitie (police department on regional level). In some cases calls can also come in directly at the fire department, the Centrale Post Ambulance Dienst (CPA, ambulance centre) or at the ANWB (Dutch Automobile Association). The call rooms try to get as much information as possible from the caller and exchanges this information with call room of the police who will warn the Centraal Meldpunt Incidenten (CMI, Centre Call room for Incidents) of the incident. The call rooms of the police agree upon which department has the closest in range surveillance vehicle. That call room will then automatically become the executing call room being responsible for any further actions.

After this the call room will warn the CMI. The information that is shared between the call rooms of the Regiopolitie and the KLPD make use of a different phone connection (national emergency net). They will look where the closest surveillance vehicle is which is then sent to the incident. The executing call room will also contact the call room of the ANWB in case assistance is needed at the incident.

After the call has been answered, both the KLPD and the Regiopolitie has the same set of information of the incident. That way, the same information is used when both perform their following actions. In each case, the information set should contain these data:

- Location of the incident;
- Number and types of vehicles involved at the incident;
- Any traffic management measures that may be used (shut off roads or lanes);
- The emergency services that have been notified.

Dependent on the nature and type of the incident, the executing call room will inform the following emergency services:

- Ambulance (if needed);
- Fire-brigade (if needed);
- CMI, who will take care of a carrier;
- Surveillance police car, if none are yet at the incident;
- Rijkswaterstaat (RWS, Dutch road operator), if any repair of the infrastructure is needed;
- ANWB.

Approaching phase

Within the involved parties, there are a number of agreements made concerning the travel times of approaching an incident. For instance, the police have to be at the location on the incident within 15 minutes in 70% of the cases. The ambulance and the fire brigade have comparable Service Level Agreements (SLA’s). The RWS, dependant on the traffic situation and the location on the incident, has to have road inspector at the incident location within 15 to 30 minutes in 80% of the cases. The carriers also have their agreement on the service level.

Handling phase

Once arrived at the location of the incident, the priority lies in securing the incident location. Dependent on the severity of the incident the police, ambulance, fire brigade and the road inspector talk over which strategy would suit the situation the best.

Normalization phase

After the handling phase, in most of the cases it takes a while for the traffic to automatically normalize itself. In some of the cases it is needed to actively manage the traffic from the traffic centres. Diverting routes may still be used until the normal traffic situation has been re-established.

3.3.8.1 Rescue operations performance

The main participating authorities in Dutch road accidents rescue operations include emergency response centres (PSAPs), rescue service providers and the police. The emergency service as it is now has been described in the previous section.

In the Netherlands there is total number of 26 PSAPs. One of these PSAPs, situated at the centre of the country, is mainly responsible to the calls coming in from the highway network. The other 25 serve or as secondary PSAPs next to this single one, or as primary calling room for the calls coming from the secondary roads/ urban areas. Each of the 25 regional PSAPs serve on average 680.000 citizens.

Numbers for the average time that an accident occurs and the emergency call is coming are unknown for the Netherlands. The average phone answering times in the first PSAP range from 15-20s according to (Donkers and Scholten, 2008). The same study showed that the average between answering the emergency call and notifying the rescue service and police is about 2 minutes. The time in which an emergency unit is dispatched after the reception of the emergency call at the emergency service ranges from 3 minutes 30 seconds and 4 minutes. The average time between notifying the rescue services and the police and their arriving at the scene (travel time) is estimated at around 8 minutes. Information on how long it takes to clear the accident scene has not been found for the Dutch situation. These numbers have been verified by Jan Malenstein of the KLPD. He was leading the CGALIES Group, the eCall PSAPs Group, which made a thorough analysis of the eCall situation in the NL.

The following table gives an overview of the previous numbers:

Table 14: Estimated times in emergency response chain

Reporting of accident	Answering phone time	Alert time of rescue brigade	Time between incoming call to dispatch moment	Time between incoming call and arriving at the scene	Incident/accident scene clearance time
unknown	*15-20s*	*2m*	*3m30-4m00*	*8m*	*unknown*

If an emergency call came in and the services are notified on the accident, there is no priority of emergency services that is leading. All required emergency services are sent at the same instance. Exceptions are there in situations where safety for the emergency services and surroundings of the incident scene is concerned when for instance flammable substances are involved at an accident. In these cases the safety must first be guaranteed before the emergency services may approach the scene.

The main strategy that is applied by emergency services on the victims of an accident is that of scoop-and-run. The injured are taken to hospitals straight away. Trauma assistant with help of helicopters are applied approximately 300 times a year.

5.5.3 *Optimisation of intervention resources / reducing costs in the value chain / added value of eCall to the value chain*

5.5.3.1 Stakeholder workshop

A stakeholder workshop was organised on the 24th of February 2009 in order to gain insight in the direct effects of eCall on safety (e.g. reduction on fatalities, severity injured), traffic (e.g. reduction of congestion) and other areas. Next to these results, the purpose was to see how the implementation of eCall affects the several stakeholders in terms of efficiency and costs.

The workshop was organised with use of an electronic brainstorm meeting room. Using this system, the participants could enter their reactions anonymously to the questions asked in a computer system. This way, we tried to collect as many information from the participants as possible. All these results could afterwards be easily printed out and re-grouped per stakeholder and per category for interpretation.

Stakeholders were chosen such that each relevant stakeholder position (see Figure 13) in the eCall/emergency service chain could be fulfilled. The figure shows how eCall will be implemented in the Dutch emergency chain according to (van Hattum, 2008).

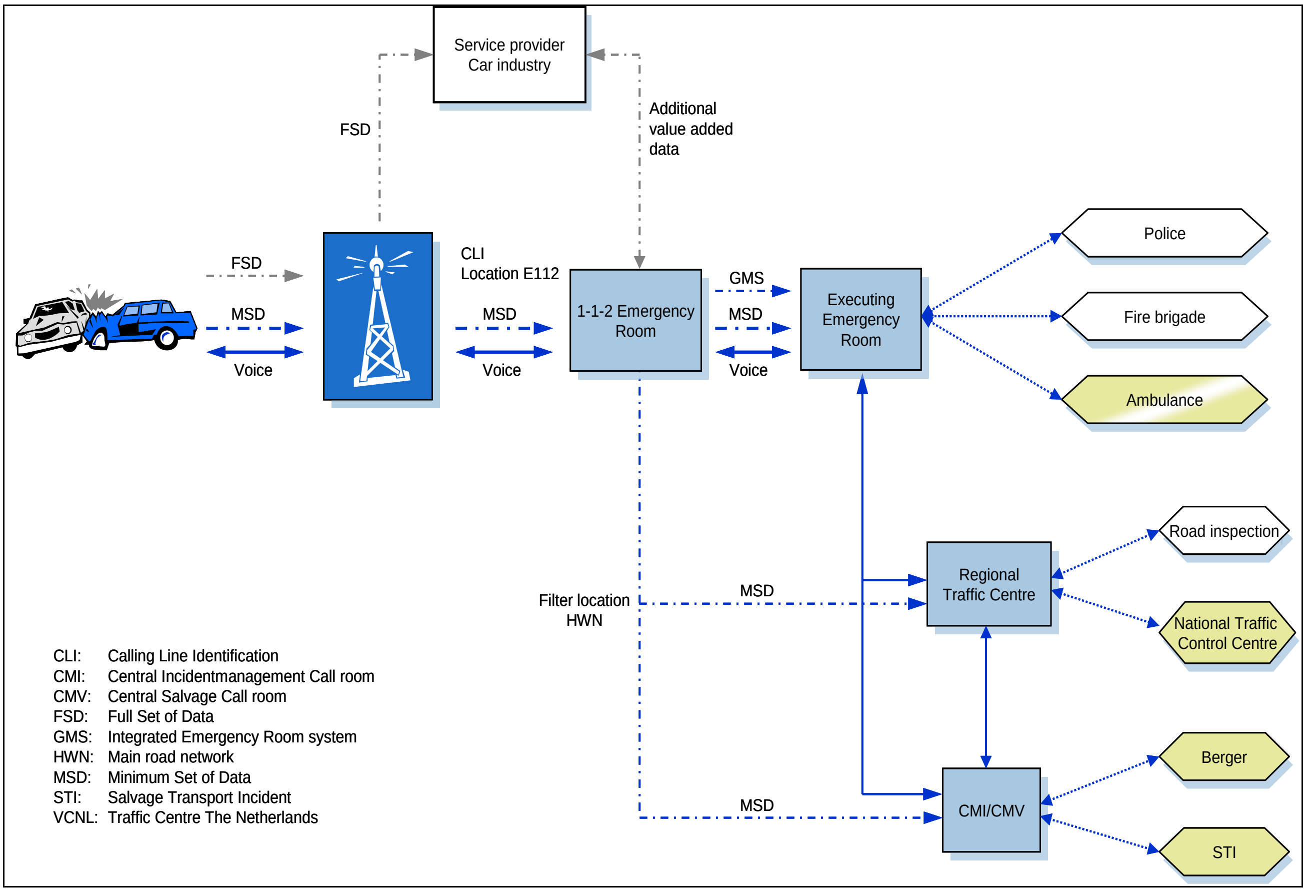


Figure 13: Overview of eCall implementation

These stakeholders attending the workshop were the following:

Table 15: Participants of Dutch stakeholder workshop

Name	Organisation/ function
A. de Rond	Hulpverleningsregio Haaglanden: leading the department "Brandweerzorg en Crisisbeheersing" (Fire brigade and crisis control)
E. de Brouwe	Rijkswaterstaat (Dutch road operator) / VCNL (National Traffic Control Centre): operator
I. Huffener	VBS-berging (carrier organisation)
J. Fleuren	KPN (mobile operator): innovation manager
M. Melters	T-Mobile (manager Technology Strategy & Innovation)
R. van Veen	KLPD (Police department:): domain manager responsible for the translation of information requests to information delivery within the Dutch Police department
W. Weijnschenk	KLPD (Police department:): program manager Intake, Emergency calls en Emergency room domain
D. Bruintjes	Salvage Transport Incident
A. Fuchs	Europ Assistance
K. Folker	Europ Assistance

Conclusions workshop

Main conclusions:

The workshop delivered some interesting discussions on some expected as well as on some unexpected effects of implementing eCall. The most important and relevant outcomes are listed below. There were two remarks to be made with regards to the workshop. A number of participants was not able to join the workshop which led to some stakeholder positions being unoccupied. Thus for these gaps, we did not get any straight feedback from any stakeholders. The necessary input for these gaps were collected afterwards through consultation with various involved persons (trauma doctors for input from the medical areas, Jan Malenstein from KLPD for verification on the found numbers).

The second concern was the fact that the results coming from the workshop were mainly qualitative outcomes. None of the participating stakeholders was able give new quantitative numbers.

Some interesting findings did surface during the workshop and are stated below. Thereafter more specific qualitative results per stakeholder are mentioned.

- eCall implementation in The Netherlands appeared to be unclear for various stakeholders

For some of the attendees it was still unclear how eCall will be implemented in the Netherlands. For some it was still not clear what the responsibilities will be for each stakeholder. Improvement in the eCall project communication could solve this problem.

- Costs and benefits are hard to estimate

It is difficult to estimate where the costs and benefits depend on. For this, it first needs to be clear how eCall is going to be implemented in the Dutch emergency chain. What will for instance be the responsibility of the PSAPs? And how automated will the implementation of eCall be?

- Good agreements needed with mobile operators

The costs for the mobile operators mainly depends on the way that eCall is implemented into vehicles (with or without *SIM*-cards). Good agreements need to be made with respect to the information that need to be carried over from the vehicles *SIM*-card.

- FSD is much more interesting than MSD

The Full Set of Data (FSD), including the Vehicle Identification Number (VIN), is very interesting for certain parties (more than the MSD), because with it more usable information is collected of the incident (e.g. sensor-information of the vehicle). With sensor-data one can conclude more on the kind of accident that had happened (causes?), and emergency services can be sent more efficiently.

- eCall saves time but does it also give enough information?

It is clear that eCall will save time in the emergency chain (e.g. direct call to call room, more precise location indication). How much time it will save, is still unclear. The attendees said at least 2 minutes in time saving of incident reporting. Knowing the exact location also saves time in driving to it.

Question is though whether the type of incident is also known with eCall. This information helps on activating the right emergency services. Thus more information is needed on the accident. The voice channel may help in this. But without it, it would be helpful if a FSD is used in the whole process.

- Decrease of people driving away after accidents

Positive side-effect of eCall: Since it is known which vehicles (and thus owners) are involved at an accident, one may expect that chances will decrease of people driving away after having an accident.

- False alarms

False eCall are considered a serious problem by the various stakeholders. Already now, 60% of all 112 calls are false. A comparison was made with the automatic fire emergency call system. They had report of 95% false alarms.

Note: Currently operational eCall or eCall-like systems such as OnStar, PSA, Volvo OnCall show statistics on the number of false alarms being very low. eCall, which like these systems is based on a very robust design, should show comparable low numbers.

5.5.3.2 Other impacts, e.g. impact on the rescue operations, processes, and organisations

The organized workshop with the different stakeholders represented has been the main instrument for collecting information on the impact that eCall has on for instance turnover due to new business operations and improved efficiency. Although the desired quantitative results on these topics were not acquired in the workshop, the participants did have their views on how eCall could affect their business and the overall emergency chain. In the following the most relevant results are stated by stakeholder:

Police:

- The police mentioned as an additional benefit of eCall the fact that the number people driving away from an accident location could be reduced since eCall could help notice these persons, and they could be tracked down later on.
- The police did not expect to need more personnel with the implementation of eCall
- They do foresee increasing capacity when a large amount of false alarms are expected.
- They do not foresee any significant material costs arising with eCall implemented, except for maybe ICT related investments.

Fire department:

- Benefits of eCall for them result from the extra information on for instance the vehicle type and exact location of the incident that comes from eCall.
- They expected to need more personnel with the implementation of eCall with the perception that eCall would increase the numbers of (false) incoming emergency calls.
- Other costs would consist of an extra call handling unit, and those of installing a new working desk.

VCNL (Traffic centre on National level):

- Traffic could maybe be notified quicker with information on congestion due to incidents.
- Less contact is needed with the regional traffic centres, which is beneficial for the work process.
- The same personnel can be used when eCall is implemented when looking at the Incident Management road network (highways and main secondary roads). Outside of this area new personnel may be required and trained.
- They expect that eCall will bring additional material costs such as new required servers, monitors and costs for receiving the eCall data.

Carriers:

- Incident location is now known immediately and is more precise which may lead to a reduction in the approaching phase.
- Less secondary accidents are expected due to quicker incident management.
- The incident type is now known immediately
- Accidents with trucks can be identified immediately, which leads to more focused response. If the system is combined with information on the load, this will improve even more.
- Additional material costs are not expected due to the already sufficient carrier fleet.
- More costs are expected with regards to communication and petrol.

Salvage Transport Incident:

- eCall will not have an effect on the number of personnel.
- Additional costs will be those of ICT system for handling the eCall data.
- Improvement in incident location approach time. They expect time savings up to 10-20 minutes.

PSAP (executing role):

- eCall leads to quicker and more precise incident location identification.
- Material costs can arise when integrated systems are needed such as software and hardware adjustments.
- Not known yet if more personnel is needed.
- Personnel may need to be trained.

Mobile operators:

- Investments in new material and personnel are not expected.
- Potential failure/breakdown can lead up to problems.

Europe Assistance:

- Extra personnel is not expected. Maybe even fewer personnel due to direct automatic registration of data.
- Benefits may arise in back office as well as in front office.
- No extra material costs are expected.

5.5.4 Safety assessment

Current situation

In 2007 there were 791 road fatalities report in the Netherlands. This was a decline of 2.5% compared to the year before. In the same year the number of severe injured because of road accidents was 8559. And the number of slight injured people was reported to be 16591. The actual number for this last statistic is expected to be quite higher due to unregistered slight injuries.

The percentage of single vehicle accidents not involving pedestrians was estimated at 46%, in the year 2007. The percentage of road fatalities in single vehicle accidents not involving pedestrians is not known. In 2007 59.9% of the fatal accidents occurred outside urban areas. 31.8% of the fatal accidents occurred in the dark.

Motorcycles

Furthermore was it known that in 10% of all fatal accidents a motorcycle was involved. In 2007 there were 64 fatalities under motorcycles counted. The accident risk for motorcyclists, expressed in the number of fatalities per driven kilometre, is significantly higher than for car drivers. In 2006 this was calculated to be 25 times higher. The number of injured per driven kilometre was estimated to be 20 times higher than with cars. This vulnerability is also found in the causes of death: in 66% of the fatality cases the motorcyclist died because of a head injury.

It is also known that 40% of the accidents where a motorcyclist is killed is a single vehicle accident. By also installing the eCall system on motorcycles, it may be assumed that the system could provide a significant benefit in these cases.

Effect of eCall on road fatalities

The Dutch study (Donkers and Scholten, 2008) from the Road Transport Authorities on the effects on eCall already delivered results estimations on the reduction of eCall on fatalities and the severity on the injured of accidents. Based on numbers concerning the cause of death of the fatalities because of accidents, an estimation was given on how many of those fatalities could have been benefited from the system eCall (50%). These indicated that eCall could save the lives of 5-15 people from all road fatalities each year. This is equal to a reduction of 1-2% of all fatalities.

In this eCall project an additional investigation was planned to verify these numbers and those for the injured people. Initially the idea was to see what the cause of dying was of each fatality, and with help of the so-called Golden Hour principle (see Figure 14) the reduction with help of eCall could be estimated. The Golden Hour rule describes the death rates of injured people with respect to different causes over time. Unfortunately the required data could not be collected anywhere. Apart from this, a good foundation of the Golden Hour principle could not be found either. Therefore we stated the results from the Dutch Road Authorities study as our best estimate.

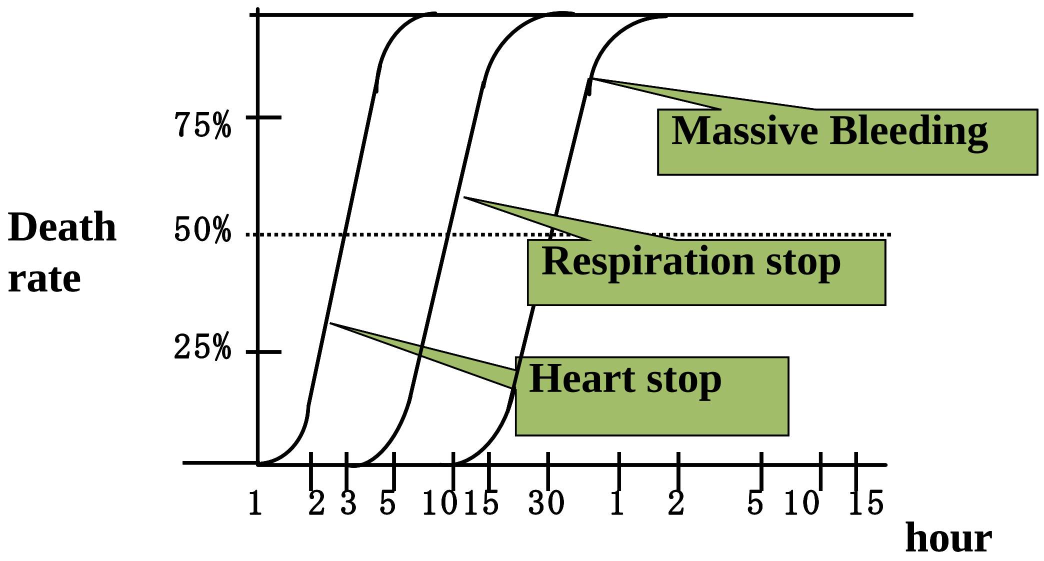


Figure 14: The Golden Hour principle

Several doctors in the trauma service with expertise in this area were consulted for their opinion on what the time savings of eCall could mean for the number of fatalities:

- Prof. dr. H. J. ten Duis, professor traumatology, Trauma Surgery Trainer, Reviewer journal: Injury, Reviewer journal: Orthopädie und Unfallchirurgie, CBO-richtlijnencommissie, Member wetenschappelijke adviesraad Nationale traumaregistratie WAR, Member Kunstcommissie UMCG, Member Hoogleraren in de Traumatologie (HIT), Chairman Wetenschapsraad Nederlandse Vereniging voor Traumatologie, Corresponding Member Deutsche Gesellshaft für Unfallchirurgie
- Prof. dr. L. P. Leenen, traumatologist medical department university of Utrecht

- Drs. A. Jansen, anestetioloog, chief medical officer FIM, MMT Twente and member of council for ICT innovation in medical healthcare

Professor Ten Duis was most explicit in his statement about the marginal improvement what can be expected of 2 minutes earlier arrival of the ambulance in most of the accidents. When looking at the Golden Hour curves a slight improvement could be made on less chance on mortality when victims suffer from massive bleeding when the arriving time of the ambulance is brought back from 15 to 13 minutes. In the same time more victims are brought in with a respiration stop and a change on mortality of 80-95%. Brought into the hospital or starting medical care gives only a very small change on surviving but a big chance (still) on mortality or life time effects of the trauma. Several international sources ((Auerbach, 2006), (WHO, 1981)) call the effect not calculable for this reason.

It was also mentioned that in a country like the Netherlands, where the amount of roads along waterways are significant, a added service for the eCall system would be an automatic detection of a vehicle being in water. As of now, eCall is initiated only by the activation of the airbags. In 2007 there were counted 36 fatalities because of cars driving into the various waterways types of which it is estimated that half of them died because of drowning. Moreover was it known that in 70% of the accidents involving a car ending up in a waterway, the accident was single sided. The eCall system could make a difference here if the system would also be activated when a vehicle ends up in the water.

Effect of eCall on injured

In the same Dutch study (Donkers and Scholten, 2008) they did an estimation on which part of all injured people from road accidents could have benefit from the eCall system in that emergency response would be quicker compared to the current situation. It was stated that about 150 injured people each year could benefit from the system. This equals to 1% of the total number of (registered) injured people.

5.5.5 Determination of the reduction of traffic congestion

The estimation of eCall of congestion has been executed with help of the TNO developed Quick Scan model (Schrijver, 2006). The Quick Scan model has been developed in order to estimate the total congestion costs caused by incidents. It is especially helpful in estimating the effect of incident management strategies such as eCall.

The model is based on a queuing model that calculates what the effects are of a reduction of capacity because of an occurring incident. If the intensity of traffic exceeds a certain reached capacity on a link, a queue will appear. The length of the queue depends on the reduction of the capacity as well on how long it takes to clear the incident area. And once the incident area has been cleared, it still takes a while for the traffic to reach his normal state. This total time and the length of the queue are used to estimate the total delay in travel time.

The intensity data for the reference scenario in the Quick Scan model come from previously done traffic assignments. First is calculated what the effect would be of one incident for each link independently. Based on the probability of an incident for this link, the expected delay in travel time is estimated. This process is repeated for each link in the network, for all periods, all vehicle types and all selected scenarios.

A number of choices can be made for the variables period, vehicle type and scenario (reference, with eCall etc.). For the periods, one may choose between only a certain peak period, outside peak periods or for a whole day. The results are then up scaled to yearly results. Two vehicle types have been considered: “normal car” en “truck”. These types differ from each other in that incident management differs among them.

Next to the choices made earlier, a number of incident data are needed. Three types of incident are defined:

- Breakdown of a vehicle
- Accidents that block only the emergency lane
- Accidents that block one or more road lanes

For these three types of incidents, the probability of them occurring for a vehicle on a driven kilometre needs to be defined. These probabilities are defined for peak hours as well as for off-peak hours. The calculation of these probabilities in short comes down by looking at the total numbers of incidents occurring each year, splitting them over the three types of incidents and dividing them over the total length of the highway network.

The choices made, the network data and the incident data together form the input for the calculation of the total delay in travel time. Figure 15 below shows how these calculations are done.

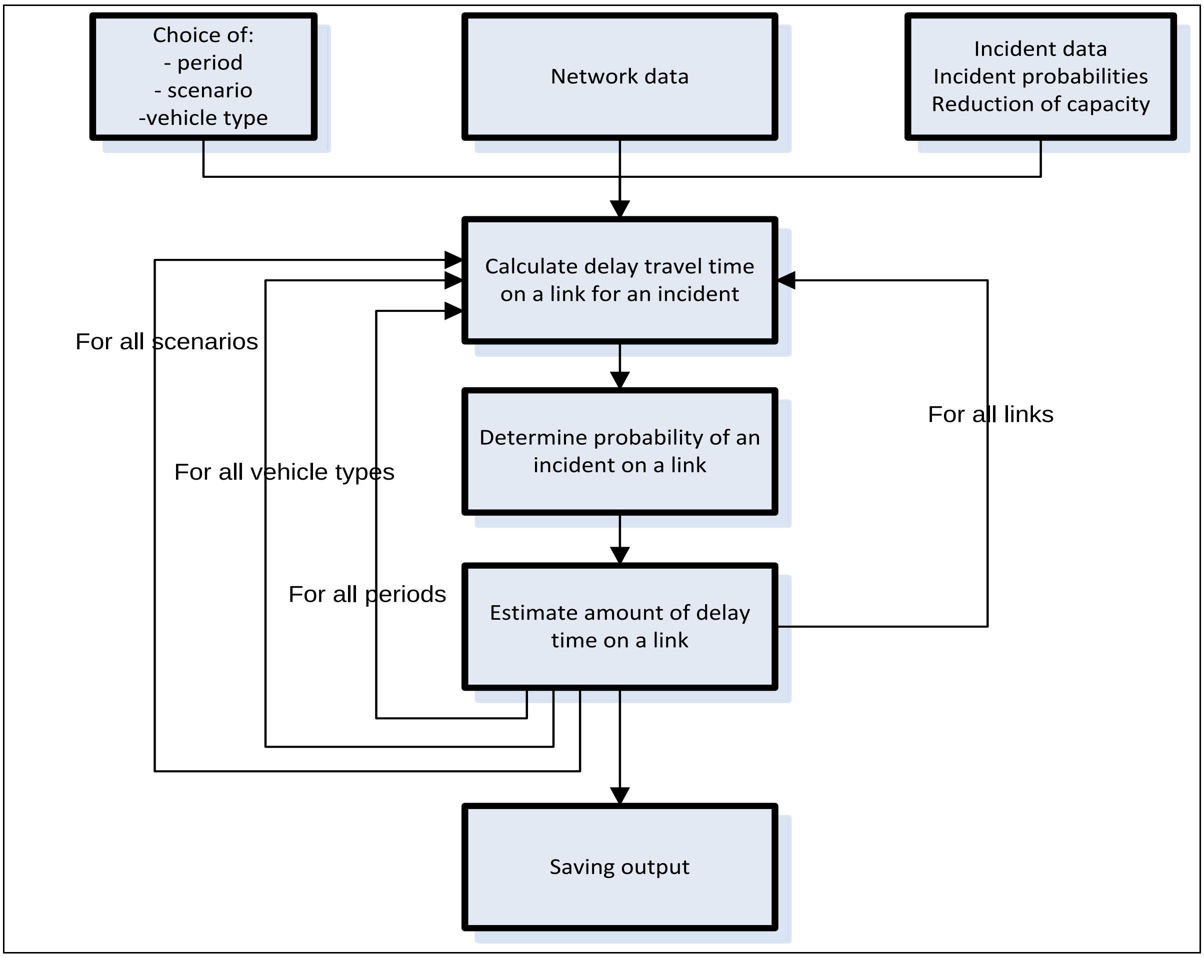


Figure 15 : Calculations in the quickscan model

First the delay time of one link is calculated if an incident occurs. Next, the expected number of incidents for an average peak and off-peak hour is estimated by multiplying the probability of an incident times the number of vehicle kilometres. The expected total amount of delay in travel time is the product of the expected number of incidents times the expected delay time caused by one incident. This is then applied for all three types of incidents.

The delay in travel time is corrected by the delay time in normal circumstances. All these calculations are done for each period, each vehicle type and each selected scenario.

The calculation of the delay in travel time on one link because of one incident is done using a queuing model. An incident can be divided into four phases in which the remaining capacity of the road can differ:

- Calling phase: Directly following an incident, this phase ends until the moment the emergency services are sent to the incident location.
- Approaching phase: This is the time needed to arrive at the incident location.
- Handling phase: The time needed to handle the incident.
- Normalisation phase: The time needed for the traffic situation to return to normal.

For each of these phases the length of the interval and the reduction in capacity are determined.

For the application of the model on eCall we have identified two time savings because of the system:

- Calling phase: average time saving of 2 minutes mainly due to the immediate emergency call (Schrijver, 2008);
- Approaching phase: average time saving of 1 minutes due to the exact known location of the incident (Donkers and Scholten, 2008)

These reductions were put into the model. For the actual model runs, the year 2010 was used. Two scenarios were run, one reference and one run with the eCall (simulated through the time reductions).

Outcomes of the Quick Scan model

The results of the model runs of the two mentioned scenarios are displayed in the following table:

Table 16: Outcomes of Quick Scan model

Scenario	Total delay hours due to congestion (in millions)	Total delay hours due to congestion caused by incidents (in millions)	Percentage congestion due to incidents
Reference	100	20.6	20.6%
With eCall	96.5	17.1	17.7%

Thus eCall gives a reduction in the total delay of 3.5 million hours. This is equal to a reduction of 16.9% of the total delay hours of congestion caused by incidents, and to 3.5% of the total delay hours of congestion overall.

This means that with the estimated time savings of 3 minutes thanks to eCall, a significant reduction can be expected in the delay hours due to congestion.

Secondary incidents

The previous results showed a significant reduction of the congestion with the implementation of eCall. By saving time in the calling phase and the approaching phase, the Quick Scan model showed a reduction of the total amount of congestion hours of 3.5% thanks to eCall. By quickening the incident management, an indirect effect may also be expected: a potential reduction of secondary incidents. During the workshop a couple of stakeholders did also mention this potential. However, they were not able to quantify this benefit.

The Dutch road authorities also did not have numbers on the total amount of secondary accidents occurring on the Dutch highways. The effect of eCall on secondary accidents could therefore not be estimated, but is expected to be significantly positive.

5.5.6 Effect on congestion by providing information to drivers via Variable Message signs and via Navigation Systems services

eCall is expected to lead to a quicker incident management by saving an average time of 3 minutes during the calling phase and approach phase. A part of this is saved in the first phase of incident management: the calling phase. This could have a positive effect on the speed of bringing traffic information concerning incidents and detours to the road users.

However this effect is estimated to be negligible. Reason for this is that the traffic information service on highways is already at a very high level in the Netherlands. More than half of the highway road network is already monitored, of which a significant part is monitored with cameras. This enables the traffic centres to identify incidents quickly, and use this for their traffic information services via for instance Variable Message Signs (VMS), or navigation systems (e.g. TomTom). On certain road parts the detection loops are even automatically connected to the available VMS. Therefore when for instance slow traffic is detected, the VMS will automatically be activated because of this.

VMS are already installed numerously on a large part of the Dutch road network. Navigation systems with real time traffic information are finding their ways into vehicles at a very fast rate. Service providers like TomTom already provide continuous online information of the traffic situation. Up to date traffic information is also being brought via radio broadcast twice an hour.

Thus not only are incidents already detected very quickly by the traffic centres because of the high level of monitoring on the Dutch highway network, the traffic information is also spread out to the road users by use of VMS, navigation systems and radio broadcast in a very efficient manner. Therefore it is not expected that, on the main highway network, eCall will reduce congestion indirectly by quickening the incident detection.

5.5.7 References

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5.6 Finland Approach and Results

5.6.1 Approach and methods used

The Finnish study (Virtanen 2005, Virtanen et al. 2006) provided reliable information on the potential of eCall to reduce fatalities, but was quite limited on the other aspects of socioeconomic assessment. The study now concentrated on the following aspects:

1. Impact on incident management (clearance, traffic management, information) and thereby on congestion and secondary accidents
2. Impact on the rescue operations, processes and organisations, taking into account all stakeholders involved in the value chain
3. Impact on injury reduction
4. Other socio-economic impacts of eCall

The reduction in congestion and in secondary accidents was estimated using expert judgments, combined with country-specific data. A stakeholder workshop was arranged in order to fill in gaps in the information and get information about impacts of eCall on the rescue operations and processes as well as other socio-economic impacts of eCall. The potential of eCall to reduce injuries was estimated based on available data on severe injuries in Finland. The experiences obtained from the earlier fatality reduction estimation study (Virtanen 2005) were used as background information. Virtanen (2005) estimated the potential of eCall to reduce fatalities based on the detailed data set of the in-depth accident investigation teams, which routinely analyse all accidents resulting in fatality and also a sample of other road accidents. The estimate was based on the expert judgment of a medical doctor, who is a specialist in road accident trauma.

Using the standard template, background information for the analyses was collected from national and international statistics, stakeholders, other studies and specific investigations tailored to the requirements of this study.

5.6.2 Results

Stakeholder workshop

Stakeholder workshop was organised in 13.3.2009 in order to estimate the gains achievable by reduction of the arrival time of emergency services to the accident scene, as well as the indirect benefits of availability of accident-related data to the police and traffic management centres. The discussions in the workshop contributed to all areas of the analysis and the outcomes are included within the relevant sections presenting the results.

Stakeholder involved in the workshop:

Name	Organisation/ function
Jukka Aaltonen	Emergency Response Centre Administration
Antti Kalliokoski	Police Department of the Ministry of the Interior
Pasi Vastamäki	Emergency response centre of East and Central Uusimaa
Antti Jeronen	Police
Tapio Kaikkonen	Internal Security ICT Agency HALTIK
Jouko Pesonen	Police College of Finland
Kari Junttila	Emergency Services College
Kimmo Tuominen	Helsinki City Rescue Department
Heikki Suomalainen	Päijät-Häme Department of Rescue Services
Ossi Kortiainen	Finnish Road Administration’s Traffic Management Centre
Juha Alikoivisto	Finnish Road Administration’s Traffic Management Centre
Anu Laurell	Ministry of Transport and Communications

Rescue operations performance

The main participating authorities in Finnish road accidents rescue operations include emergency response centres (PSAPs), rescue service providers and police. In addition, private towing service providers are involved in the rescue operation, as well as the Road Administration’s Traffic Management Centre, which collects and conveys information via media to other drivers.

There are fifteen 1st level Emergency Response Centres in Finland. There are no 2nd level PSAPs, but there are few command and control rooms in Police forces (9) and in Fire Brigades (22). The smallest Emergency Response Centre in Finland serves about 150 000 people and the biggest one serves about 550 000 people. Rest of the ERCs are somewhere between. The number of PSAPs will probably decrease in future from 15 to 4–6. This reform proposal is part of the data system improvement, which will be finished by 2015.

Requirement is that over 90% of the emergency calls are answered within 10 seconds and that units will be dispatched within 90 seconds. The percentage of "false" emergency calls received yearly is 22%.

In the answers of the questionnaire sent during this study to the Finnish Emergency Response Centre Administration, it was estimated that the average time occurred between a traffic accident and the emergency call reporting the accident is 1–5 minutes. It was also estimated that sometimes there are notification delays that have materially affected the medical outcomes.

In earlier Finnish eCall study (Virtanen 2005, Virtanen et al. 2006) the time delay between the accident occurrence and notification of the emergency response centre was estimated from information in the phone log of the emergency response centres and from the information provided by the road accident investigation teams. This study showed that more than 80% of the emergency calls were made within 5 minutes of the accident occurrence (Table 17). However, in 13% of cases the emergency call had been made 5–30 minutes after the accident occurrence, and in roughly 3% of cases more than 30 minutes after the accident occurrence. Long delays seem especially typical of accidents involving occupant fatalities in motor vehicles not designed for eCall, with a high proportion of single-vehicle accidents and animal collisions. The delays were shortest in the accidents between unprotected road user and motor vehicle because usually in these cases the driver of the vehicle did not have any serious injuries and was able to call help immediately after the accident. Longer notification delays occurred more frequently on less trafficked roads, at night time and in single-vehicle accidents, followed by accidents with animals.

Table 17: The estimated emergency call delays in fatal accidents involving motor vehicles in Finland in 2001-2003 (Virtanen 2005, Virtanen et al. 2006)

Emergency call delay	Accidents involving motor vehicle occupant fatality, (N)		Accidents involving unprotected road user fatality, (N)		Overall, (997)
	eCall designed for vehicle (725)	eCall not designed for vehicle (24)	Motor vehicle involved (221)	No motor vehicle involved (27)	
Less than 5 minutes	79,8%	70,8%	97,3%	77,2%	83,4%
5 to 30 minutes	17,0%	4,2%	1,8%	11,7%	13,2%
More than 30 minutes	3,2%	25,0%	0,9%	11,1%	3,4%
Total	100,0%	100,0%	100,0%	100,0%	100,0%

The average time for the PSAP operator in Finland to answer the emergency call is less than 10 seconds. If the caller cannot identify his or her location, the emergency centres currently receive an approximate location of the cellular phone on the basis of the closest tower. Because the accuracy of the location information depends on the density of the towers, the location information ranges from tens of metres in urban areas to kilometres in sparsely populated rural areas.

When operator of the emergency response centre answers the call, he or she first assesses the urgency of the case. If the call is assumed to concern a major accident or people are injured, the rescue operation is launched. The operator aims to identify the location of the accident and the number of injured persons. Secondly, on the basis of the received accident information, the required number and quality of rescue units are sent to the site. The first rescue unit is usually alerted within 30–180 s of the start of the emergency call. The average time an emergency unit is dispatched after the reception of the emergency call is 1–3 minutes. The rescue units are expected to leave within 1 minute of being alerted.

The average time between the dispatching of the emergency unit and the arrival of the emergency rescue at the accident scene is 5–10 minutes. Finnish Emergency Response Centre Administration estimated that quite often time is lost locating the actual crash scene, but the typical range of this additional search time is usually less than 5 minutes.

In Virtanen 2005 study majority of the respondents (63% of 181 respondents from Finnish emergency response centres) estimated that there are only seldom delays in the arrival of rescue units at the accident scene because of insufficient or incorrect location information. 30% of respondents estimated that there are sometimes delays. However, it is worth noting that the questions in this survey concerned all types of severe road accidents, because operators could not know at the time of the emergency call whether the accident resulted in fatalities.

In Finland, fire brigades take care of the car accident clearance very often, especially in small accidents. If any special clearance unit is needed the average time to get incident clearance at scene will be more than 30 minutes. The average time to clear the scene after incident clearance has arrived such that traffic can flow again is 30–60 minutes depending on the size of the accident.

In Finland operator of the Emergency Response Center dispatches all rescue units together in the same time (ambulances, police units and Fire and Rescue units), so there is no order “who must go first” to the scene. All units are needed and they work together at the accident place. The order of arrival to the accident scene depends mostly on travel time (who has longest driving distance from post place to the site).

In most cases rescue units apply the method “stay and play”, where the patients are first taken care of at the scene of the accident and then taken to the hospital. In the big accidents there is of course also lot of combination depending on assessment.

Safety: Fatalities

The Finnish study (Virtanen 2005, Virtanen et al., 2006) provided reliable information on the potential of eCall to reduce fatalities and there was no need for new analyses in this area.

In Virtanen (2005) study the estimated number of fatalities that could be avoided using the eCall system was based on case reports made by road accident investigation teams in 2001–2003. The data included 1 080 fatal road accidents, involving 1 192 fatalities, of which 919 were motor-vehicle occupants and 261 were unprotected road users.

Case reports made by road accident investigation teams were examined specifically focusing on the injury reports, estimated emergency call delays and the possibility of rapid medical treatment such as first aid. The in-depth analyses were carried out by a research team involving two medical doctors, who are specialists in traffic accident traumatology. In the study it was assumed that eCall would have been installed in each vehicle involved in these accidents, except for bicycles, trams and trains.

Overall, the main results showed that eCall could very probably have prevented 3.6% of the road fatalities. However, there were substantial differences by accident type. The system would have been most effective in accidents involving vehicles for which eCall is not designed (i.e. motorcycles, mopeds etc.), followed by accidents involving vehicles for which eCall is designed (i.e. cars, vans, lorries and buses). The very probable effect of eCall could not be authenticated for any fatality resulting from the accidents involving unprotected road users. The proportion of single-vehicle accidents was high among accidents involving vehicles for which the system is not designed.

In addition to the very probable effect of eCall, it was ascertained that there were cases where the system might possibly have prevented the fatality. This proportion was approximately 5% for motor-vehicle occupants and 1% for unprotected road users, which means that the upper limit of the estimate would be roughly 8% (3.6%+[(882+37)*5% + (233+28)*1%]/1,180 = 7.7%). Consequently, these findings suggest that eCall could have prevented approximately 4–8% of the road fatalities that occurred in Finland during 2001–2003.

Exact location information produced by eCall might have extra impact on fatality prevention. Often time is lost searching the actual crash scene. The typical range of this additional search time was estimated by Finnish Emergency Response Centre Administration to be usually less than 5 minutes. In some occasional cases, the lost time while searching the crash scene could be critical to the outcome of the injuries. However, the amount of these cases was estimated to be insignificant. Hence, the effect on fatalities can be assumed to be included in the above mentioned range of 4–8%.

Safety: Injuries

Virtanen (2005) did not examine the impacts of eCall on the severity of the persons' injuries. It can, however, be assumed that the implementation of the eCall system would alleviate also the severity of the injuries

In Finland, information about severe injuries is very limited. Finnish statistics on road traffic accidents are among the very few sets of European statistics on road accidents in which injuries are not classified by their severity.

The data used in this analyses contained information of 657 seriously injured persons, who had claimed compensation for their bodily injuries from The Finnish Motor Insurers' Centre during 15.8.2001–15.8.2002. The accidents had happened in years 1970–2002. The Finnish Motor Insurers' Centre is a cooperation body of Finnish motor insurers and it handles all traffic and vehicle insurance claims. The data used in this study included information about conditions during the accident, vehicle type, accident type and type and mechanism of the injuries. The available data included no information about emergency call delays.

Data included (N=657)

- Drivers and passengers of automobiles, 54%
- Drivers and passengers of motorcycles, 9%
- Other (mostly unprotected road users), 37%

The analysis was focused on drivers and passengers of motor vehicles and motorcycles as based on earlier analyses for fatalities it was expected that eCall would have very little effect on injuries resulting from the accidents involving unprotected road users.

The main area of injuries of drivers and passengers of automobiles was the following:

- Head and neck, 15%
- Face, 9%
- Chest, 11%
- Abdomen, 5%
- Spine, 11%
- Upper Extremity, 15%
- Lower Extremity, 31%

Injuries of drivers and passengers of motorcycles were distributed as follows:

- Head and neck, 11%
- Face, 7%
- Chest, 8%
- Abdomen, 5%
- Spine, 13%
- Upper Extremity , 16%
- Lower Extremity, 39%

It was estimated that eCall could have biggest injury severity reduction effect on head, chest, abdomen and spine injuries which represent 42%/37% of all injuries. Of these it was estimated that eCall could have effect only on patients with MAIS (Maximum Abbreviated Injury Scale Score) 4 or 5 (32% of all patients) as it was assumed that eCall would not affect slight injuries. As the proportion of the AIS 4 and 5 injuries was highest among head, chest, abdomen and spine injuries it was assumed based on doctors that the target group could be 40-60% of these injuries (42%*40%=16.8% to 42%*60%=25.2% / 37%*40%=14.8% to 37%*60%=22.2%). This estimation took into account that reduction in response time has no significant impact on the outcome of some injuries (e.g. delay in medical treatment is not so critical in a case of broken leg).

Based on experiences from fatality estimations it was assumed that eCall would have bigger effect on motorcycle accidents as the delays are usually longer in these cases. It was estimated that 10% of above mentioned severe injured drivers and passengers of automobiles would convert into slight injured. For drivers and passengers of motorcycles this was estimated to be 30%. (16.8%*10%=1.7% to 25.2%*10%=2.5% / 14.8%*30%=4.4% to 22.2%*30%=6.7%). This estimation took into account the fact that only in some cases there is has been delay between accident and emergency call or the arrival of rescue services has been delayed.

The percentage of cases where the severe injuries would convert into slight injured is therefore: 54%*1.7% + 9%*4.4% + 37%*0% = 1.3% to 54%*2.5% + 9%*6.7% + 37%*0% = 2.0%.

Safety: Secondary accidents - Effect of eCall on secondary accidents

Based on the Finnish crash figures, 2% of injury crashes and 3% of fatal crashes on rural roads included static obstacles struck by vehicles. These figures are probably lower than in EU25, where these percentages could be 3% for injury crashes and 4.5% for fatal crashes. We estimated that 1/3 of these crashes are secondary crashes both in Finland and EU. On motorways in general, the proportions of secondary crashes are much higher. Based on U.S. literature (Birriel 2007, Hoffman 2002, Truckflix 2006, Warren 2006), it is reasonable to assume that 25% of all crashes on motorways in EU25 including Finland are secondary. (Kulmala et al. 2008.)

Based on Schirokoff 2003 it was estimated that average duration of incidents in Finland is circa 60 minutes. With eCall the reduction in emergency call delay is estimated by emergency centre experts and Virtanen (2005) to be circa 3 minutes. It was estimated that a similar gain can be made in time of reaching the incident site due to more accurate positioning of the incident. Thereby the total gain in duration of incidents can be estimated to be 6 minutes, which corresponds to 10% of the average incident duration.

The combination of the % changes above indicate a crash risk change of 0.07% (2%*33%*10%) for injury crashes and 0.1% (3%*33%*10%) for fatal crashes on other roads than motorways. On motorways, the reduction for injury and fatality crashes is 2.5% (25%*10%). In Finland 2% of both injuries and fatalities occur on motorways. Hence, the average effect of eCall on secondary accidents is estimated to be 0.12% (98%*0.07%+2%*2.5%) for injury crashes and 0.15% (98%*0.1%+2%*2.5%) for fatal crashes.

Congestion – Effects of eCall on vehicle hours spent in congestion

In Finland, there are no studies regarding amount of congestion or emissions due to congestion. However, compared to other EU countries, there is much less congestion, only for some peak hours in urban areas and weekends as well as incidents.

Based on estimations made above for secondary accidents it can be assumed that congestion related to accidents will be reduced by eCall by 10%.

Based on Kulmala 2008, in EU 25% of congestion costs are related to incidents (accidents, obstacles like crashed vehicles on the road, unexpected road weather problems etc.). Because of low traffic volumes, in Finland this is estimated to be 70–80%. Based on this we estimated that in Finland 30–50% of congestion is accident related. From above figures it is calculated that in Finland eCall would reduce 3–5% of congestion (30%*10%–50%*10%).

Based on figures for EU25 from eIMPACT, it is estimated that vehicle hours spent in congestion is 0.5–1% of total vehicle hours in Finland. Based on this it was calculated that the vehicle hours spent in congestion is reduced by 0.02–0.05% by eCall (3%*0.5%–5%*1%).

Environment and Energy - Effect of eCall on emissions and gasoline consumption

In congestion vehicle's speed is lower than in normal traffic and the drive is less harmonised. The less harmonized the speed of one vehicle is the more emissions it produces. Also at lower speeds the amount of most of the emissions is higher.

Based on Finnish calculations it is roughly estimated that amount of CO2, PM and NOx emissions produced in congestion is twice as big as in normal traffic. Hence, if vehicle hours spent in congestion is reduced by 0.02–0.05% by eCall, the amount of emissions CO2, PM and NOx is reduced 0.04–0.10%.

The fuel consumption (gasoline and diesel) will be decreased by the same percentage as the CO2.

Other impacts, e.g. impact on the rescue operations, processes, and organisations

This chapter is based on the results of the expert workshop and the responses to the Finnish PSAP questionnaire. The baseline for the estimations and discussion in the workshop was that devices are generally in use and they function well.

<u>Effect on PSAP operations</u>

Location:
At the moment automatic fire alarms are processed under 30 seconds. For normal emergency calls the goal is that units will be dispatched within 90 seconds from the start of the call. If eCall sends the exact location of the traffic accident to PSAP, the eCall alarms could be processed as fast as automatic fire alarms. Later, when more information about the accident is obtained, there is possibility to send more units if needed. Nowadays, the most difficult and time-consuming task in the traffic accidents is the positioning of the accident. Roughly estimated 1/3 of the call time goes to positioning. The location of the mobile phone can be traced, but the information is often inaccurate.

Estimation was that if the location information is exact and other eCall-data is obtained immediately, the average time an emergency unit is dispatched after the reception of the emergency call at the emergency service will shorten on average 1/3 from the current value.

MSD data:
Information about vehicle type was estimated to be valuable, as the needed units can be estimated more precisely when the type of the accident vehicle/vehicles are known.

If more than one eCall is received from the same location the operator can conclude that the accident is a multiple vehicle collision (head-on, angle or rear-end collision depending what the directions of the vehicles were before the accident). In case of a multiple vehicle collision more units can be dispatched compared to single vehicle accident.

Costs:
The costs of eCall to PSAP were hard to estimate as e.g. gateway decisions will effect on the costs. It was estimated that needed investment costs in Finland are something

between 500 000 € and 1 million euro in total for all 15 PSAPs. This includes modifications to emergency response centre's information system and telecommunication system between eCall -data transmitters and ERC's. Maintenance costs were estimated to be in total for all PSAPs something between 15 000 euro and 40 000 euro. Orientation and introduction training costs were estimated to be 100 000 € for all operators in Finland at the first time eCall is launched. Later the training would be included to the normal training sessions without any special costs.

Efficiency of PSAP operations:
It was estimated that if the number of emergency calls won't significantly increase because of eCall (false alarms or people calling by phone from the same accident eCall has already alarmed), the saving time in risk assessment with location and MSD will be the most important thing which eCall brings to PSAPs. However, it was not possible to give any quantitative estimate on how much the efficiency of PSAP operations would be improved by eCall.

<u>Effect on rescue operations</u> (rescue services, fire brigade, health care, the police)

Location:
The benefits of eCall to rescue operations come mostly from the more exact location information. When the exact location of the accident is known, it is more certain that the nearest rescue unit is sent to the place. Exact location information also speeds up the arrival of help in situations where the emergency caller can't tell the accurate place of the accident as time is not lost searching the place. In addition, especially in urban areas like Helsinki metropolitan area (ring roads and arterials) the units know based on the precise location information which ramp to take. If the correct ramp is missed, it can take several minutes to find the next suitable ramp to enter the road. Also at intersections time is saved, when the correct direction is known and u-turns are avoided. Also in these situations several minutes can be saved.

In Finland, the police would like to get the eCall alarms at the same time as the PSAPs receive them. If the eCalls would be displayed straight away also in police system, a free unit could drive towards the accident even before the PSAP has actually alarmed the units. This would speed up the arrival of police in every case at least slightly and in some cases by several minutes (e.g. 5–10 minutes in Helsinki metropolitan area). The rescue services, fire brigade and health care are usually waiting for an alarm at the fire station. Hence, the benefits of getting the eCalls same time as the PSAPs would not be as high as for police as the rescue units can't head towards the scene before the actual alarm.

MSD data:
Rescue services and fire brigade could benefit from the vehicle identification number (VIN) received from MSD. If the drive to the accident place is long, they could e.g. determine where the airbags are in that specific type and model. The final decisions are of course in any case done at the accident place. Especially in future information whether vehicle is electric vehicle or hybrid electric vehicle was stated to be important for work safety of rescue personnel.

The police could also benefit from the VIN received from MSD. Based on the VIN they could know if the driver of the accident vehicle has e.g. history with drugs (this can be safety issue). Based on the VIN police could also discover, if the vehicle is stolen (this can affect the amount and quality of police of units sent to the place). Nowadays information can be asked based on the license number, but based on the VIN the information could come automatically.

It would also be extremely important for the rescue units to know if the vehicle is carrying dangerous goods. This information is not included in current MSD. One proposed option was be that vehicles carrying dangerous goods would have own type of eCall device in which they would be required to input the quality of the goods they are carrying before departure. Other option could be that information about dangerous goods would be filed to the registry with interface to the VIN. This way the information about accident vehicle's cargo could be received if needed.

From the point of view of accident investigation, the information from the "black box" of the vehicle would be useful. In some cases e.g. speeding could be verified with this additional information. The use of "black box" data would probably require change of legislation (data protection issues). It was proposed that the use of "black box" data could be allowed e.g. in accidents with personal injuries. In some cases the time to investigate the accident would be shorten and work time of several months could be saved. It was also estimated that the work of the police would become more efficient, if the vehicle information received from MSD would already be included in the police report.

The opinion of health care was that at least at the beginning they are not sending ambulance based on MSD, but only after accident has been verified by eCall voice connection or by normal emergency call. After eCall alarms have been proved reliable, this can be changed.

No quantitative estimation about change in the efficiency of rescue units (as saved person hours or equipment costs) could be done.

Effect on incident management

Immediately when one of the public authorities is present, road can be closed and traffic control actions can be started. The faster the traffic control actions are started the more road blocks and secondary accidents are prevented. The incident management is enhanced by as much as the arrival of rescue units is quickened by the eCall. In addition, when the exact location is known already when driving towards the place, the police can stop at a suitable intersection to divert the traffic, without first going to the accident place to see where it is exactly located.

The precise accident location is essential for the traffic incident information services especially in the urban areas, where it is important to know exactly in between of which intersections the accident has happened. In addition it is beneficial if the information of the vehicle type is included in the traffic announcements from the Traffic Management Centre of the Finnish Road Administration. Information could be used e.g. when determining the length of incident. Detailed location information enables earlier planning of detours. In winter the winter maintenance contractors can be alarmed to plough the snow from the detour earlier.

It was also stated that in general the traffic incident information becomes more efficient as the penetration TMC devices increases.

General

The participants of the workshop highlighted that the amount of false alarms is crucial for the outcome and that there has to be certification controls that only high quality devices are brought to market. False alarms consume recourses and if the number of false alarms is high, the confidence in the devices is reduced (alarms are not taken so seriously anymore). The checking and maintenance of the devices was proposed to be done in periodical vehicle inspections.

Especially the manual alarms raised some concerns. It was highlighted that the device abuse has to be sanctioned and alarms from a faulty or misused device should be able to be blocked off from the PSAP. It was also proposed that manual calls could go to service centres and not straight to PSAP as there can be many non-emergency calls among these.

There was also discussion about positioning of certain device when the call is not on. It was considered whether this should be allowed, if the device causes lot of false alarms or other damage. The normal emergency calls can currently be positioned.

It was highlighted that the eCall device has to be strong enough to tolerate the crash forces and function even after the accident so that emergency message can be sent. The tolerance of the device has to be certified.

From the point of view of the operators, it was emphasized that the voice connection should not open automatically but the PSAP operator should have the possibility to open the connection at the suitable moment. One problem of the voice connection may be that after the accident no one wants to stay at the crashed vehicle longer than necessary or the participants of the accident don't even remember that they have eCall and that it may have called to the PSAP.

5.6.3 References

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5.7 Hungary Approach and Results

5.7.1 Approach and methods used

5.7.1.1 Transport Policy / ITS strategy back-ground

- The ***"Comprehensive transport development strategy"*** of the Ministry of Transport, Telecommunication and Energy gives the framework of all infrastructural development between 2007-2020. The *"White Book"* of this paper defines a comprehensive *harmonised strategy* for all transport modes, making possible the identification of the real development needs for the future.
- The document identifies - besides the strategy plans for the personal transport and freight-transport systems, as well as for the transport infrastructure - the strategy plan for the development of *horizontal issues.* The identified *horizontal issues* are: ***transport/traffic safety;*** cleaner, energy-efficient transport systems; sustainable mobility and ***ITS systems/services.*** The foreseen *"ITS developments/deployments"* of the document includes also the *eSafety priority systems.*
- In this context, the ITS issues will have in Hungary in the future a crucial role to achieve the main goals of the European/Hungarian Transport Policy.
- In 2009, an updated comprehensive ***"ITS strategy for the road-transport"*** was elaborated in the frame of the CONNECT project and were discussed with several experts.

The strategy for intelligent road transport systems should comprise priority fields that suit the European tendencies and Hungarian requirements – taking into consideration the road network development concept, traffic development trends, main objectives of the transportation policy and road user (drivers and other travellers) needs, as well as the Hungarian and EU strategic documents and tendencies.

Most important application areas and priorities are: deployment of ITS systems and services in modern road operation – traffic management, traffic control and information systems on highways; traffic control centres; multimodal traffic information: real time traveller information systems; electronic fee collection, e-ticketing, ITS applications in freight transport/logistic, eSafety systems supporting road safety (traffic safety), eCall (integrated European emergency call service).

Horizontal issues: system architecture: "uniform framework" for fixed connection interfaces of separate systems and services; evaluation of intelligent transport systems and services; standardization issues of ITS systems.

5.7.1.2 Status of the signature process of the eCall MoU in Hungary

The eCall integrated European emergency call service is one of the priority of the "ITS strategy" of the Ministry of Transport, Telecommunication and Energy, which is technically concerned in eCall issues because of the road-safety.

The positions of Hungarian decision makers / stakeholders are the same in connection with the implementation of integrated European eCall emergency service. They agree, that this service could save human lives, hence the implementation / operation is reasonable.

The responsibility for the upgrading of the existing 112 emergency service (E112, eCall) is at the Chancellery.

The European MoU for eCall is going to be signed by Hungary (by the responsible Secretary of State by Chancellery) in the near future. The preparation of the signature is under progress.

5.7.1.3 Working method for the impact assessment of the Hungarian eCall study

The goal of the Hungarian study is to analyse the possible impacts of the future introduction of the integrated eCall emergency system in Hungary.

The following methods were used in the Hungarian impact assessment on the introduction of the eCall service:

- Own research involving experts for the estimation of the impacts on road safety / numbers of fatalities (detailed medical analysis, detailed road accident analysis);
- new model has been developed for the estimation of the impacts on congested hours / disturbed traffic flow (taking into consideration the congestions caused by road accidents, as well as all congested hours on the entire road-network);
- preparation and evaluation of own questionnaires to estimate / calculate the different components of the whole rescue time (reporting time of accidents, arrival of the clearance unit to the accident scene and the clearance time of the roads);
- large scale of expert-discussions involving all interested potential stakeholders to estimate the other elements of the rescue time (such as emergency call answering time, alert time of rescue brigade, travel time of rescue brigade) and to discuss the eCall related important questions (such as priorities, strategies, institutional issues etc.) The involved partners were:
    - Hungarian National Ambulance and Emergency Service;
    - Hungarian National Police Office;
    - Hungarian National Disaster Recovery Emergency Service;
    - road-safety experts from: Engineering Bureau for Road Safety Research and GRSP Hungary Association;
    - medical experts from: Traumatology Department of Károlyi Sándor Hospital;
    - road-operators from: Hungarian Public Roads Co.;
    - technical experts from: Corvinus University of Budapest, Faculty of Business Administration and Central Office for Administrative and Electronic Public Services;
    - Non-governmental organizations;
    - Prime Minister’s Office;
    - Minister for Transport.
- own calculations for the impacts on the environment and also energy consumption; the results of new /recent guidelines in Hungary (elaborated in the frame of the CONNECT project) were used.

The impact assessment contents the follows analyses:

- Expected impacts of the deployment of eCall on road safety in Hungary;
- Impact of eCall on rescue time;
- Medical analysis of deadly injured in road accidents after being hospitalized;
- Estimated congestion delays and costs caused by road accidents in Hungary;
- Impacts of eCall related environment and energy consumption.

The chapter "*Expected impacts of the deployment of eCall on road safety in Hungary*" gives an overview about the status of road accidents occurred on the Hungarian road network. This study analyses the most important accident characteristics and data, and makes estimation for lives, that might have been saved by eCall.

The chapter "*Impact of eCall on rescue time*" analyse the components of the rescue time in the current situation (112 centres in Hungary).

The aim of the chapter *"Medical analysis of deadly injured in road accidents after being hospitalized"* is to make an assessment based on the data available about how can eCall influence the outcome of injuries among those injured in road accidents. It is a question if the injured person is taken to hospital earlier the critical or serious injuries could be eased or life could be saved.

The chapter *"Estimated congestion delays and costs caused by road accidents in Hungary"* analyses the impact of the accidents on the traffic flow, based on a new model developed for this purpose the hours of the congested / disturbed traffic flow are defined.

The chapter "*Impacts of eCall related environment and energy consumption"* analyses the impact of eCall service on the environmental characteristics as well as on the energy consumption, taking into consideration of the results of the congestion-analyse. All calculations related environment and energy consumption are based on the „Guideline for evaluation and cost / benefit analyse of ITS applications in the road-transport", elaborated by COWI Hungary Ltd., in the frame of the euro-regional CONNECT project.

The ***conclusions*** of the Hungarian study were made according to results of calculations, analyses, expert opinions and assessments.

5.7.1.4 Actual status and development tendencies of the Hungarian emergency eCall system

The chapter "*Actual status and development tendencies of the Hungarian emergency eCall system"* based on the actual development concept of the Chancellery (responsible organisation for eCall issues in Hungary).

Actual status of the eCall system/process in Hungary

The existing classic emergency call system with historical backgrounds is attached to the following three organisations:

- Police (107),
- Ambulance (104),
- Fire Service (105).

This national emergency call system has been directly matched to the local structures and geographic locations of the said organisations.

The "112" eCall system operated in the European Union for over a decade based on the philosophy of fast response and cost efficiency, as well as supposed to be well known also to foreigners, has been superposed on the existing system.

In Hungary 112 calls are received by the central call rooms (acting as Public Safety Answering Points) of the Police.

The Police is generally structured according to the administrative zones existing in the Hungarian Republic.

Currently 20 General Police Offices operate in the country with a central call room in each:

- Budapest General Police Office (BGPO),

– 19 County General Police Offices (County GPOs).

Call rooms capable of receiving emergency calls are also available in the Police Offices reporting to GPOs.

The PO call rooms are not authorised to receive 112 calls, however, they may receive specific international emergency calls, and a parallel system actually exists in the country.

Since eCall is a free service all over the world including Hungary, false alarms can occur quite frequently, generating unreasonable workloads for the organisations.

In the 112 eCall system, this problem can be minimised by a pre-screening process that can guarantee that the alarms reaching the emergency services are limited to the calls requiring effective intervention and that these alarms are channelled to the most competent emergency organisations.

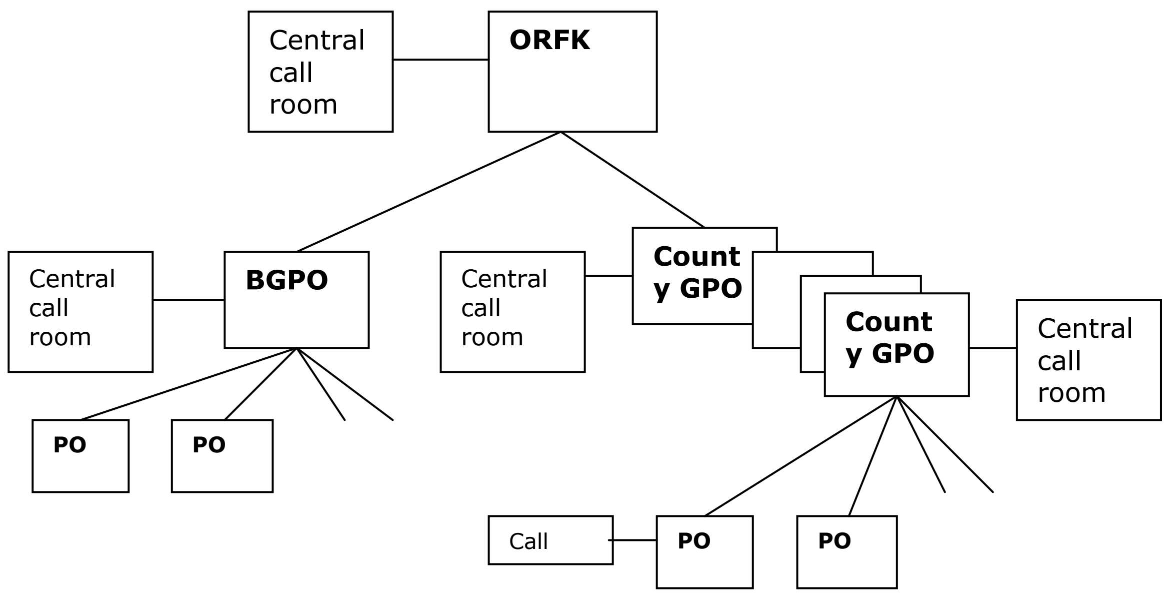


Figure 16: Police organisation structure

112 eCalls can be received independently by the central call rooms of the 18 County GPOs.

Physically the central call rooms of Pest County GPO and BGPO are separate organisations; however, in respect of the 112 eCall function they form one unit.

Each central call room has direct connections to the call centres of partner organisations, of the emergency services (Ambulance, Fire Service), and of the Police Offices reporting to it.

a. Possibilities for emergency calls

Theoretically the emergency calls can access the relevant organisations in three ways:

– by mobile phone,
– by wireline phone, or
– rarely by personal report to a police organisation.

The relevant GPOs are virtually accessed by 100% of the calls made by wireline phone. Mobile calls can be misconnected perfectly at random, but typically to other (bordering) counties.

Queuing can be a typical problem also in case of emergency calls.

If the calling party has to wait for the answer, then after a while the queuing call is redirected to BGPO. The queuing time limit may be slightly exceeded because such a ”buffer” is not available to BGPO.

b. Processing of emergency calls

The reported events typically concern the following authorities / organisations:

- Police,
- Fire Service,
- Ambulance.

The reported events can cause ”deformations” in the site which may require on site inspection by other organisations, e.g.:

- road operators, or
- utility service providers (gas, water, etc.)

The incoming calls received by the Police are promptly ”switched over” to the relevant emergency or rescuing organisations, except if police action is required.

If the Police is involved, the calls must undergo a brief pre-processing prior to ”switching”.

If the presence of the Police is required on the site of the event, the necessary data are notified to the competent and relevant authorities.

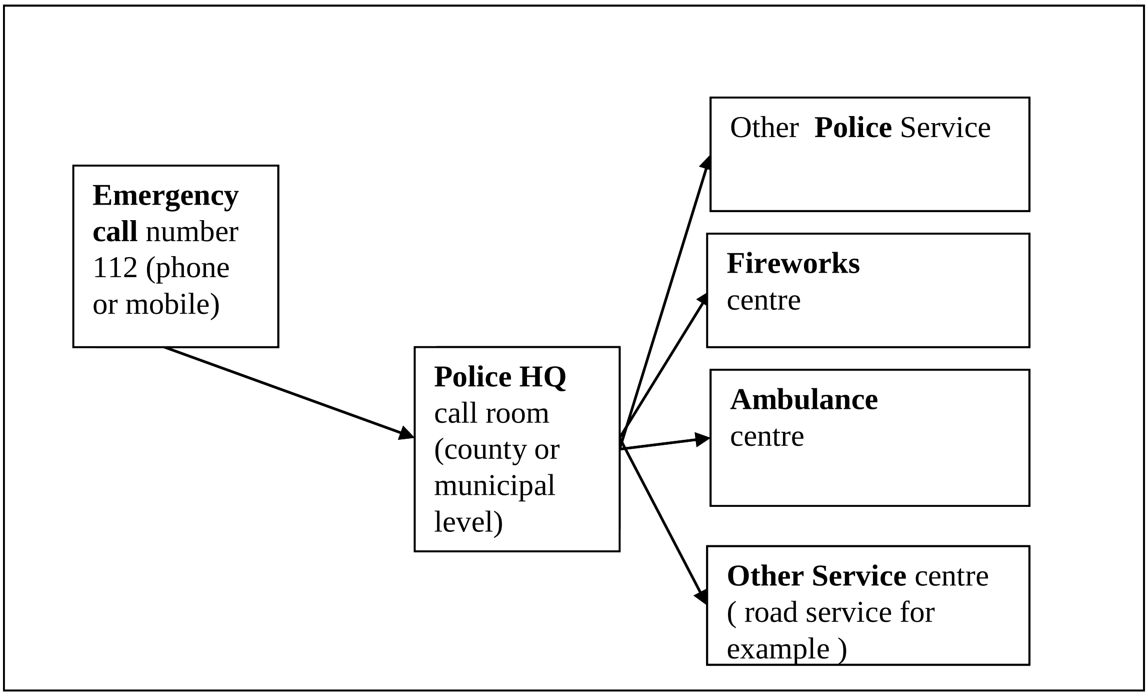


Figure 17: Flow chart of incoming emergency calls

The implementation of the integrated eCall system can contribute greatly to the improvement of the standards of emergency activities and to the elimination of the redundancies existing in the present system.

Conceptual grounds of the implementation of the European emergency call system in Hungary

a. General overview main task to be performed

The definition of the exact scope of the project is the most critical precondition to the successful implementation of the *European emergency call system* based on a standard European dial No. (112). As a rule the scope of a project is defined by the requirements of the concerned parties. In this case there can be many concerned parties; however, the most important one is the actual end user, namely, the citizen seeking help.

The goal of the *European emergency call system* will have been achieved if the citizens seeking assistance can access a competent call receiving service where they can get prompt and reassuring answers and if the help arrives on time and with adequate skills to successfully overcome the situation or event that has led to the emergency call. This means that *efficiency* can be rated by *response time* in the first place, and efficiency in time can be reached through smooth, fast and non redundant information flow between the actors of the entire process, from call receiving to activity control. Naturally the high level of this efficiency ratio implies the pre-screening of false or hostile alarms. Since the process itself can follow several scenarios depending on the events asking for assistance, the efficiency principle requires a system that can support the relevant standby organisations in using a master information system of activity control enabling *concerted control* in various emergency situations and offering a live and operative system of contacts between these organisations.

Efficiency in time, the possibility of concerted control, and user satisfaction are the three key success criteria of the *European emergency call system* and they form the frameworks of interpretation to be always kept in mind.

The key agreements already mutually accepted by the relevant standby organisations in respect of the above objectives are as follows:

- In the responding process, the standby organisations will use an integrated basic *activity control* process supported by a background infocommunication framework, to be automated along with the implementation of the *European emergency call system*.
- The call centres receiving 112 emergency calls and the activity control centres will be separated. The required human resources will be provided by the Central Office of Administrative and Electronic Public Services (KEK KH) in case of the call centres and by the relevant standby organisations in case of the activity control centres.
- No objection to the integrated management of the information content of the communication flow between the call centres and the activity control centres.
- The incoming information is simultaneously transmitted by the call centre to the standby organisations responsible for the coordination of the actions required by the event and for activity control.
- No objection to the full traceability and monitoring of the complete process of emergency call receiving / management and activity control.
- Based on economy of scales computations ***three call centres*** will have to be set up, which can mutually take charge of the areas covered by the other ones if necessary.
- The whole technical support infrastructure must be available for 7x24 hrs a week. In the call centres altogether 120 + 30 workstations are required to answer the calls.

- The *European emergency call system* must be in full compliance with the *European guidelines*.[11]

As it appears from the above, from the point of view of project scope it is clear that an *integrated information system covering both key processes* is required. At the same time both processes have their specific input data for which open interfaces must be created in thee call centres to other systems: these typically include third party systems providing expert information services, and the resource management systems of the relevant standby organisations.

From the point of view of the complete services the *emergency call receiving and management* process can be perceived as an intermediary service, since it is not responsible for actual assistance. At the same time this process is the primary user interface to the citizen seeking help in connection with the event requiring the assistance. If this function is to be performed in a successful and satisfactory manner it needs *real time information feedback* from the *activity control* process.

Consequently this is clearly a two-tier service, however, from the organisational point of view it could be equally implemented in one organisation or separately. Currently two factors are to be considered in deciding between the two alternatives. First, the model of separate activity control centres has been accepted by the relevant organisations. Second, the control of the two processes by one and the same organisation is not enabled by the effective legal environment. This means that *at present it is an unviable alternative to assign any activity control tasks to the three call centres.*

However, the existing concept tries to relieve this limitation in two ways. Call centre workstations with the additional capacity to perform activity control functions is already supported by the integrated standard system, actually this is simply a matter of user *authorisation.* As the second important policy factor, once the legal harmonisation is completed, the requirements specified for the eCall system can be designed so as to enable this integration at acceptable costs without any additional project financing. This means that the *public procurement tender* of the emergency call system can be issued for the *two-tier model,* and integration at a later date will not be a problem.

According to the concept the existing dial Nos. *104, 105 and 107* will be kept, however, the relevant emergency calls will be automatically directed to the 112 call service. The existing dial Nos. may be phased out in the future, but only as they gradually get out of use. Therefore *the promotion of 112 is an especially important* activity, thus it will be a responsibility of government communication and will not form part of the project scope.

b. Reasons for the implementation of the emergency call system

The main process and key elements of call receiving and assistance sending are the same irrespectively of the levels of infocummunication support:

- call receiving, interview, evaluation,
- management of non emergency calls,
- location of the sites,
- assessment of competences,
- finding and dispatching the available resources,
- action/measurements,

11 Directive 2002/21/EC issued by the European Parliament and the European Council on March 7 2002 on the universal services and user authorisations relating to electronic telecom networks and services;
- Directive 2002/58/EC issued by the European Parliament and the European Council on July 12 2002 on the processing and privacy of personal data in the electronic telecom sector.

– report and evaluation.

Historically the main processes have been the same, except that the tools are checkered exercise books and not PCs, the sites are located on wall maps and not digitally, and resource management is based on records or magnetic tables and not electronic charts. Mobile units are followed by radio rather than by GPS based automatic systems.

The main processes are not changed by the mere deployment of E-call functions, but they are made faster and more efficient. It also enables the flexible configuration of the organisations.

The problem is similar worldwide, the main processes are the same; consequently more or less standard solutions have been found to the standard questions. They tend to be based on integration, ”911” or ”112”, except for some variations in the organisational configurations (such as national, regional, local, shared, or individual activity control) following the national laws and traditions. The other tendency shared by these solutions is an approach where the said main processes are taken as one uniform process, and efforts are made to create uniform infocommunication support systems for them, regardless of the organisational or geographic configurations. The current and accepted applications or ”products” actually contain the same functions.

The pilot systems of call receiving and activity control implemented in Hungary in the nineties, like the deployment control project *"Kreutler"* implemented by the police HQ ORFK in Tímár Street, or the "*TAFELKOM"* test in Heves County, were actually based on the same complex process, naturally within the bounds of the then available technology. The flexible configuration of the organisation structure was not supported by the technological and especially the data transfer capacities of the times.

It should be emphasized here that while the direct user interface is represented by the emergency call receiving function, from the citizens' point of view it is actually an *intermediary service,* as the ultimate user services mean the effective assistance arriving on time. It follows from the above that for an efficient emergency call receiving process it is not enough to be strong in its user services, but this strength must be coupled with fast and ”powerful” output to the assisting organisations as well. While the proposed service standards of the E-call project are mainly concerned with the direct telecom contacts with users, the true objective is to support the standby organisations in improving their service standards (e.g. response times) and optimising their resource utilisations.

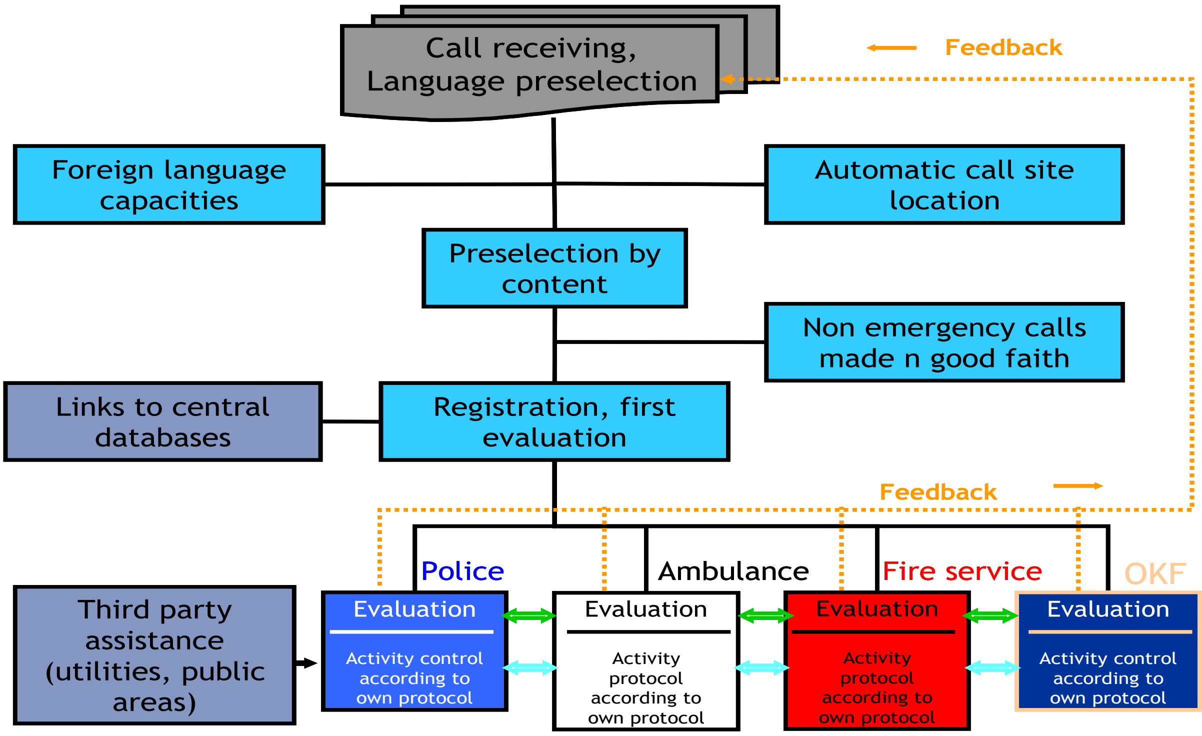


Figure 18: General Outline of the *European emergency call system*

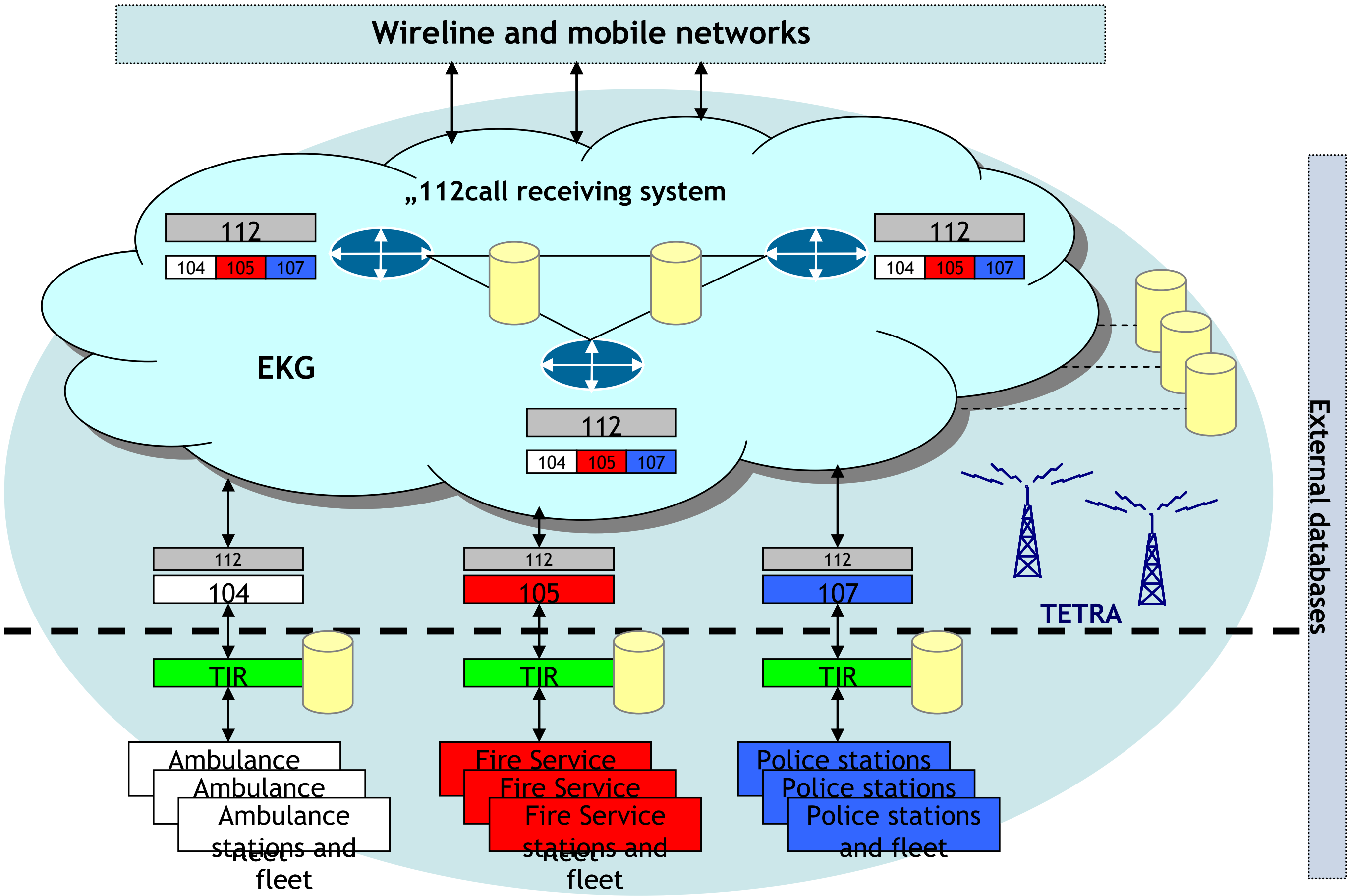


Figure 19: General Outline Call receiving and activity control

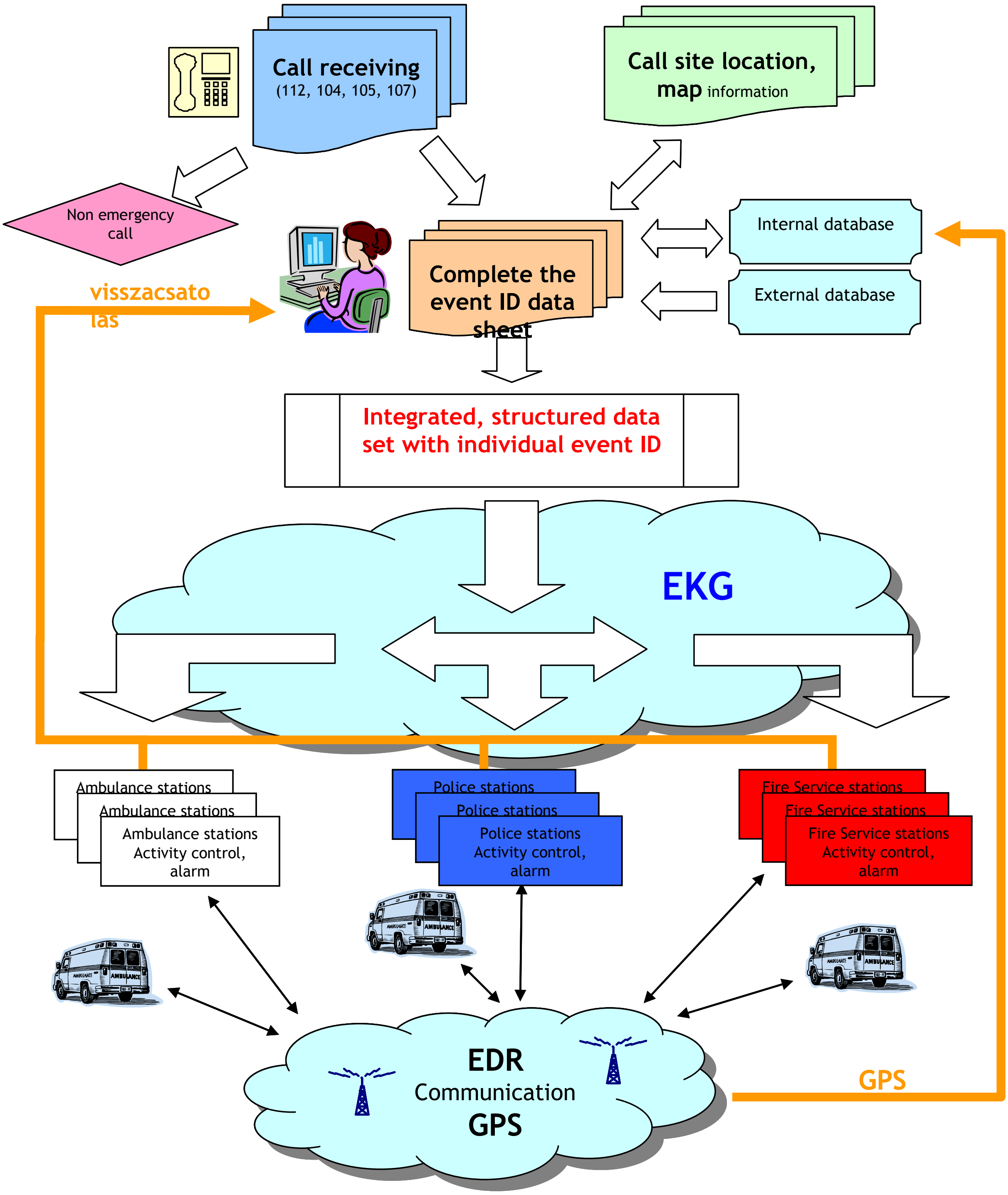


Figure 20: Data flow of the emergency call system

c. Description of the emergency call receiving process (Outline)

- Incoming calls are directed by the call router to the operators who have been idle for the longest time (this may be overruled by the senior operator, e.g. by directing the calls to the least busy available operators).
- Calls in foreign languages are transferred by the operators to the operator speaking that language (who may work in another location), or connects the available interpreter to assist in the telcon.
- The information about the call site is displayed on a separate map screen.
- Using a ”dynamic smart questionnaire”, the operator interviews the caller about the event and records the answers. The individual ID of the event is generated and the conversation as well as the background noise is recorded by the system.
    - From the recorded data the system automatically checks whatever it can against central databases (e.g. plate Nos.) or local databases (e.g. register of addresses).
    - The available data are continuously evaluated by the operator (e.g. different sites of the call and of the event, or fictive street No.)
    - Clearly hostile calls are interrupted by the operator and the caller phone Nos. are logged by the system.
    - False calls are interrupted by the operator.
    - Calls in good faith but not requiring action (e.g. inquiries) are switched on to special operators responsible for the management of this type of calls, or in clear cases to another short dial No. (e.g. 189).
    - In case of repeated calls concerning events that have been already addressed, the callers are briefed, the calls are interrupted, and the recorded data are referenced to the given event by means of the ”chart of open events”. The additional details if any are forwarded again.
- In case of any event actually requiring additional action/measure, the operator determines the organisation(s) to be alarmed. The site of the event is defined or delimited on basis of the available data. Decision support for the determination of competences by area is available from the system.
- The collected data are forwarded to the competent standby organisation(s). If necessary in the opinion of the operator, the call may be switched on to the standby organisation or to a specialised operator of the call centre (such as coordination of on-site first aid).
- The operator waits for the active (not automatic) confirmations to be sent by the alarmed organisations upon receipt of the alarm, upon launching the action, and upon the completion of the action. The event may not be closed unless each confirmation has been received.
- The operator will have the option to inspect the open events at any time in the records of the relevant standby organisations, or to request information by phone, e.g. in order to inform the citizens trying to expedite the action by repeated calls.
- If the confirmation -”Action launched” has not arrived or a message “Unable to act in lack of resources” is received, the alarm is transferred by the operator to another organisation (e.g. national centre).
- Once each confirmation has been received the event is closed by the system and archived in a readily traceable way.

d. Alarm receiving and activity control process (Outline)

- The alarm accompanied by sound and light signals is received by the on-call officer of the standby organisation. (In case of several workstations the receiving workstation is defined by the in-house protocols of the relevant organisations, e.g. in a regional division of labour).
- The data set of the event and information about any other alarmed organisations are displayed on the screen of the receiving workstation. The map screen shows the site of the event (and not of the call). This is confirmed by the officer.
- The busy and the available resources are displayed by the resource manager. Practically, in case of resources not based in the location, this information is shown on the map screen (AVL) by means of GPS signs and status information transmitted by EDR. The complementary data are available from the resource chart according to the internal protocols of the organisation, and downloaded from local databases (such as equipment standards and skills of the relevant units, or data of the crew on duty).
- Based on the available information the officer decides the units to be activated and alarmed to attend the event. The system offers the available unit which can reach to the site in the shortest time; however, this may be overruled by the officer.
- The mobile units are alarmed by the officer by EDR and the units in the location by EDR or wireline phone. The operator may send data to the acting units if the necessary means are available. This type of data transfer is not supported by EDR. The alarm is confirmed to the call centre operator by whom the emergency call has been received. Fast communication is supported by the EDR interface of the system (e.g. the voice channel is opened by clicking).
- The measures taken by the officer are automatically logged. This log, too, should be reasonably cross-referenced to the event ID generated by the call centre operator.
- In case of more than one alarmed organisations, the cooperation of the services on the site of the occurrence is arranged by themselves according to their protocols. In case of any escalation of the event they will be also responsible to arrange their further cooperation according to their own protocols.
- Once the action has been completed a confirmation is sent to the call centre operator. Naturally this is not equivalent to the reporting obligations specified in the internal protocols of the organisation.

5.7.2 Expected impacts of the deployment of eCall on road safety in Hungary

5.7.2.1 Overview of the traffic accident conditions in Hungary

In Hungary 30,000 km of the total road network is operated by the government and more than 100,000 km by local governments. During the recent period the yearly accident rate amounted to round 20,000 accidents involving personal injury, including 5-6% fatal accidents. 2008 was the first year since 2000 in which the fatal accident rate decreased significantly by 20%.

The fatal accident rates in the period between 2001 and 2007 are reviewed in Figure 21 and the distribution of these accidents between road categories is illustrated in Figure 22**.**

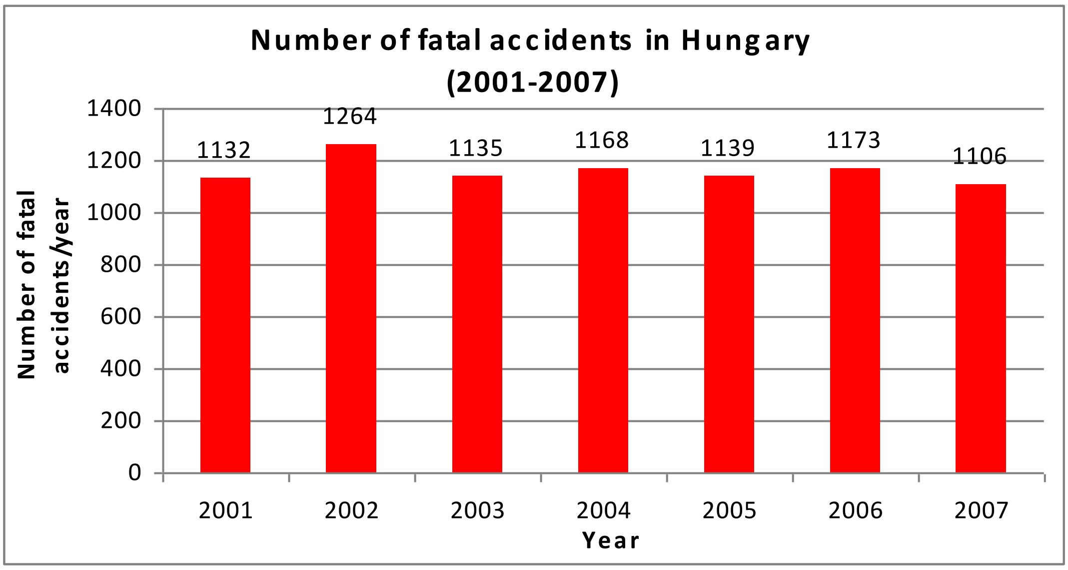


Figure 21: Number of fatal accident in the Hungarian road network

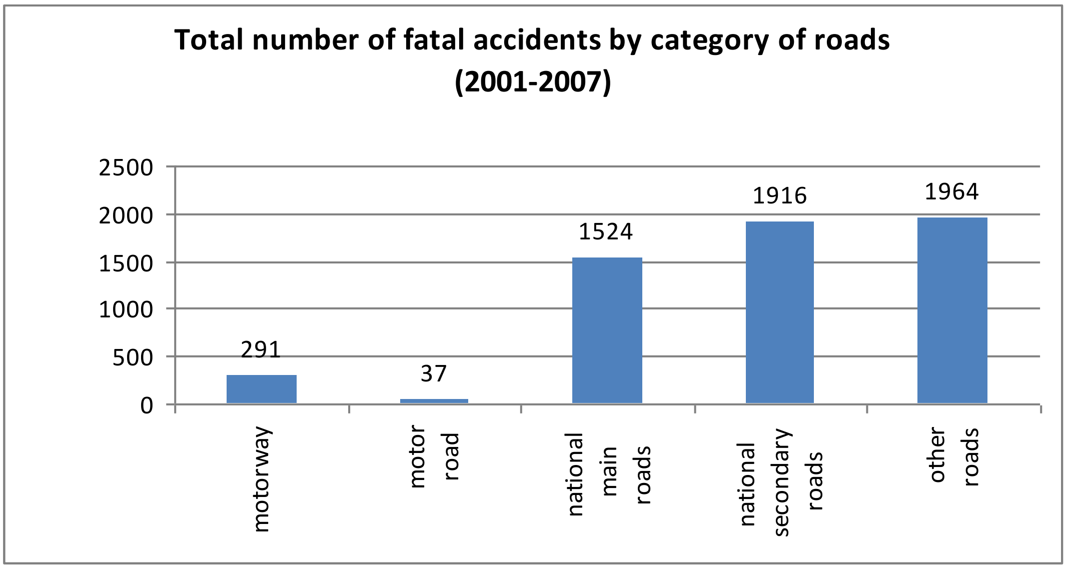


Figure 22: Total number of fatal accidents by category of roads

The yearly rates of accidents involving personal injury are reviewed in Figure 23 and their distribution by road categories in Figure 24.

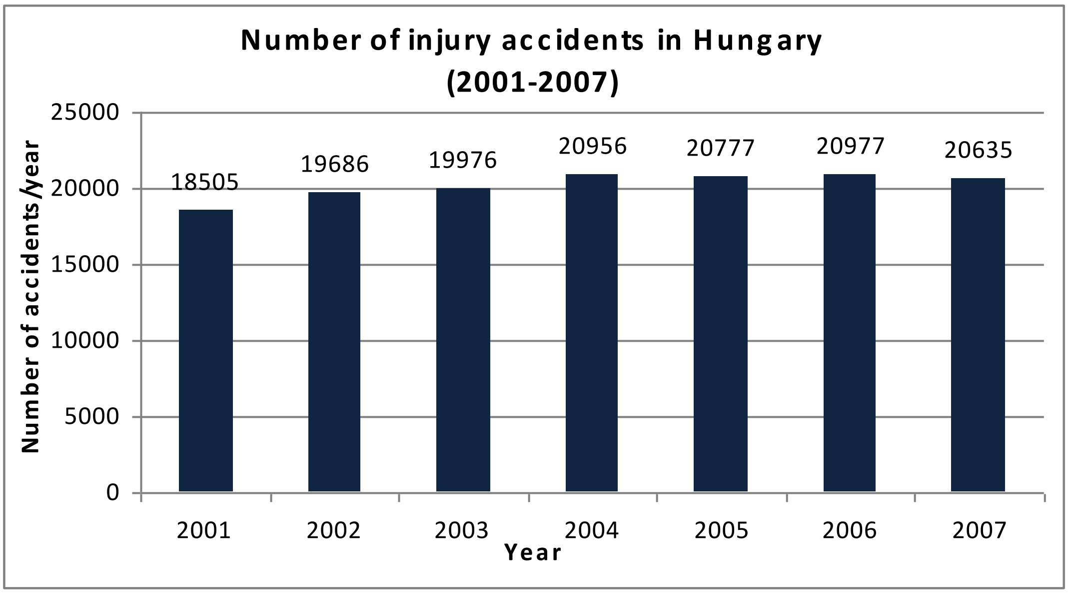


Figure 23: Number of injury accidents in the Hungarian road network

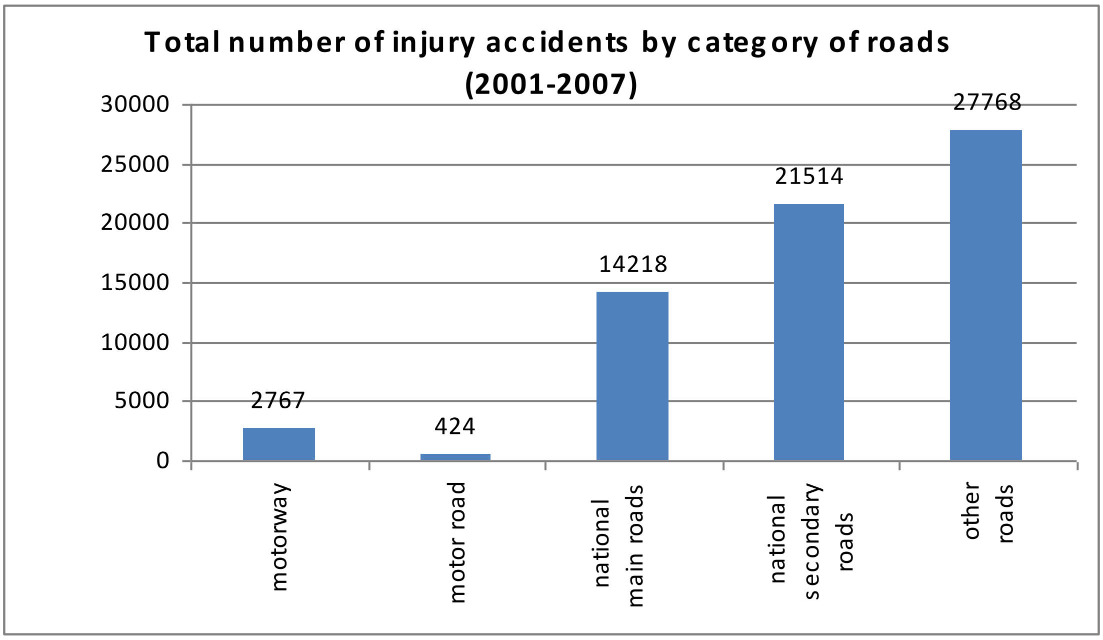


Figure 24: Total number of injury accidents by category of roads

Table 18 and **Figure 25** concerning Year 2007 include the data of personal injury accidents published by the Central Statistical Office (CSO), indicating the number of accidents and the number of the injures.

Table 18: Accident data 2007 Distribution by outcome

Outcome	***Accidents***		***Injured***	
	No.	*Share, %*	*No.*	*Share, %*
Fatal	1106	5%	1232	4%
Severe	6876	33%	8155	28%
Slight	12653	61%	19297	67%
Total	20635	100%	28684	100%

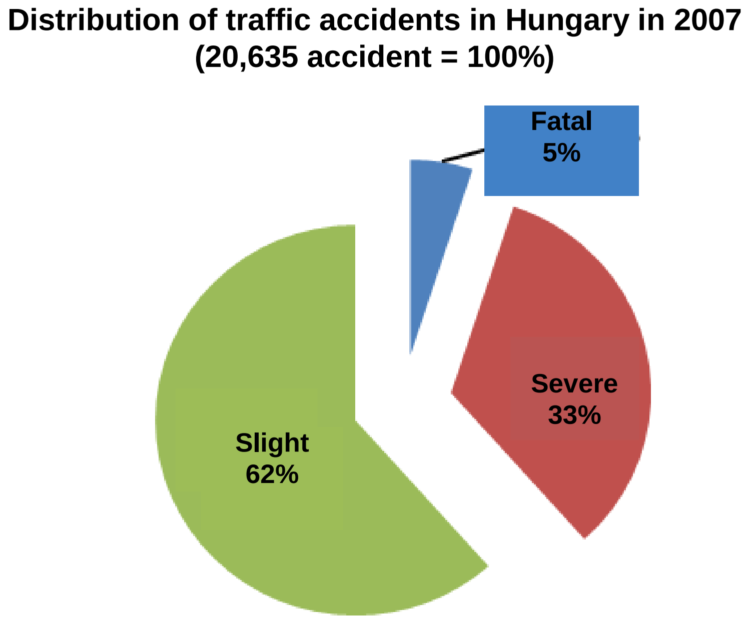


Figure 25: Distribution of personal injury accidents by outcome

In 2007 altogether more than 28,000 people were injured and 1232 (4%) were killed in road accidents in Hungary. The objective of deploying the eCall system is to reduce the amount of the casualties through the promptest possible medical care.

5.7.2.2 Occurrence of fatal accidents by regions

Road traffic flows partly inside of cities and communities (”urban areas” according to the definition of the traffic regulations KRESZ) and partly on non urban roads between communities. The most significant differences between these two types of areas are shown in the patterns of users and the specified speed limits. In 2007 in Hungary 57%, i.e., the larger part of the total fatal accidents occurred in roads outside urban areas. While the intensity of road traffic is significantly higher during the daytime than at night (during the dark hours), the share of fatal accidents occurring in ”night visibility” is as surprisingly high as 44%. (”Night visibility” does not necessarily mean night traffic conditions. For example the CSO data sheets indicate ”night visibility” in case of accidents occurring after 6 p.m. in Wintertime even though the traffic is not of the ”night” type at all.)

As it appears from Table 19, 280 fatal accidents 25% of total road fatalities occurred in night visibility (as defined by CSO) at places and times of special importance from the eCall point of view.

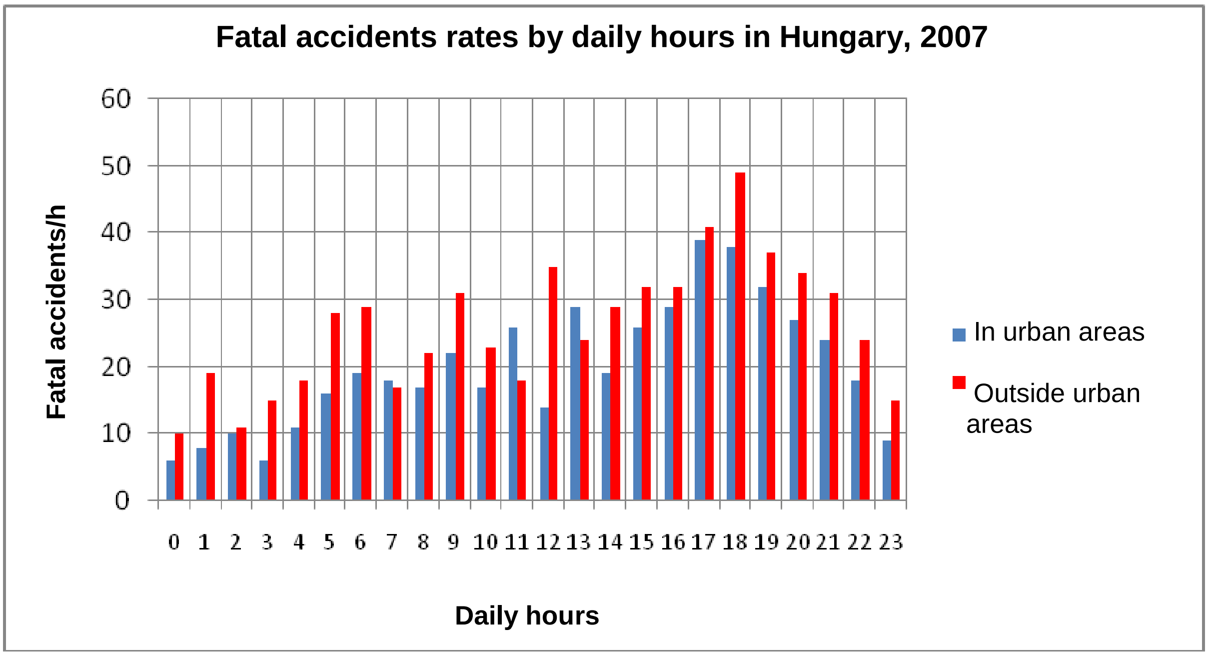
Table 19: Accidents of fatal outcome in 2007

Accident site	***Daytime visibility***	***Night visibility****	***Total***
Urban area	277	203	480
Outside urban area	346	280	626
Total	623	483	1106

*As used on the accident data sheet of CSO in Hungary

5.7.2.3 Amount of fatal accidents by daily hours

If the number of the events is evaluated by the hours in the day a more accurate idea is obtained. The fatal accidents in and outside of urban areas are shown by hours in Figure 11 based on 2007 data. It is clear without any further scrutiny that the frequency of fatal accidents is considerably higher during the afternoon hours. On the other hand, from the eCall point of view its is especially remarkable that outside urban area many accidents occur in the period between 10 p.m. and 3-4 a.m., as it also appears from Figure 26 (below).



The fatal accidents occurring in and outside urban areas during the actual night and daytime hours, i.e., in the periods of heavy and light traffic, are charted in Table 20.

Table 20: Fatal accidents by day parts

Period (hour to hour)	*In urban area*	*Outside urban area*	*Total*
10 p.m. – 6 a.m. (light traffic)	84	142	226
6 a.m. – 10 p.m. (heavy traffic)	397	483	880
Total	481	625	1106

In Hungary 142 fatal accidents occurred between 10 p.m. and 6 a.m. outside of urban area in 2007. During the same period of time 85 fatal accidents were recorded in urban areas.

With an efficient eCall system in these cases there is a higher possibility for saving lives (through the prompt emergency calls reaching to be received by the call centres, and the fast responses of the Ambulance and the Fire Service).

It should be also taken into account that altogether 174 lives were lost in the 142 fatal accidents occurring during the night outside urban areas, while in the 84 cases in urban areas 91 fatal injuries were suffered by 91 persons during the same period. This means that outside urban areas the accidents have much more grave consequences. On the average *122 persons were killed* in 100 fatal accidents outside urban areas during the night, as against *108 killed* in 100 comparable accidents in urban areas.

Therefore it is critical to notify any accidents occurring outside urban areas to the Ambulance as promptly as possible.

5.7.2.4 Rate of fatal accidents occurring outside urban areas between 12 p.m. and 6 a.m. by accident types

The distribution of fatal accidents during the late night (when traffic volumes are very low) is presented in Table 21 broken down by accident causes.

Table 21: Type of accidents with fatal outcome outside urban area (12 p.m. – 6 a.m.)

Accident type	*Number of fatal accidents*	*Casualties*
Collision of vehicles in opposite direction	18	33
Collision of vehicles in the same direction	10	10
Collision of vehicles in crossing direction	4	5
Driving off the road, without collision against solid object	21	27
Driving off the road, collision with solid object outside of the pavement	29	34
Hit pedestrians	19	19
Other	2	3
Total	**103**	**131**

Table 21 explains the higher mortality of fatal accidents occurring outside urban areas late at night and especially at early dawn. The frequency of head-on collisions is high and their outcome tends to be dramatic (due to the high speed of collision). In these cases the availability of automatic eCall can be a great help.

Table 21 shows that 33 lives were lost in 18 head-on collisions. In other words, in nearly each case two persons were killed. According to the experiences of site inspectors, 5-10% of 131 persons (in these accidents involved roadusers) suffered critical injuries that could have been saved by prompt medical intervention.

The so-called single vehicle accidents (driving off the road) totalled at 50 or nearly 50% of the occurrences. It happens most often in these cases that the motility of the lonely driver is lost and he/she becomes unable to ask for help, while the traffic flow is too thin for a damaged vehicle outside of the road to be discovered in time; consequently the emergency call is badly delayed.

If the analysis of single vehicle accidents is extended from one year to a horizon of 7 years with a focus on the timing of the accidents, it is clear that the frequency by hours is the highest during the dark hours. The distribution accident frequency during the day is presented in Figure 27.

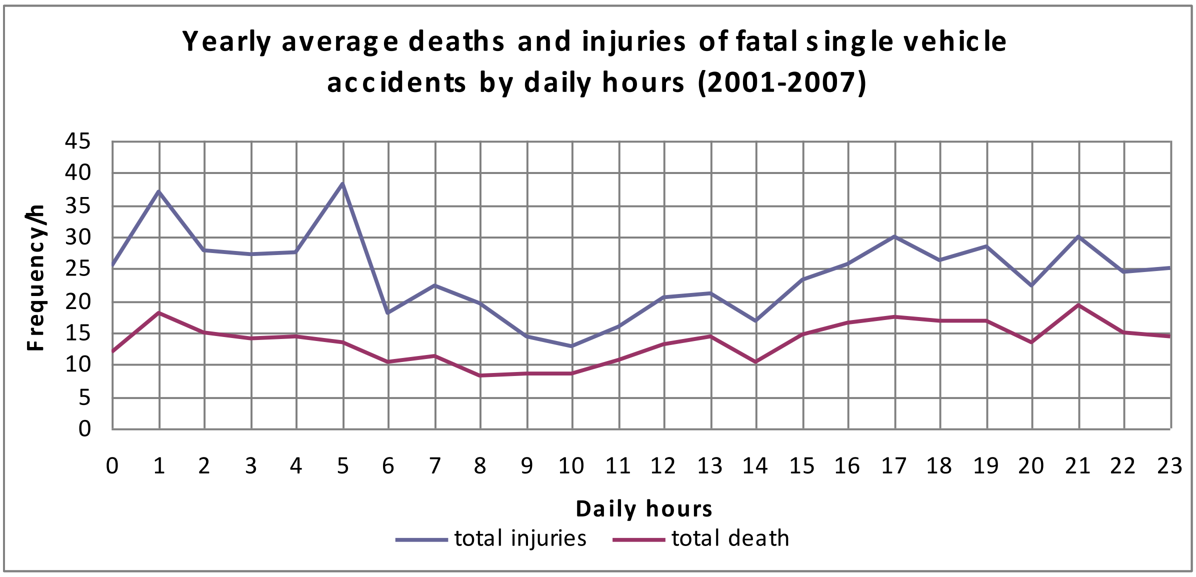


Figure 27: Frequency of single vehicle accidents involving personal injury by hours

The revealing trends of single vehicle accidents during the 24 hours of the day in the different road categories are presented below.

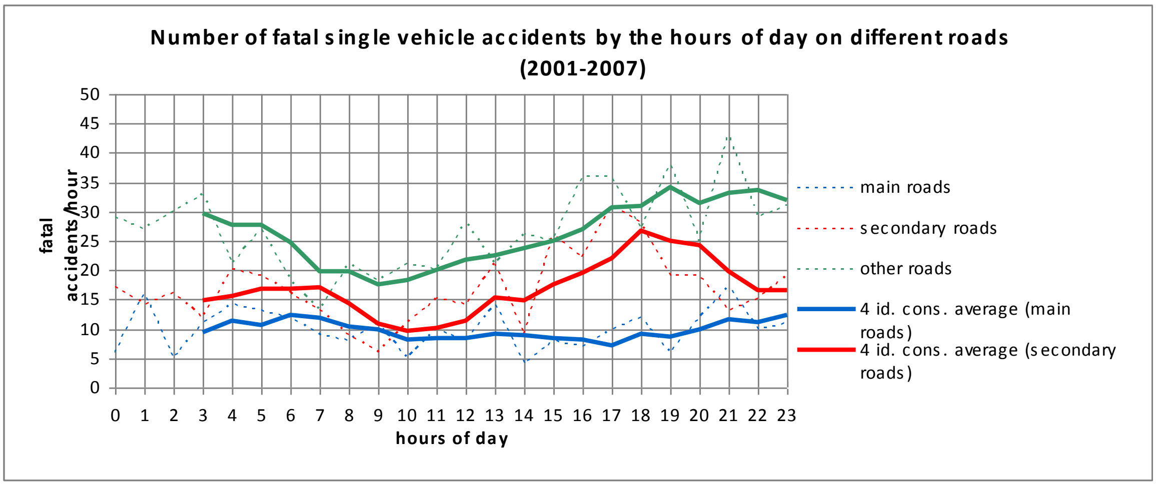


Figure 28: Number of fatal single vehicle accidents by hours of day on different roads (2001-2007)

Figure 28 shows the rate of fatal accidents by daily hours in 3 road categories. The data are yearly averages calculated from the data of the 7-year review period. This time sequence is rather volatile, therefore the results are shown by dashed curves, and the values ”smoothened” by the moving average (of 4 factors) is also included in the table. The first element of the smoothened trend line means the average of the first 4 points. The second one means the average of points 2 and 5, and so forth.

It is apparent that on primary roads the rate of fatal single vehicle accidents does not show much fluctuation within a day.

On primary accidents the frequency of this accident type is higher and even the fluctuation (or in a more professional terminology: the seasonality within the day) is higher compared to primary roads (with extremely high values peaks around 6 p.m. meaning the average of the hours between 3 p.m. and 6 p.m.).

The values obtained for link roads are higher (this is only natural as the total length of this road category is the longest), the fluctuation within the day is high, and the frequency of fatal single vehicle accidents is the highest in the dawn which is a highly relevant circumstance from the eCall point of view.

3.3.8.2 Fatality rate of fatal accidents outside urban areas between 10 p.m. and 6 a.m., by road categories

The data are presented in Table 22. The number of deaths occuring before midnight and after midnight have been collected. The hours after midnight are especially dangerous as reflected by the very high fatalities of primary roads and link roads.

Table 22: Number of deaths outside urban area by road categories

Fatal accident site	***Between 10 p.m. – 12 p.m.***	***Between 12 p.m. – 6 a.m.***	***Total***
Government Municipality road	3	8	11
Motorway	5	17	22
PrimaryMain road	13	41	54
Secondary road	11	24	35
Link(side) road	10	33	43
Other road	1	8	9
Total	**43**	**131**	**174**

The data of Table 22 illustrated by Figure 29 are showing the distribution of the 174 total casualties by the sites of fatal accidents.

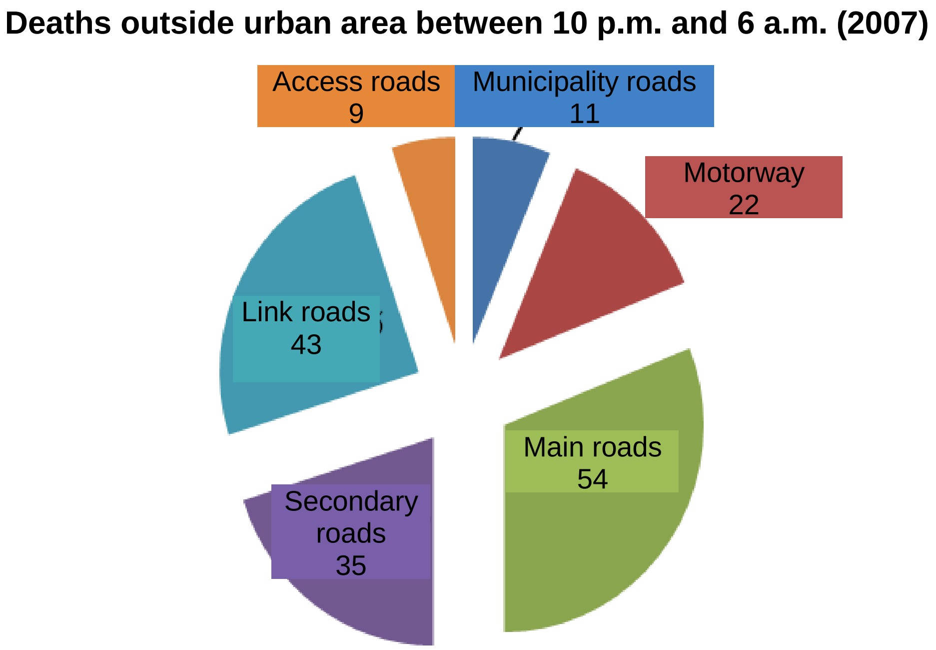


Figure 29: Deaths outside urban area between 10 p.m.- and 6 a.m. (2007)

It is very interesting to analyse Figure 29, showing the distribution of all fatal accidents in 2007 on the different types of roads, during day and night, distinguished between single and multiple vehicle incidents.

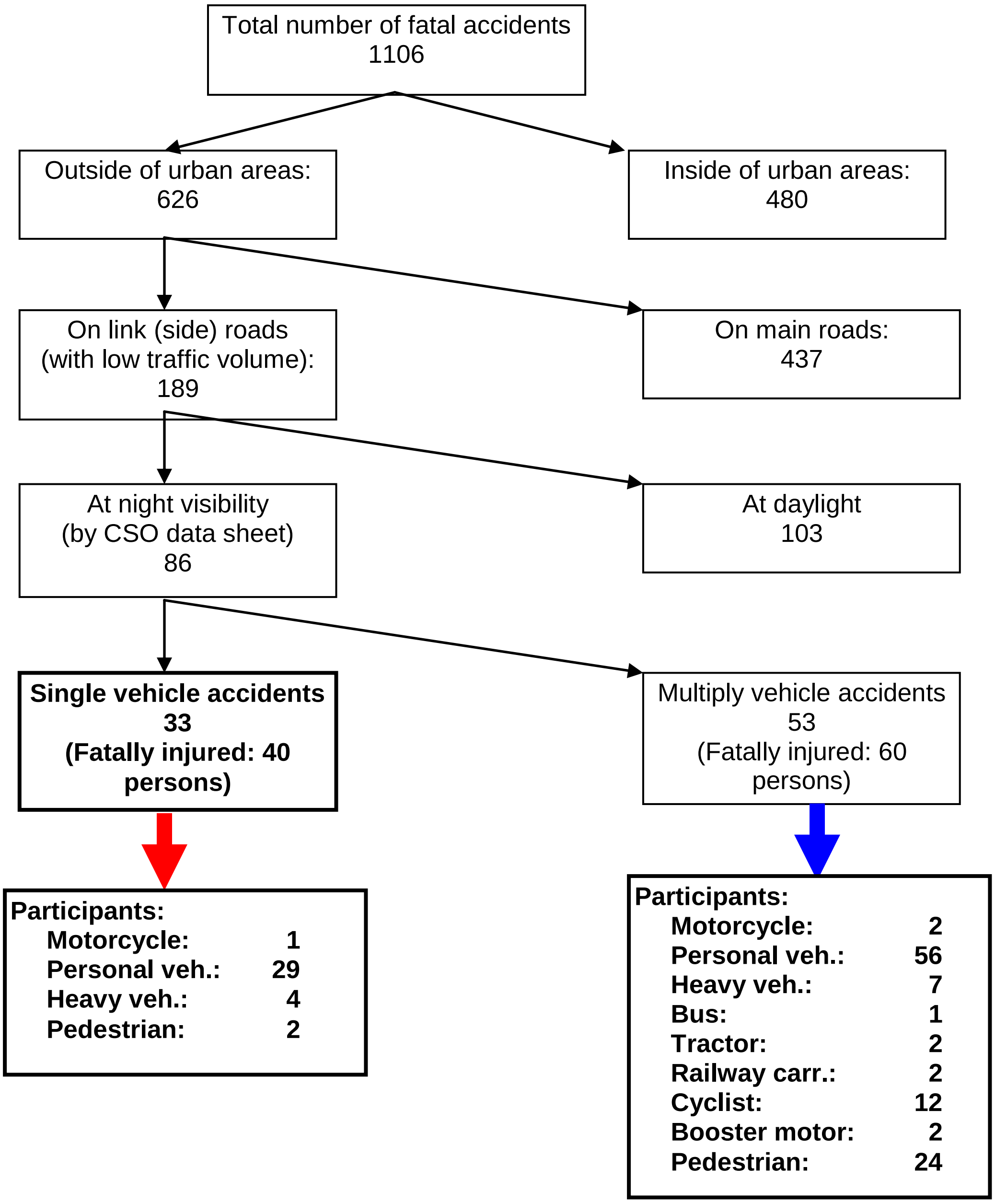


Figure 30: Distribution of fatal accidents on the road-network in 2007

According to the experiences of accident site inspectors, in case of accidents occurring on secondary roads and link roads in the dawn it often happens that the emergency calls are delayed and consequently the rescuing process is delayed too. Naturally in the case of fatal accidents occurring in other parts of the day and other types of roads it can happen, and there can be injuries that seem to be fatal on the spot, where the death of the injured person can be prevented by fast rescuing.

It should be noted that the eCall system could be very useful also in the frequent case of hit pedestrians. The pedestrian does not have any emergency call system, but he/she is typically hit by a vehicle and the driver generally remains able to act, i.e., to promptly ask for help by eCall in manual mode, and the site of the accident can be identified.

All in all, it follows from the statistical data and practical experiences that once the eCall system is fully implemented in Hungary, chances are that 24-28 persons suffering lethal fatal injuries can be saved.

Estimated impact of the eCall system based on the detailed analyses as well as on several expert-discussion: **about 2-2.5% of fatally injured road users yearly.**

5.7.3 Impact of eCall on rescue time

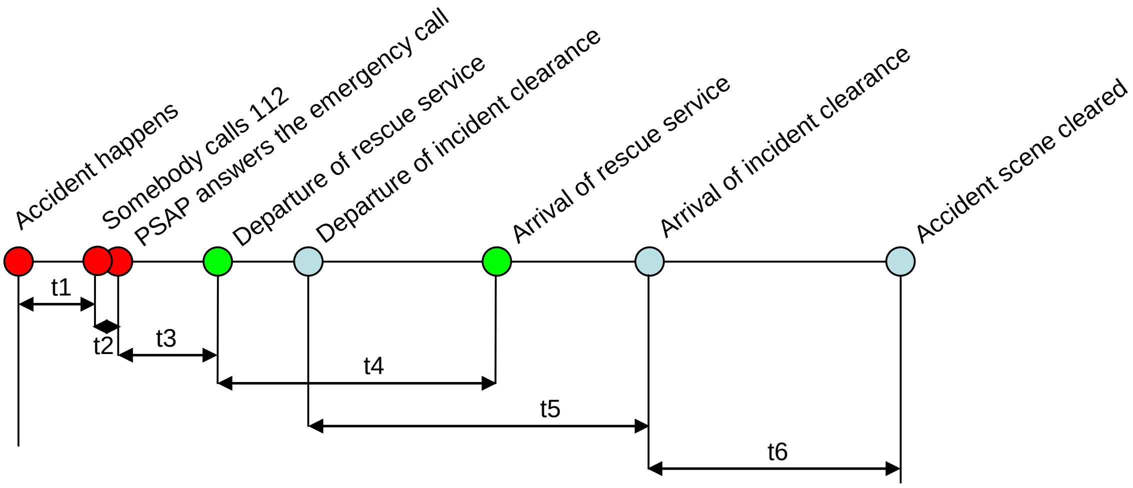
5.7.3.1 Identification of the components of the current rescue time The calculation of the elements of the rescue time

As Figure 31 shows the rescue time from the occurrence of an accident consists of the reporting of the accident, the emergency call answering time, than the alert time of the rescue service, after that their travel time is also very important.

Road accidents inevitably lead to more or less disorder and congestion, which is manifested in reduced road capacity, obstructed and congested traffic flow. Before the normal traffic flow is recruited the incident clearance need to clean the scene. That is why the travel time of them and their cleaning time could be also interesting.

Hereinafter is to be found the Hungarian results for the above-mentioned time components and also either the method of their calculation or the way they are gained.

(The below mentioned result are summarised in the **Criteria Template** and in the ***PSAP questionnaires*** done by Hungary.)



t1 – time between accident and the reporting of the accident
t2 – emergency call answering time
t3 – alert time of rescue brigade
t4 – travel time of rescue brigade
t5 – travel time of incident clearance
t6 – time to clear the accident scene

Figure 31: Time components of rescue chain

a. Average time between occurrence and the emergency call reporting the accident (t1)

This is the most important time that could be significantly improved by eCall, and this is the date, about which the less data we have. However, the method of the Hungarian study was to analyse the so called "short reports" of accidents made by the police investigator right after an accident. Therefore the Police Headquarter of county Győr – Sopron were selected, where approximately 500 cases were analysed properly, though data could be found only in 174 cases out of the 500.

According to this analysis the result is to be found in Table 23.

Table 23: Results of the analyses regarding reporting time

Time between the occurrence and the reporting of the accident	2008								TOTAL [pcs]	TOTAL [%]
	Vehicle accident*				Alone motorcyclist		Pedestrian and cyclist road accident			
	1 single vehicle accident		Multivehicle accident							
	Fatal	Severe	Fatal	Severe	Fatal	Severe	Fatal	Severe		
< 5 min.	1	8	9	29	0	0	5	17	**69**	**40%**
5-15 min.	2	17	13	48	4	2	2	10	**98**	**56%**
15-30 min.	1	2	0	0	0	0	0	0	**3**	**2%**
30-60 min.	0	0	1	1	0	0	0	0	**2**	**1%**
> 1 hour	0	2	0	0	0	0	0	0	**2**	**1%**
> 1 day	0	0	0	0	0	0	0	0	**0**	**0%**
TOTAL	**4**	**29**	**23**	**78**	**4**	**2**	**7**	**27**	**174**	**100%**

* Personal cars, heavy vehicle, busses

This means that most of the cases (96%) are reported within 15 minutes, but there is about 4% of the accidents, in which the prompt reporting might help, because of the faster arrival of the rescue service / ambulance.

b. Emergency call answering time (t2)

Regarding this data expert discussion was the best way to estimate this time. According to the experience of the present stakeholders this time is the following:

- 20-30 sec - 112 centres
- <10 sec - 104 - Ambulance centres

The stakeholders though remarked that it depends on also the duration/hours of the day and as well as on season, place etc.

c. Alert time of the rescue brigade (t3)

Though a questionnaire was also prepared to the Ambulance centres because of some circumstances there were no possibility to make them fill in. In this case the expert discussion gave an appropriate experimental answer, involving the representative of the Hungarian National Ambulance and Emergency Service. The time is about:

- 1-3 minutes.

d. Travel time of the rescue brigade (t4)

According to the stakeholders interview in the round table meeting (expert discussion) the travel time is about 10-20 minutes. Officially in 75% of the road accidents the ambulance arrives within 15 minutes.

Remark: In the frame of our study in case 36 analyzed fatal accidents average time between the reporting of the accident to the ambulance and the arrival of the patient to the hospital is less than 1 hour.

e. Travel time of incident clearance (t5)

This time was provided by the Hungarian Public Roads Co. and State Motorway Management Company through questionnaires. Regarding public roads 60, regarding motorways approx. 8 maintenance centres were involved in this questionnaire.

The involved maintenance centres of Hungarian Public Roads Co. are shown in Figure 32**.**

The evaluated questionnaire of the Hungarian Public Roads Co., which is shown in Figure 33, gives a result of an statistical average 32 minutes. Regarding State Motorway Management Company this time is 25 minutes.

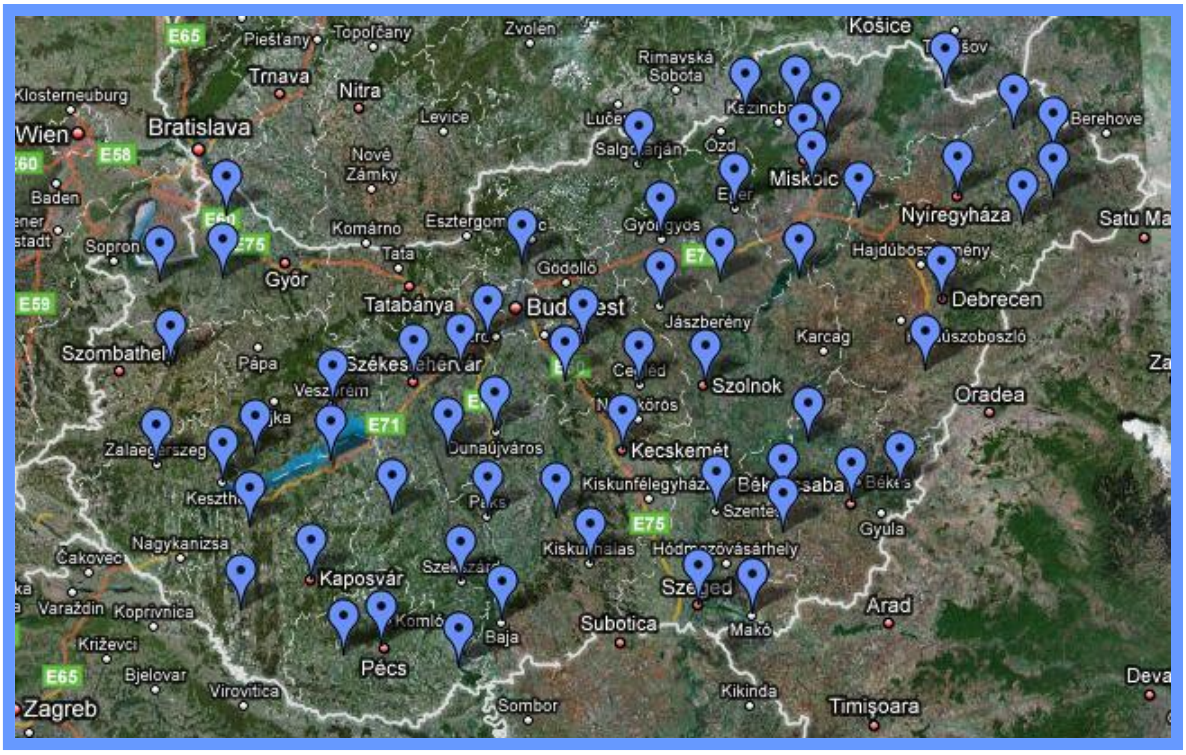


Figure 32: Involved maintenance centres of Hungarian Public Roads Co.

Both road operator companies have remarks on this question, which are the following.

The travel time of incident clearance depends on the follows:

- The accident happens during the work-hours, or not (after work-hours the travel time can be longer);
- location of the accident / distance from the maintenance centre;
- traffic, weather and road conditions;
- the number of accidents happen at the same time.

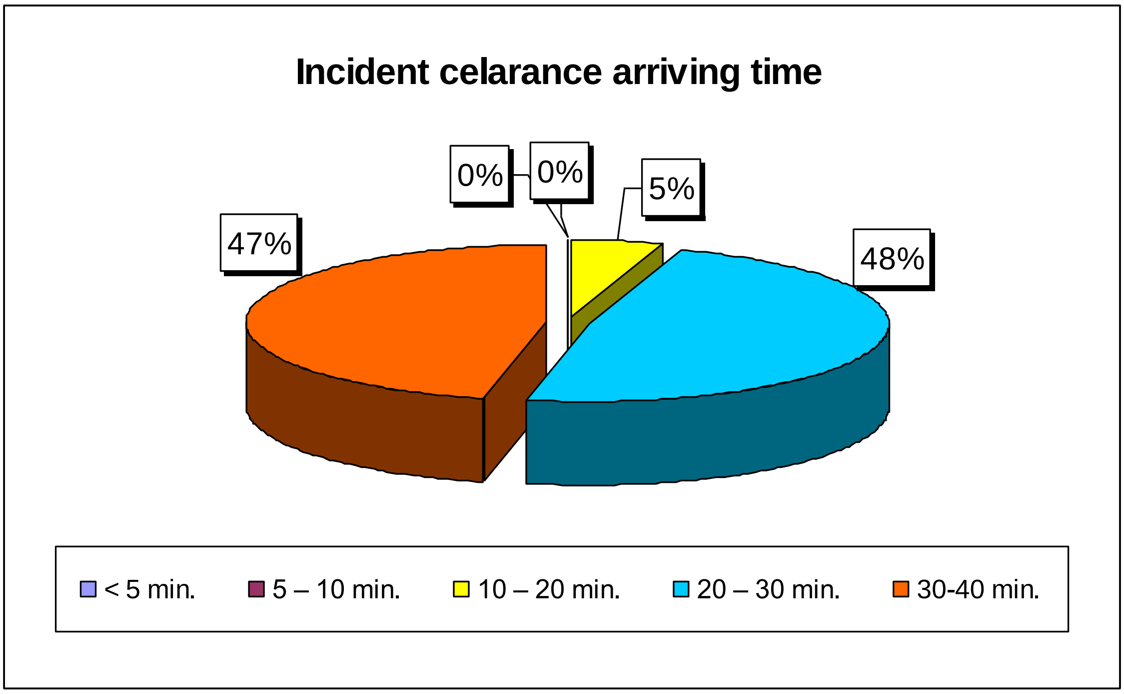


Figure 33: Average arriving time of the incident clearance team

f. Cleaning time of accident scene (t6)

Through the questionnaire the clearing time of the scene could also be found. Regarding public roads the statistical average result is 25 minutes. Detailed results can be found in Figure 34.

The average time to clear the scene in case of an accident, which occurs on motorways, is about 10-20 minutes.

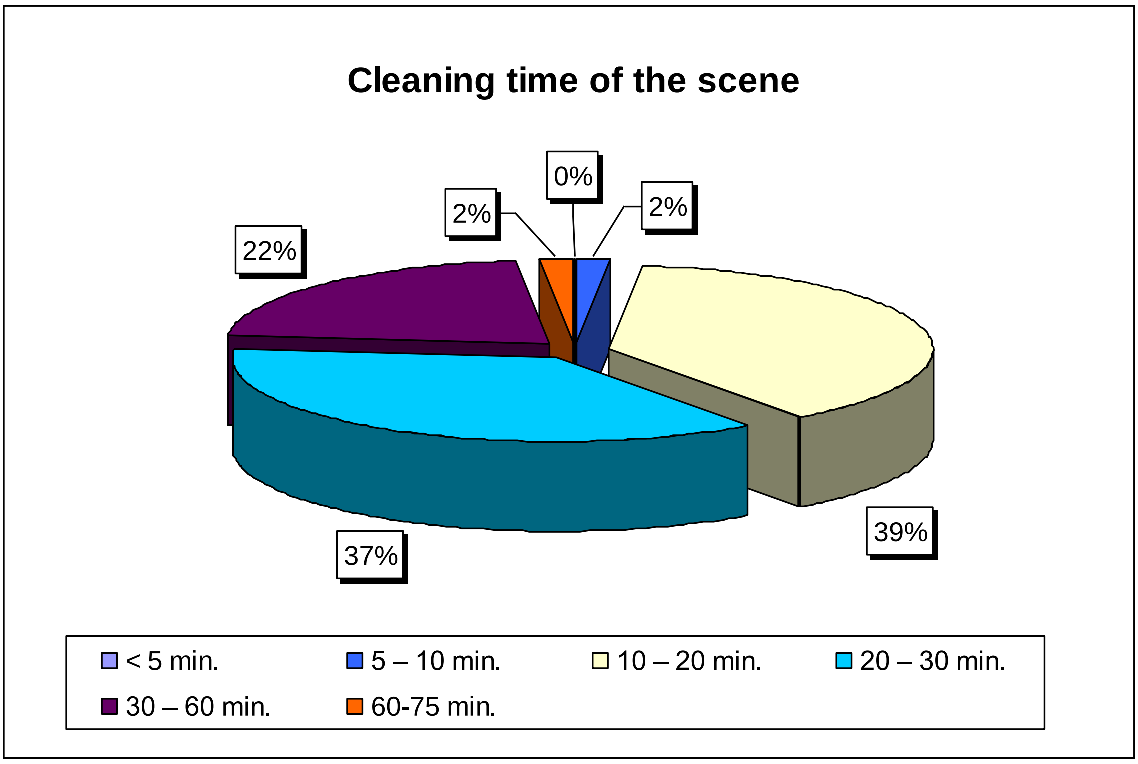


Figure 34: Average time to clear the scene

Both results were commented, as follows:

Remarks: The incident clearance time depends on the follows:

- Severity of the accident, extent of the accident scene;
- quantity/ quantity of the impurity of the road-surface;
- weather conditions;
- the need of technical rescue, as well as the need and time of traffic engineering measures (deviation, closure of lanes, etc.);
- the police investigation required ("lost time": the clearance brigade is on the scene, but because of measures/investigations done by the police no possibility for the clearance).

The most remarkable is the 'lost time' that means a time, in which the clearance team cannot do any significant work till the police investigation has finished. This time is about 20 minutes according to the questionnaire, which means in that sense that the cleaning time could me much longer, even double much as it could be.

5.7.3.2 Reduction of rescue time by eCall

Among the above mentioned time components of the whole rescue crucial is the reporting time.

Taken into consideration that the average reporting time is in Hungary about 15 minutes in the 96% of the cases, using eCall this component of the rescue time could be reduced to almost zero.

Therefore a reduction of 10-15 minutes is the basis of our calculations regarding congestion, and medical analyses (see detailed report).

5.7.4 Medical analysis of fatal injuries in road accidents after being hospitalized

5.7.4.1 Introduction

The number of road accidents has been permanently increasing parallel with the development of motorization. The change of the vehicles used in road traffic and the appearance of powerful engines have caused a certain change in the character of injuries and in the degree of severity. A part of seriously injured die on the scene of the accident, another part die during being taken to hospital and another part die during hospital treatment. Road safety experts have been permanently trying to enhance safety in several ways. Some of them focus on prevention of accidents, others focus on developing safety equipments which can reduce the severity of injuries suffered in road accidents, while another part focus on modernising rescue. Rescue includes technical rescue and sanitary measures as well.

The circumstances mentioned above mean permanent tasks for the adequate institutions of the EU and the member states, too.

In the recent years in Hungary the number of road accidents has been constantly increasing. This process seems to be interrupted in 2008. The currently known data show a decrease in the number of fatal road accidents. Beside other reasons it is likely that the new principles of police enforcement carried out in that period have a significant role in it.

According to certain studies, between 1 and 1.2 million people die on the roads of the world every year. In the EU 27 this figure is about 50,000. It means a rate of 90/100,000 persons.

In the ranking of accidental fatalities in the EU road accidents are on the 3rd or 4th place. In Hungary they are on the 3rd place, preceded by household and workplace accidents.

The sanitary rescue of road accidents is carried out by the National Ambulance Service (Országos Mentőszolgálat) in Hungary. They can ask for help from the police, the fire brigade or the disaster management if it is necessary.

The aim of this study is to make an assessment based on the data available about how can eCall influence the outcome of injuries among those injured in road accidents. It is a question if the injured person is taken to hospital earlier the critical or serious injuries could be eased or life could be saved.

The database of this study is based on the patients of the Traumatology Department of Károlyi Sándor Hospital. The period checked is 2005-2007.

Some features of the department involved in the study:

- Name: Karolyi Sandor Hosp. Dept. of Traumatology. Budapest, Hungary
- Number of beds: 110
- Service: Level 1 Trauma Center
- Injury type treated: any
- Estimated population in the area: 650,000
- Number of treated people injured in road accidents during the period: 110/month (estimated)
- Period checked: 2005-2007
- Number of people died in road accidents after being hospitalized between 2005-2007: 36

5.7.4.2 Analysis

Method: retrospective analysis

- Selection of cases: those who died of road accidents after being hospitalized.
- Death over 35 days was a reason of expelling from the study.

Discussion

It is an axiom that the severity of injury is determined at the moment of the accident. The task of the healthcare service is to prevent the development of any kind of aftermath or complication or the worsening of the state of the patient. The primary goal is to save human life.

The most difficult factor of the analysis is the lack of data. The data given can be found at different services and to get informed and to collect them sometimes means really difficult legal issues.

As it was mentioned earlier those cases have been analysed where the seriously injured person had been taken to hospital by the ambulance, but during or after the treatment they died. Data was sought about the time of reporting the injury and how long it took to hospitalize the person. The time of survival of the injury was also analysed. The injuries have been rated according to their severity and based on the ISS (Injury Severity Score) system. Autopsy was carried out in each of the cases. The injuries were analysed by the reports of those autopsies.

Analysis of selected cases

36 cases have been analysed. (n=36). Figure 41 shows the distribution of genders (24 males, 12 females).

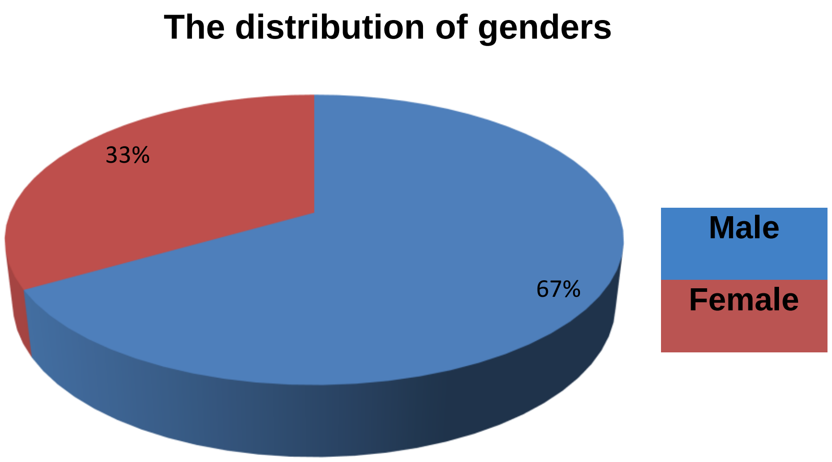


Figure 35: Distribution of genders (24 males, 12 females)

Average age: 52, youngest: 17, oldest: 86.

The average time between happening and reporting accidents in Hungary: (data given)

- less than 5 minutes 40% of cases
- between 5-15 minutes 56% of cases
- more than 15 minutes 4% of cases

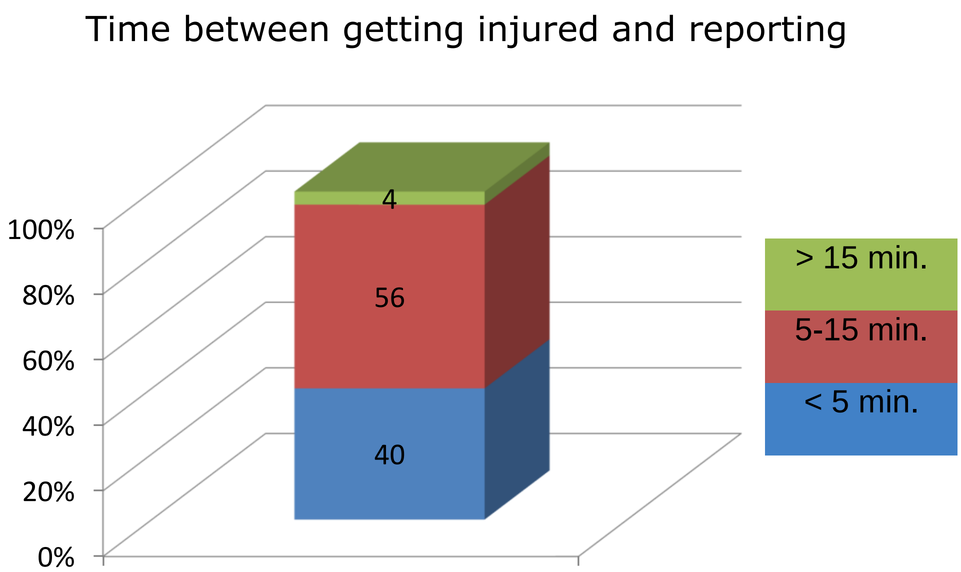


Figure 36 : Time between getting injured and reporting

Based on the small amount of data given the average time is 59 minutes between reporting and hospitalization. It has to be remarked that in Hungary according to the principles of rescue the rescue team first try to stabilize the state of the injured on the scene and only after primary minimal treatment can start carrying the injured person to hospital.

The diagram below shows how the injured person was involved in the accident. n=36

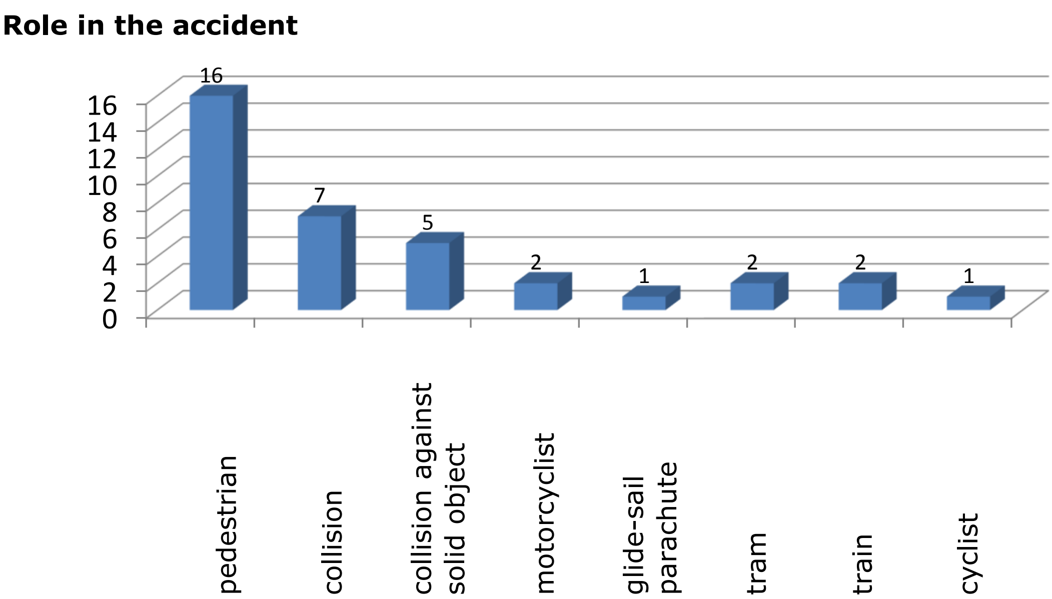


Figure 37: Role in the accident

It can be seen that the biggest proportion is represented by pedestrians followed by collisions of vehicles motorcyclists and cars collide against solid objects.

Injury Severity Score (ISS)

The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury

Scale (AIS) score and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities (including Pelvis), External. Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. An example of the ISS calculation is shown in Table 24.

Table 24: Results of the analyses regarding reporting time

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver Complex Rupture Spleen	2 5	 25
Extremity	Fractured femur	3	
External	No Injury	0	
Injury Severity Score:			**50**

The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. The ISS score is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity.

It's weaknesses are that any error in AIS scoring increases the ISS error, many different injury patterns can yield the same ISS score and injuries to different body regions are not weighted. Also, as a full description of patient injuries is not known prior to full investigation & operation, the ISS (along with other anatomical scoring systems) is not useful as a triage tool. (http://www.trauma.org/archive/scores/iss.html)

According to the reports of autopsies the injured persons have been rated by the severity of their injury. The rating is based on ISS). The diagram below shows the arrangement based on ISS.

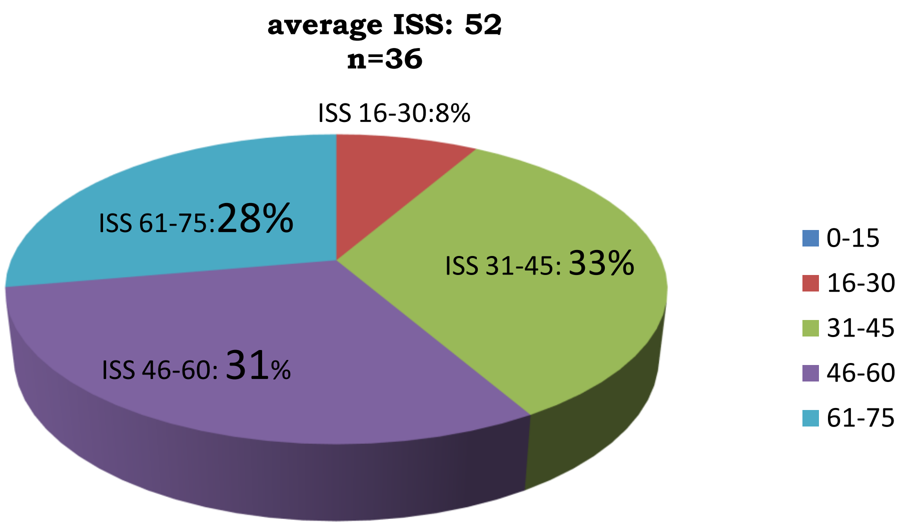


Figure 38: Distribution of Injury Severity Score

Applying that score system makes it possible to rate according to the severity of injury. The most severe category from traumatological point of view is the polytraumatized injured who score 22-25 ISS points. A score of 35 and above means critical state and possible fatal outcome. The maximum score is 75 points. This value is given to those die on the scene, injuries incompatible with life and those who have several different injury scores added and calculated as a maximum value.

The average ISS score regarding to the analysed cases is: 52.1

Analyses of death

In most cases of the injuries were accompanied by loss of consciousness. The injured have been divided into three main categories according to the cause of death. They are: bleeding, brain injury, brain injury and bleeding together.

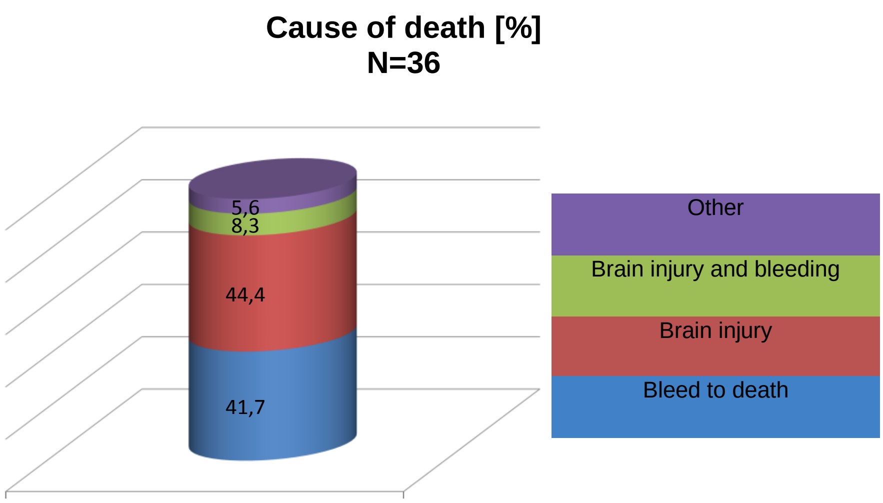


Figure 39: Cause of death

The reports of autopsies have been looked and the possibility of survival have been analysed from the point of view of saving life with a possible earlier hospitalization.

The injured have been categorised according to the time of survival in the hospital.

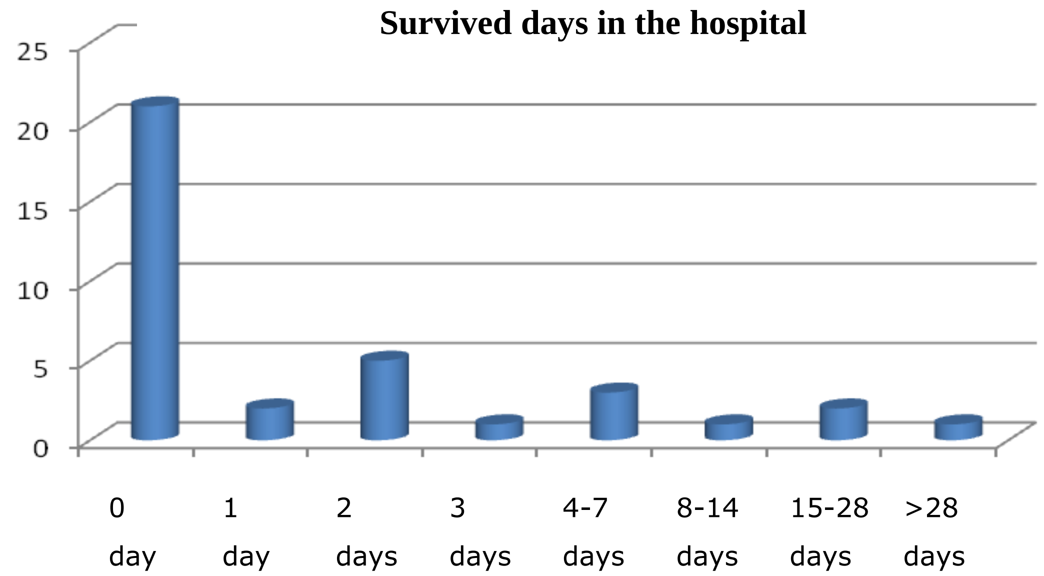


Figure 40: Survived days in hospital

Distribution of mortality within 24 hours

n=21

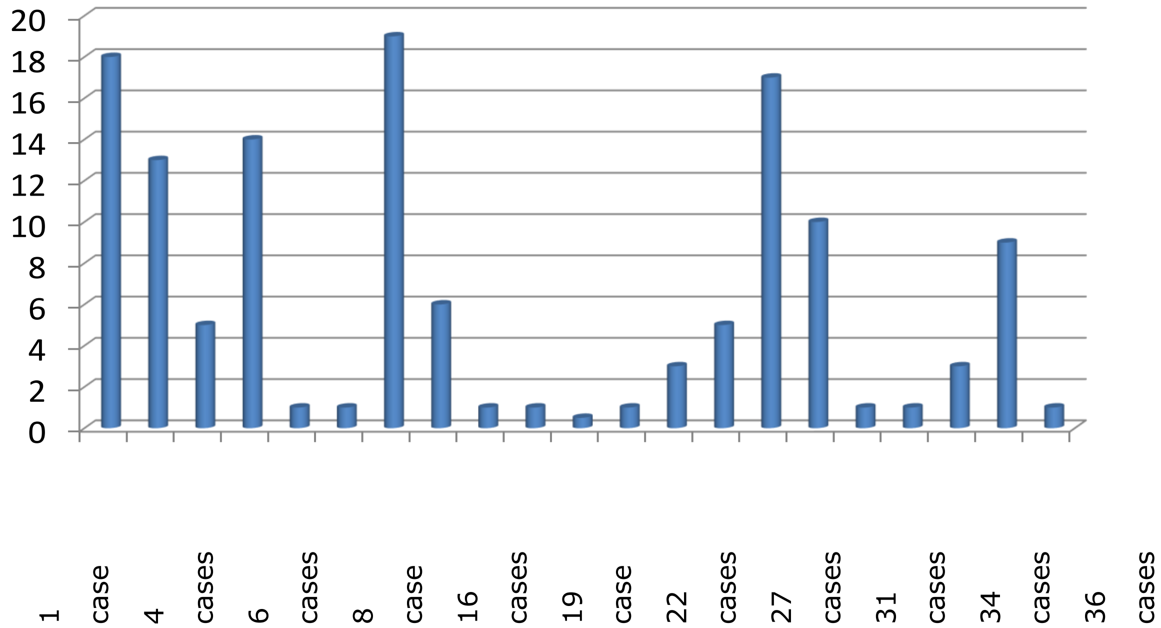


Figure 41: Distribution of mortality within 24 hours

Results of the evaluation

The injured involved in this current study represent the most severe category according to the relevant classification. Based on the data given they were immediately taken to hospital after the urgent oxyological treatment on the scene. The average time of hospitalization is considered to be good. It has to be remarked that the time shown represents the period between the report of the injury and the reception in the hospital, so arriving to the scene, medical treatment on the scene and carrying are also included. The average ISS of the injuries is very high, the state of the majority was critical from the point of view of survival. In our opinion the factor of time is of crucial importance regarding rescue, especially the three categories mentioned below:

- cases involving bleeding,
- certain skull-brain injuries,
- cases involving loss of consciousness.

Unconsciousness represents a separate category. It requires immediate medical assistance even in case of slight injury because the possible complications can cause severe damage of health. Concussion itself, for example, does not require any substantial traumatological or neurotraumatological treatments, but in case of respiratory aspiratio it can cause major worsening of state. (Respiratory aspiratio means objects in the respiratory system. They can be vomit, pieces of food, set of artificial teeth, chewing gum which can block the respiratory system). In these cases the arrival of the ambulance on time could be enough while in cases of major bleeding, especially hemorrhage in a body cavity, the earliest possible hospitalization can influence the final outcome. The majority of brain injuries are not effected with the earlier possible hospital treatment.

In at least 3 cases with injured persons they had an injury incompatible with life. (tear of medulla oblongata in 1 case, tear of aorta in 2 cases). In two cases organ donation occurred because of brain death.

According to the reports of forensic autopsies each injured received the expected optimal treatment according to the medical rules.

It is stated that the severity of injury is determined at the moment of the accident. Serious or critical injuries do not turn into slight injury, the fast and professional treatment can help to avoid the worsening of the state or save human life.

According to the cases shown there are only two cases where there is a potential possibility of survival if there is more time for treatment. Summarizing the cases we are convinced that 30-60 minutes is that time which can be considered as a claim for plus. Due to the small number of cases analysed the rate of 5.5% with the two cases mentioned can be exaggerated.

In our opinion - from medical/traumatological aspect, ***based on a 30 year experience with in road accidents injuried persons/victims*** - the potential possibility for life-saving in case of implementing eCall is about 2-3%.

Other added statements:

- The number of cases is small – the study cannot be considered as representative.
- There is not any appropriate database for an exact survey
- There is not any regular registration where the time between the happening and the reporting of the accident can be calculated
- The data searched can be found at different institutes and different state organizations where they are archived that is why it is extremely difficult to get the information
- Access for certain data can be blocked by legal difficulties
- A representative survey could be implemented in that case if the fatal accidents were registered on the scene
- It would be necessary to receive all of the reports on autopsies of fatal accidents to analyse

- There is not an exact limit between fatal and non-fatal outcome. Regarding eCall the different scoring systems can only be interpreted with conditions.

Remarks

Currently in Hungary (and in several other European countries) the victims of road accidents are categorised according to the outcome of the accident: fatal / severe / slight injury.

It would be essential to make differences in ***severity*** of injury. The Abbreviated Injury Scale (AIS) and the Injury Severity Score ISS are important tools for grading the severity of injury to trauma patients. Other tools for this purpose are: Modified Severity Scale (MISS), Glasgow Coma Scale (GCS), Trauma Score (TS, simple physiological measure of injury severity). The Trauma Chart provided a simple and concise guide for scoring and recording this useful information. In Hungary, regarding the victims of road accidents AIS and ISS scorings are only used in researches. Additional analyses need to be done to decide which scoring system from the above mentioned would be appropriate for scoring the victims of road accidents.

To make a better assessment regarding the impact of eCall and to the cost-benefit analysis usage of 3 different types of severe injury categories might be more appropriate instead of the existing one category. These would be the following:

"Slightly severe"	(low ISS rate, injured person could recover after 2-10 days of medical treatments)
"Medium severe"	(higher ISS rate, injured person could work after 10-30 days of medical treatments)
"Serious severe"	(very high ISS rate, after 1 year of medical treatments the injured person could not recover totally and partly or totally disabled in work)

Summary

Retrospective analysis has been carried out among patients who sustained injuries in road accidents. The polytraumatised cases have been listed who were brought to the traumatological department by the ambulance and died at the department no later than 35 days after their injuries. In all the data of 36 injured patients have been processed. The average age is 52 years, the average time of survival 3.4 days. Most of them (67 %) died within 24 hours. 44 % were pedestrians hit by car. The average time of transportation is 58 minutes, by which the time between notification and reception at the hospital is meant. In each case autopsy was performed in the forensic medical institute of the local medical university. The injured and injuries have been grouped on the basis of their ISS (Injury Severity Score) and have also been compared with the results of the autopsy findings. In our view the severity of the injury is determined at the moment of the accident, which is not affected by the early start of the treatment, though it may help to avoid complications and improve the chances of survival. In the case of three types of injuries the introduction of e-call may improve treatment: if the patient is unconscious, certain brain injuries, and injuries accompanied by hemorrhage in a body cavity.

Because of the small number of cases the study cannot be called representative. We estimate – from medical/traumatological aspect – that at 2 to 3 % the number of cases where the introduction of e-callCall emergency system may improve the chances of survival. An important additional remark is that for a representative study it would be necessary to study the cases of deaths on the spot at the same place at a given time. At present no adequate data base is available which would document the time elapsed between the occurrence of the injury and notitification. We find it important to state that the point cannot be exactly determined where the outcome is irreversibly fatal.

5.7.5 Estimated Congestion Delays And Costs Caused By Road Accidents In Hungary, possible impact of eCall

5.7.5.1 Introduction

Road accidents are classified to two categories. Category 1 includes the accidents causing financial loss and damage only but no personal injury, while Category 2 includes the personal injury accidents with at least one slight injury. While the rate of damage only accidents is much higher, this category is not recorded by the Central Statistical Office, however, in Category 2 rather detailed records are maintained.

Road accidents inevitably lead to more or less disorder and congestion since they occur in road traffic. The disorders manifest themselves in reduced road capacity, vehicles often forced to wait, obstructed traffic flow, queues generated by the arriving vehicles, and congestion.

Thus the road accidents cause more or less time loss to users compared to smooth traffic.

DECA (***DE***lay ***C***aused by Personal Injury ***A***ccident) is a proprietary software product developed by Road Safety Research Co. to support the estimation of traffic time loss due to personal injury accidents.

5.7.5.2 Application of DECA for the definition of time losses relating to congestions due to accidents

Overview of DECA

Personal injury accidents typically cause traffic disorder and congestion. The disorder depends on several factors, especially on the outcome of the accident, the traffic flow rate at the time of the accident, the nature of the accident and, last but not least, on the notification times of the Police and Ambulance, their response times, how quickly they can attend the injured persons, and the time required by the road operator to restore the original condition of the road.

DECA uses a simple vehicle queue building and relieving model to compute the time loss expressed in vehicle/hours based on available databases and expert estimates, and the loss defined by the given cost indicators and expressed in Hungarian Forints.

Parameters can be assigned to certain factors of the product, thus the user can change the parameters to run repeated computations, or to calculate correlations and impacts.

The input data used by DECA for the computations are as follows:

- accident data;
- traffic rate;
- fractional intervals (as adjustable parameters) of the *total period of time* from the time of the occurrence to the resumption of smooth traffic.

Accident data

The following data are automatically selected from the road accident database published and made available to road operators by the Central Statistical Office:

- accident time: year/month/day/hour/minute;
- accident site: county/urban/non urban/district/road No./km section;
- accident outcome: fatal/severe/slight;
- accident type: collision of vehicles / single vehicle accidents / hit pedestrian

Definition of traffic rate

The traffic data of the national network expressed in Average Daily Traffic (ADT) are maintained in the National Road Databank (OKA2000).

The following traffic pattern is used for the computations:

"*passenger car*" means vehicles other than HGV

"*non passenger car*" means HGV

The traffic data referring to the exact site and time of the accident are defined by the product from *annual average daily traffic* (AADT) by applying correction factors. The charts of the factors include:

- factors by months;
- factors by days in the week;
- factors by hours in the day;
- percentages of HGV traffic.

The values of the factors used in the computations of eCall evaluation are presented in the *Annex* (Table M1-M4). The user has the option to revise the values of the factors for the purpose of other computations.

Since no detailed traffic database is available for roads managed by municipalities, estimated values have been given for the computations (default values for streets: 200 vehicles/h, other roads: 500 vehicles/h). The user has the option to revise the traffic data of municipality roads for the purpose of other computations.

Adjustable fractional time parameters

The fractional time intervals used in the computations (as parameters) are defined by the user in an Excel chart of *5 worksheets.* The factors and time data needed for the computations are included in the worksheets. The adjustable fractional times are as follows:

Time of the emergency call

The interval between the time of the accident and the time of notification (i.e., of the eCall) virtually equal to the time loss that can be "saved" using the eCall system.

As part of the project, the eCall data recorded in the daily accident reports of the Police were collected in a county (Győr-Moson-Sopron) and used in setting up the parameter charts (these data are also included in the PSAP questionnaire and in the criteria template.

In the computations it was assumed that the time of the emergency call depends on the density of the local population and on the time of the day in which the accident has occurred. In the parameter chart different eCall "base times" have been selected by counties depending on the density of the population of the specific county. The data are charted in Table 25.

Table 25:"Base times" of emergency call by counties depending on the density of the population of the specific county

Population density (inhabitants/km²)	56-75	76-87	88-99	100-170
eCall base time (hour)	0.15	0.11	0.12	0.10

The base times are increased by factors according to the occurrence, i.e., *in urban area or outside urban area,* and *daytime or at night.* The factors applied to the base times are presented in Table 26.

Table 26: "Base time" factors taking into account the occurrence, i.e., in urban area or outside urban area, and daytime or at night

In urban area		***Outside urban area***	
8 p.m. – 6 a.m.	*6 a.m. – 8 p.m.*	*8 p.m. – 6 a.m.*	*6 a.m. – 8 p.m.*
1.1	base	1.2	1.15

Times of the emergency calls for the Hungarian counties taking into account the occurrence, i.e., *in urban area or outside urban area,* and *daytime or at night* is included in *Annex* (Table M5).

<u>*Ambulance response time*</u>

According to the PSAP questionnaire the average response time of the Ambulance is in the range of 10-20 minutes. In the computations the base response time (base time) of the Ambulance depends on the size of the given county, therefore the response time has been prorated to county sizes considering the values shown in PSAP. The data are summarized in Table 27.

Table 27: "Base response time" (base time) depending on the size of the given county

County sizes (km²)	2265-3765	3766-5266	5267-6400	6401-
Ambulance base response times (hour)	0.25	0.35	0.45	0.55

Again, the base times are increased by factors according to the occurrence, i.e., *in urban are or outside urban area,* and *daytime or at night.* The factors applied to the base times are presented in Table 28.

Table 28: "Base time" factors taking into account the occurrence, i.e., in urban are or outside urban area, and daytime or at night

In urban area		***Outside urban area***	
8 p.m. – 6 a.m.	*6 a.m. – 8 p.m.*	*8 p.m. – 6 a.m.*	*6 a.m. – 8 p.m.*
0.9	base	1.8	1.4

The ambulance response time for the Hungarian counties taking into account the occurrence, i.e., *in urban area or outside urban area,* and *daytime or at night* is included in *Annex* (Table M6).

<u>*Time spent by the Ambulance on the site*</u>

The time spent by the Ambulance on the site varies according to the number of injured persons and the severity of the injuries. Consequently this time has been defined on basis of *accident type.* This time is not necessarily prolonged by the severity of the accident as the persons who have been killed immediately and beyond help do not require much time from the Ambulance.

During the rescuing process the traffic flow is not necessarily obstructed by the ambulance cars as they are generally parked out of way. On the other hand the injured person may have to be dislodged from a car stopped on the road. In this case the Fire Service and the Ambulance are working together and the traffic is completely blocked.

A detail of the parameter chart is presented in Table 29 below. The complete chart including the times selected for the computations is presented in the *Annex* (Table M7).

Table 29: Time [hour] spent by the Ambulance on the site on the basis of *accident type* (detail of the parameter table)

	Fatal	***Severe***	***Slight***
	1.7	*1.4*	*Basis(1)*
Collision of vehicles driven in opposite direction (head-on collision)	0.85	0.7	0.5
Collision of vehicles driven in the same direction (rear-end collision)	0.68	0.56	0.4
Collision of vehicles driven in crossing direction	1.02	0.84	0.6

<u>*Clearing time by the road operator*</u>

According to the PSAP questionnaire this time is longer than 30 minutes in the public road network and ranges between 20 – 30 minutes in the motorway network (these results were obtained from a survey of 74 road maintenance centres and motorway maintenance centres).

The cleaning time is clearly defined by the contamination of the pavement and the amount of scattered wrecks, and these in turn strongly depend on the type and severity of the accident.

In the computations the clearing time of the road operator (and the site inspection activities of the Police) have been defined in function of the above two factors. A detail of the parameter chart is presented in Table 30 below. The complete chart including the times selected for the computations is presented in the *Annex* (Table M8).

Table 30: Clearing time [hour] by Road Operator on the basis of accident type (detail of the parameter table)

	Fatal	***Severe***	***Slight***
	2.5	*1.5*	*Basis(1)*
Collision of vehicles driven in opposite direction (head-on collision)	0.5	0.3	0.2
Collision of vehicles driven in the same direction (rear-end collision)	0.3	0.18	0.12
Collision of vehicles driven in crossing direction	0.375	0.225	0.15

Computation of time lost due to congestions caused by accidents

It is assumed that the traffic flow is stopped in the site of the accident and a queue is developed by the arriving vehicles. After the departure of the Ambulance and the Police and the road is cleared, the traffic flow is resumed and the queue is gradually relieved. Most public roads have 2x1 lanes. The traffic of these roads is completely blocked and it is only restarted as the rescuing and site inspection activities are progressing, first in alternate directions or stalling. The option of traffic diversion is open more often in urban areas and less often in non urban sections, however, traffic delays and losses are unavoidable.

In the motorways completed with 2x2 or 2x3 lanes the traffic can be diverted in a part of the accidents, but time losses are nevertheless suffered. However, in case of many motorway accidents the traffic of the relevant carriageway is fully blocked, especially during site inspection or technical rescuing. For example the southern sector of Ring M0 is an expressway of 2x2 lanes and one of the carriageways is generally blocked by any accidents occurring in the daytime, leading to gargantuan queues and heavy time losses.

Steps of DECA computations

1. Download the required parameters and factors in the parameter chart.
2. Start the product, select the period to be computed, then select 3 screening criteria. 12 different computations can be performed by setting the screening criteria for the periods selected by the user.
3. Once the product has been started the results are displayed in 6 windows on the right side of the screen. Column 1 shows the time loss expressed in vehicle/hours and Column 2 shows the loss in ‘0001000 HUF.

Opening screen display

Upon starting the product the opening screen presented in Figure 22 is shown. The screening criteria can be selected through the opening screen as follows:

- review period;
- accident outcome: fatal/severe/slight;
- road operator: national public road / municipality road;
- accident site: urban/non urban area.

Figure 42: Opening screen of the DECA model

Sample computation

Figure 23 shows the results of a sample computation. The input data and sub totals of each accident appear in one line on the displayed table.

Let us calculate, on basis of the 2007 accident database, the total vehicle delays and the total economic loss suffered in May 2007 in consequence of congestions, obstructions or queues due to fatal accidents in the non urban sections of the public road network.

The per unit values of triptravel time loss have been defined on basis of the data of the research project *Methodological guidelines for the TEMPO evaluations and cost-benefit analysis of ITS road projects* (*Módszertani Útmutató közúti ITS projektek TEMPO értékeléséhez, költség-haszon elemzéséhez*) prepared by COWI Hungary LLC in the frameworks of the CONNECT project.

Thus the per unit loss values used in the computations are as follows:

passenger cars: 3300 HUF/veh/h

non-passenger cars: 9500 HUF/veh/h

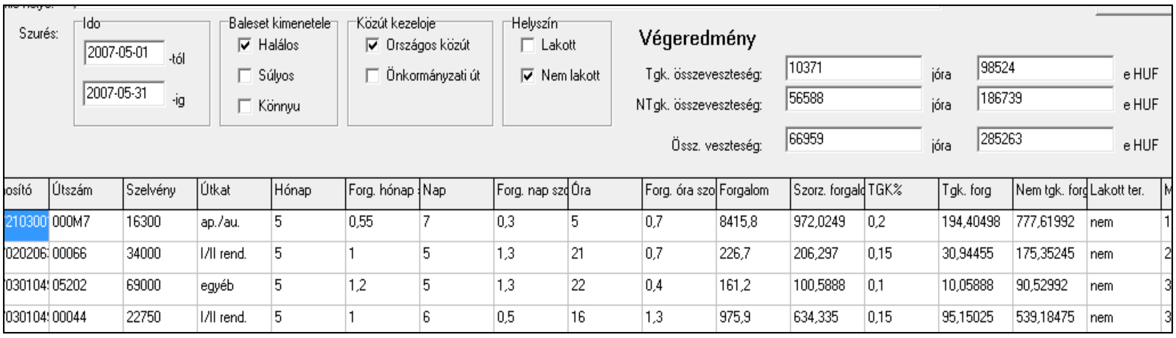


Figure 43: Totals of the sample computation

The totals of this sample computation are presented in Figure 4.2. According to the answers to the above questions, in May 2007 the total delay generated in the sites of fatal accidents amounted to 66.959 vehicle/hours and the consequent total loss incurred by the national economy amounted to 285.263 million HUF.

Figure 4.2 only shows a detail of the sub totals. The product completes one line for each accident, in which the input parameters and the sub results of the computations can be checked. The results can be exported to Excel charts to perform any other computations.

The losses *"without eCall"*, i.e., in the present situation, were computed using the data of four intervals specified in the parameter chart (emergency call, Ambulance response time, time spent by the Ambulance on the site, and clearing time).

The losses *after the deployment of the eCall system* were computed assuming that the reporting time using *eCall* could be "*0*", thus the time values of callthis parameter in the related chart were set to zero.

<u>Note</u>*:* The response times of the site inspection police and the technical rescuing staff of the Fire Service were not taken into account separately as the PSAP questionnaire fails to include these data; this is considered a gap since the traffic flow is surely blocked during activities like inspecting the site, recording the data, or determining the exact breaking distance and other distances. Therefore we tried to define the times considered in the computations, especially the Ambulance response times and clearing times, so as to include the times of these police and technical rescuing activities.

5.7.5.3 Results obtained for year 2007 using the DECA model

By means of the DECA product the total *congestion hours* was determined considering all personal injury accidents occurring in 2007; the reduction of congestion hours was determined for the scenario with eCall, and the total economic loss due to the time losses was determined. The results of the completed calculations are presented in *Table 4. 6* and the time values used in the computations are presented in the annexed parameter charts (Table M5-M8).

The per unit values of triptravel time losses were defined on basis of the data of the research project *Methodological guidelines for the TEMPO evaluations and cost-benefit analysis of ITS road projects* prepared by COWI Hungary LLC in the frameworks of the CONNECT project.

Computations were performed separately for the sections of the public road network outside urban areas, in urban areas, as well as for municipality roads. Computation results are also available for passenger cars and HGV.

Time loss relating to congestions due to accidents

According to the completed computations, if the eCall system is deployed the estimated *reduction of congestion time loss* will be as follows:

- public road sections in urban areas: 17.8%;
- public road sections outside urban areas: 17.2%;
- municipality roads: 16.8%;
- *in the total road network: 17.4%.*

The detailed results of the computations are presented in Table 31.

Table 31: DECA computation results: Vehicle hours spent in congestion without and with *eCall* system (on the basis of 2007. data)

Type of network	Vehicle-hours spent in congestion [* 10^6 h/year]					
	without eCall (present situation)			*with eCall (estimated)*		
	Passenger cars	**Heavy vehicles**	**All**	**Passenger cars**	**Heavy vehicles**	**All**
Public road network (urban area)	5.03	0.83	5.86	4.13	0.69	4.82
Public road network (outside urban area)	9.37	1.70	11.10	7.79	1.40	9.19
On municipality roads	0.13	0.01	0.14	0.10	0.01	0.12
Sum	**14.53**	**2.54**	**17.10**	**12.03**	**2.10**	**14.13**

As Table 28 shows the congested hours caused by incidents is 17.10 millions of hour. According to experts' estimation this is approximately 20 % of the total congested hours, which means that the total congested hour is 85.5 millions of hour. Taking into consideration that eCall can't reduce the congested hours caused by heavy traffic (68.4*106 hours) the total hours of congestion using eCall is 52.53 millions of hour.

That means with the help of eCall **all together 3.5% reduction** could be reached in comparison to the total congested hours.

Scenario	Total delay hours due to congestion (in millions)	Total delay hours due to congestion caused by incidents (in millions)	Percentage congestion due to incidents
Reference	85.50	17.10	20.0%
With eCall	82.53	14.13	16.5%

Additional analyse

The analysis made for the *all road-network* on Hungary took into consideration the *total time-frame* of the rescue-chain (beginning from the accident occurrence until the end of the cleaning works), assumed a *disturbed or/and congested* traffic flow.

Using the DECA model for *the public road-network* (30.000 km) taking into consideration only the *fatalities* (774 in 2007) *and severe injuries* (3416 in 2007), defining the congestion as really *stopped traffic flow*, the result is as follows:

Actual situation (without eCall):

880.900 vehicle-hours/year (210 vehicle-hours /accident)

With eCall:

699.232 vehicle-hours/year (167 vehicle-hours /accident)

The reduction of the congested hours is *180.000 vehicle/hours*, about **20 %**, in this case the number of the saved congested hours is higher.

***Travel time** losses in financial terms*

The per unit values of triptravel time losses relating to congestions due to accidents were defined on basis of the data of the said research project *Methodological guidelines for the TEMPO evaluations and cost-benefit analysis of ITS road projects.*

According to the completed computations, if the eCall system is deployed the estimated reduction of economic loss arising from the estimated congestion time losses will be as follows (in percentage of HUF):

- public road sections in urban areas: 18.0%;
- public road sections outside urban areas: 17.6%;
- municipality roads: 18.2%;
- *in the total road network: 17.7%.*

The detailed results of the computations are presented in Table 32

Table 32: DECA computation results traveltime losses (HUF) without and with *eCall* system (on the basis of 2007 data)

Type of network	**Triptravel time loss [* 10^9 HUF]**					
	without eCall (present situation)			***with eCall (estimated)***		
	Passenger cars	**Heavy vehicles**	**All**	**Passenger cars**	**Heavy vehicles**	**All**
Public road network (urban area)	16.62	7.95	24.57	13.63	6.52	20.15
Public road network (outside urban area)	31.2	16.15	47.35	25.7	13.31	39.01
On municipality roads	0.42	0.13	0.55	0.34	0.11	0.45
Sum	**48.24**	**24.23**	**72.47**	**39.67**	**19.94**	**59.61**

5.7.5.4 Annexes

Table 33: Factors by months

Months	***Motorway***	***Main roads and secondary roads***	***Other***
1	0.40	0.80	0.75
2	0.40	0.80	0.75
3	0.40	0.80	0.75
4	0.55	1.00	1.20
5	0.55	1.00	1.20
6	0.55	1.00	1.20
7	0.75	1.40	1.30
8	0.75	1.40	1.30
9	0.43	1.20	1.10
10	0.43	1.20	1.10
11	0.40	0.80	0.75
12	0.40	0.80	0.75

Table 34: Factors by days in the week

Days in the week	***Motorway***	***Main roads and secondary roads***	***Other***
Monday	0.55	1.10	1.10
Tuesday	0.50	1.00	1.00
Wednesday	0.50	1.00	1.00
Thursday	0.50	1.00	1.00
Friday	0.65	1.30	1.30
Saturday	0.30	0.50	0.50
Sunday	0.30	0.50	0.50

Table 35: Factors by hours in the day

Hours in the day	***Motorway***	***Main roads and secondary roads***	***Other***
0	0.70	0.60	0.50
1	0.70	0.60	0.50
2	0.70	0.60	0.50
3	0.70	0.60	0.50
4	0.70	0.60	0.50
5	0.70	0.60	0.50
6	1.40	1.30	1.20
7	1.40	1.30	1.20
8	1.40	1.30	1.20
9	1.40	1.30	1.20
10	1.40	1.30	1.20
11	1.40	1.30	1.20
12	1.40	1.30	1.20
13	1.40	1.30	1.20
14	1.40	1.30	1.20
15	1.40	1.30	1.20
16	1.40	1.30	1.20
17	1.40	1.30	1.20
18	0.80	0.70	0.40
19	0.80	0.70	0.40
20	0.80	0.70	0.40
21	0.80	0.70	0.40
22	0.80	0.70	0.40
23	0.80	0.70	0.40

Table 36: Percentages of HVG traffic

	Motorway	***Main roads and secondary roads***	***Other***
Percentages of HGV traffic [%]	0.20	0.15	0.10

Table 37: Time of the emergency call (interval between the time of the accident and the time of notification) in hours

County	*In urban area*		*Outside urban area*	
	8 p.m. – 6 a.m.	*6 a.m. – 8 p.m.*	*8 p.m. – 6 a.m.*	*6 a.m. – 8 p.m.*
	1.1	Base (1)	1.2	1.15
Budapest [01]	0.088	0.08	0.096	0.092
Baranya [02]	0.121	0.11	0.132	0.1265
Bács-Kiskun [03]	0.165	0.15	0.18	0.1725
Békés [04]	0.165	0.15	0.18	0.1725
Borsod-Abaúj-Zemplén [05]	0.11	0.1	0.12	0.115
Csongrád [06]	0.165	0.15	0.18	0.1725
Fejér [07]	0.165	0.15	0.18	0.1725
Győr-Moson - Sopron [08]	0.11	0.1	0.12	0.115
Hajdú-Bihar [09]	0.121	0.11	0.132	0.1265
Heves [10]	0.165	0.15	0.18	0.1725
Komárom-Esztergom [11]	0.11	0.1	0.12	0.115
Nógrád [12]	0.132	0.12	0.144	0.138
Pest [13]	0.11	0.1	0.12	0.115
Somogy [14]	0.165	0.15	0.18	0.1725
Szabolcs-Szatmár-Bereg [15]	0.121	0.11	0.132	0.1265
Jász-Nagykun-Szolnok [16]	0.165	0.15	0.18	0.1725
Tolna [17]	0.165	0.15	0.18	0.1725
Vas [18]	0.132	0.12	0.144	0.138
Veszprém [19]	0.132	0.12	0.144	0.138
Zala [20]	0.132	0.12	0.144	0.138

Table 38: Ambulance response time (interval between the emergency call and the arrival of the ambulance) in hours

County	***In urban area***		***Outside urban area***	
	8 p.m. – 6 a.m.	*6 a.m. – 8 p.m.*	*8 p.m. – 6 a.m.*	*6 a.m. – 8 p.m.*
	0.9	Base (1)	1.8	1.4
Budapest [01]	0.27	0.3	0.54	0.42
Baranya [02]	0.315	0.35	0.63	0.49
Bács-Kiskun [03]	0.495	0.55	0.99	0.77
Békés [04]	0.405	0.45	0.81	0.63
Borsod-Abaúj-Zemplén [05]	0.495	0.55	0.99	0.77
Csongrád [06]	0.405	0.45	0.81	0.63
Fejér [07]	0.315	0.35	0.63	0.49
Győr-Moson - Sopron [08]	0.315	0.35	0.63	0.49
Hajdú-Bihar [09]	0.405	0.45	0.81	0.63
Heves [10]	0.225	0.25	0.45	0.35
Komárom-Esztergom [11]	0.225	0.25	0.45	0.35
Nógrád [12]	0.225	0.25	0.45	0.35
Pest [13]	0.495	0.55	0.99	0.77
Somogy [14]	0.405	0.45	0.81	0.63
Szabolcs-Szatmár-Bereg [15]	0.405	0.45	0.81	0.63
Jász-Nagykun-Szolnok [16]	0.405	0.45	0.81	0.63
Tolna [17]	0.225	0.25	0.45	0.35
Vas [18]	0.225	0.25	0.45	0.35
Veszprém [19]	0.315	0.35	0.63	0.49
Zala [20]	0.315	0.35	0.63	0.49

Table 39: The time spent by the ambulance on the site in hours

	Fatal	***Severe***	***Slight***
	1.7	*1.4*	*Base (1)*
Collision of vehicles driven in opposite direction (head-on collision) [11]	0.85	0.7	0.5
Collision of vehicles driven in the same direction (rear-end collision) [12]	0.68	0.56	0.4
Collision of vehicles driven in crossing direction [13]	1.02	0.84	0.6
Collision of railway and road vehicles [14]	0.68	0.56	0.4
Collision of vehicle driving in a straight line and vehicle turning left or right [15]	0.68	0.56	0.4
Collision of standing vehicles [21]	0.68	0.56	0.4
Collision to obstacle on road [22]	0.51	0.42	0.3
Skidding, swerving and turning over on road [31]	0.85	0.7	0.5
Leaving of the road without collision to obstacle [32]	0.34	0.28	0.2
Leaving of the road with collision to obstacle outside the road [33]	0.425	0.35	0.25
Running over pedestrian [51]	0.51	0.42	0.3
Accident of passengers [61]	0.51	0.42	0.3
Collision with animals [71]	0.51	0.42	0.3
Other [81]	0.51	0.42	0.3

Table 40: Clearing time by road operator in hours

	Fatal	***Severe***	***Slight***
	2.5	*1.5*	*Base (1)*
Collision of vehicles driven in opposite direction (head-on collision) [11]	0.5	0.3	0.2
Collision of vehicles driven in the same direction (rear-end collision) [12]	0.3	0.18	0.12
Collision of vehicles driven in crossing direction [13]	0.375	0.225	0.15
Collision of railway and road vehicles [14]	1.25	0.75	0.5
Collision of vehicle driving in a straight line and vehicle turning left or right [15]	0.375	0.225	0.15
Collision of standing vehicles [21]	0.3	0.18	0.12
Collision to obstacle on road [22]	0.5	0.3	0.2
Skidding, swerving and turning over on road [31]	0.625	0.375	0.25
Leaving of the road without collision to obstacle [32]	0.25	0.15	0.1
Leaving of the road with collision to obstacle outside the road [33]	0.25	0.15	0.1
Running over pedestrian [51]	0.25	0.15	0.1
Accident of passengers [61]	0	0	0
Collision with animals [71]	0.25	0.15	0.1
Other [81]	0.5	0.3	0.2

5.7.6 *Impacts of eCall related environment and energy consumption*

All calculations related environment and energy consumption are based on the *„Guideline for evaluation and cost / benefit analyse of ITS applications in the road-transport"*, elaborated by COWI Hungary Ltd., in the frame of the euro-regional CONNECT project, Phase III in 2008 (*later: Guideline, 2008, COWI).*

The guideline was already successful used for the evaluation of traffic control and information systems on the Hungarian motorway network for the identification of a priority –list of the possible traffic control systems: CONNECT project, Phase III: *„Elaboration of a Technical Guideline for the traffic control and traffic information systems of the motorway network Part II"*, by Inter-út XXI. Ltd. in 2009 *(later: Technical Guideline, 2009, Inter-út XXI).*

5.7.6.1 *The effect of eCall on environment*

The effect of eCall on the environment can be concluded from the decrease of emission caused by the expected reduction decrease of congested hours caused by accidents.

During the calculation the specific emission of passenger cars and heavy vehicles it has been taken into account which is in direct proportion with speed. In case of passenger cars and heavy vehicles the speed of congestion is assumed to be *5 km/h.*

The specific emission of passenger cars and heavy vehicles, compared to the speed, is in Table 41.

Table 41: The specific emission of passenger cars and heavy vehicles, compared to the speed (*source: Guideline, 2008, COWI)*

Speed [km/h]	**Factors of specific emission in 2005 [g/km]**					
	Passenger car			***Heavy vehicle***		
	CO_2 [g/h]	**PM_x [g/h]**	**NO_x [g/h]**	**CO_2 [g/h]**	**PM_x [g/h]**	**NO_x [g/h]**
0	2.22	0.7690	1.940	3.680	1.390	28.8
5	326.3	0.1280	0.868	1375.5	0.954	7.32
10	275.6	0.1070	0.857	1078.5	0.774	6.57
20	212.0	0.0784	0.811	838.7	0.602	5.38
30	179.4	0.0626	0.834	743.0	0.532	4.87
40	161.3	0.0486	0.845	682.7	0.490	4.71
50	153.9	0.0424	0.879	659.2	0.470	4.68
60	153.5	0.0410	1.000	656.4	0.467	4.92
70	157.3	0.0415	1.140	684.7	0.462	5.38
80	163.2	0.0437	1.280	745.9	0.484	6.09
90	172.8	0.0512	1.370	852.9	0.546	7.10
100	186.3	0.0564	1.490	1026.9	0.616	8.70
110	202.7	0.0617	1.610			

As it was seen in the chapter on congestions, the number of vehicle-hours spent in congestion due to accidents is 14.53 million hours in case of passenger cars, while in case of heavy vehicles this figure is 2.54 million, that is 17.1 million hours a year. These figures can be reduced with the use of eCall system to 12.03 million hours in case of passenger cars and to 2.1 million hours in case of heavy vehicles. (See Table 42) The vehicle-hours in congestion can be reduced by nearly 3 million hours per year with the implementation of eCall.

Table 42: The results of DECA model calculation: vehicle hours spent in congestion without and with *eCall* system (on the basis of 2007 data)

Type of network	**Vehicle-hours spent in congestion [* 10^6 h/year]**					
	without eCall (present situation)			***with eCall (estimated)***		
	Passenger cars	**Heavy vehicles**	**All**	**Passenger cars**	**Heavy vehicles**	**All**
Public road network (urban area)	5.03	0.83	5.86	4.13	0.69	4.82
Public road network (outside urban area)	9.37	1.70	11.10	7.79	1.40	9.19
On municipality roads	0.13	0.01	0.14	0.10	0.01	0.12
Sum	**14.53**	**2.54**	**17.10**	**12.03**	**2.10**	**14.13**

The measurement of emission of road traffic in 2005 according to the database of the Ministry of Environment and Water:

- emission of carbon-dioxide: 12,002,499 tons/year
- emission of particles (soot): 6,193 tons/year
- emission of nitrogen-oxides: 98,365 tons/year

The effect of eCall on environment can be calculated from the data mentioned above. Details are in the next points.

The effect of eCall on the emission of carbon-dioxide

The speed and the CO2 emission of vehicles are connected and their measurement is shown in Table 5.1. In case of passenger cars with an estimated *5 km/h* speed of congestion the emission is 326.3 g/h, in case of heavy vehicles with the same speed it is 1,375.5 g/h. Table 5.3 shows that comparing the vehicle-hours spent in congestions without eCall the annual emission is 8,235 tons, with eCall it is reduced to 6,814 tons, which means reducing the carbon-dioxide emissions by road traffic in Hungary by 1,421 tons a year which was **0.0118%** of the annual amount in 2005.

The effect of eCall on the emission of particulate matter (PM)

The main source of particulate matter, emitted by road traffic, is the emission of soot from the defective burning of the fuel of two-stroke and diesel engines. The particle emission (mainly soot) of diesel engines is significantly bigger than petrol engines. (*source: Wikipedia*)

With the introduction of eCall besides reducing congestions the measurement of PM emission can also be reduced. According to Table 5.1 the PM emission of passenger vehicles at the speed of 5 km/h is 0.128 g per hour, while this figure at heavy vehicles is 0.954 g/h multiplied by the proportion of reduced congestions the number of annually saved PM-emission can be calculated shown in Table 5.3.

The proportion of particulate matter in Hungary can be reduced by 0.74 tons a year which is the **0.0046%** of total emission (16,193 t/year) in 2005.

The effect of eCall on the emission of nitrogen-oxides

Nitrogen-oxides are given off by burning fossil fuel, emitting exhaust fume, and having artificially fertilized soil.

Nitrogen-oxide emission coming from exhaust fume in case of 5 km/h average speed is 0.87 g, at passenger cars, while this figure is eight times bigger at heavy vehicles, 7.32 g per hour. In the current situation, without eCall, congestions mean 31.2 tons of carbon dioxide emitted a year. Taking into account those 3 million vehicle-hours in congestions which would be reduced by eCall means that the emitted amount would decrease by nearly 17% (Table 43).

The nitrogen-dioxide emission in Hungary would be reduced by 5.39 tons with the introduction of eCall. This amount is the **0.0055%** of the annual emission in 2005.

Table 43: Change of emission with the effect of eCall

Without eCall (present situation)	**CO_2 [g/h]**		**PM_x [g/h]**		**NO_x [g/h]**	
	Passenger cars	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles***
Emission at 5 km/h [g/h]	326.3	1375.5	0.13	0.95	0.87	7.32
Vehicle-hours spent in congestion[*10^6h/year]	14.5	2.5	14.53	2.54	14.53	2.54
Total emission [t/y]	**4 741.1**	**3 493.8**	**1.86**	**2.42**	**12.61**	**18.59**
	8 234.9		**4.28**		**31.20**	
With eCall	**CO_2 [g/h]**		**PM_x [g/h]**		**NO_x [g/h]**	
	Passenger cars	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles***
Emission at 5 km/h [g/h]	326.3	1 375.5	0.13	0.95	0.87	7.32
Vehicle-hours spent in congestion[*10^6h/year]	12.0	2.1	12.03	2.10	12.03	2.10
Total emission [t/y]	**3 925.4**	**2 888.6**	**1.54**	**2.00**	**10.44**	**15.37**
	6 813.9		**3.54**		**25.81**	
Difference	**CO_2 [g/h]**		**PM_x [g/h]**		**NO_x [g/h]**	
	Passenger cars	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles***	***Passenger cars***	***Heavy vehicles.***
Total emission without eCall [t/y]	4 741.1	3 493.8	1.86	2.42	12.61	18.59
Total emission with eCall [t/y]	3 925.4	2 888.6	1.54	2.00	10.44	15.37
Reduced emission together [t/y]	**815.8**	**605.2**	**0.32**	**0.42**	**2.17**	**3.22**
	1 421.0		**0.74**		**5.39**	
Total emission 2005	**12 002 499**		**16 193**		**98 365**	
Reduced emission [%]	**0.0118%**		**0.0046%**		**0.0055%**	

5.7.6.2 The effect of eCall on energy consumption

The energy gained by the introduction of eCall can be calculated with the amount of the fuel consumed during the vehicle is stuck in congestions.

The earlier calculated reduction of congestions is nearly 3 million hours per year (Table 5.2). Taking into account that the average fuel consumption in congestions is 3 litres per hour (*source: Technical Guideline, 2009, Inter-út XXI*) it can be simply calculated how much fuel can be gained with the use of eCall system. It is the following:

- $2.97*10^6$ h/y * 3 l/h = $8.91*10^6$ l/y

As we do not have any data on the distribution of petrol and diesel engine vehicles the above result is divided into two equal parts. The quantity of fuel at the certain types is $4,455*10^6$l/y.

Comparing to the petrol and diesel consumption figures in 2008 percentages with the costs are shown in Table 44.

Table 44: Energy reduction with eCall system

Fuel	**Fuel consumption 2008**	**Quantity of fuel gained by eCall (estimated)**		**Price of fuel (04.05.2009)**	**Cost gained by eCall (estimated)**
	[liter/year]	**[liter/year]**	**[%]**	**[Ft]**	**[Ft/year]**
Petrol	1 612 619 491	4 455 000	0.276%	267	1 189 485 000
Diesel	1 643 590 106	4 455 000	0.271%	257	1 144 935 000
Total	**3 256 209 597**	**8 910 000**	**0.547%**		**2 334 420 000**

5.7.7 Summary of the results / Conclusion

- There can be injuries that seem to be fatal on the spot but the death of the injured person could be prevented by faster rescue. Based on the detailed medical/traumatological and traffic engineering road-safety analyses, as well as expert discussions the estimated impact of eCall emergency call service on the ***reduction of fatal accidents*** is remarkable, **between *2 -2.5 %***.
- The impact of eCall emergency service on the *reduction of congested and disturbed traffic flow* caused by road accidents is remarkable according to the calculations carried out this figure is ***between 15 – 20%.***
- The impact of eCall emergency call service on the *reduction of all congested and disturbed traffic flow* on the total road-network is also significant; this figure is ***about 3.5 %.***
- The impact of improvedeCall on ***environment and energy consumption*** according to the figures of road-transport is ***rather insignificant.***
- Within the whole rescue time the reporting time is the most crucial, since the eCall emergency service has a direct positive impact on this time-component. A ***possible reduction of 10-15 minutes*** could be reached in Hungary.
- It would be essential ***to make differences in severity*** of injury. To make a better assessment regarding the impact of eCall and to the cost-benefit analysis usage of 3 different types of severe injury categories might be more appropriate instead of the existing one category.
- The responsible stakeholders of the expert-roundtable meeting are dedicated to discuss the eCall issues of this project proposed ***to use eCall systems also for motorcycles****, buses dedicated to transport school-children; as well as for vehicles dedicated to transport dangerous goods.*
- An important additional remark is that a representative study would be necessary to analyse the cases of deaths on the spot at the same place at a given time. At the moment there is no any adequate data base available which would document the time elapsed between the occurrence and notification of the injury.

Hungarian decision makers / stakeholders agree that an integrated European eCall emergency service could save human lives hence the implementation / operation is reasonable.

5.7.8 References

COWI Hungary Ltd, Guideline for evaluation and cost / benefit analyse of ITS applications in the road-transport, Budapest, 2008; (in the frame of the CONNECT Phase III)

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Dr. Lindenbach., Dr. Jankó, Elaboration of a Technical Guide for the traffic control and traffic information systems of the motorway network Part II (study), 2009; (in the frame of the CONNECT Phase III)

Dr. Lindenbach, Dr. Bokor, Dr. Mészáros, "Strategy for the development of intelligent transport systems in Hungary", Budapest, June 2008; (in the frame of the CONNECT Phase III)

Ministry of Transport, Telecommunication and Energy: Comprehensive transport development strategy, December 2008

5.8 Conclusions

The process of emergency response can be improved with eCall in four phases of the process:

There can be an improvement of the time between the actual happening of the accident and the first call for help. The time between accident and first call can only be estimated. There is no scientific logging of this time lap. The improvement is higher in scarcely populated areas and with single-user accidents. It is suggested to cover also motorcyclist et cetera in the eCall services because of their high score at single-user accidents.

There can be an improved allocation of the accident; this improvement is higher on non motorways and in situations where the location is not clear for the people who call the alarm centre (PSAP).

The improvement in these two steps is independently estimated in all four in-depth studies. In all cases the estimation was an average improvement of 2-3 minutes of this part of the process. Single-vehicle accidents or accident in remote locations are in an extreme minority; they are "newspaper stories". However, they do occur infrequently.

A third improvement could be reached at complex accidents with several vehicles. With eCall the impact of the accident and the amount of needed help will be faster and better estimated then when the first rescue service on the spot determines that more or extra help is necessary to carry out the rescue service.

A fourth improvement could be the preparation "during travel time" by the rescue services. E.g when the type of vehicle is known in advance, the rescue service (most times fire brigade) can prepare the "cutting out" of people from the car wreck as this is based on specific, vehicle type bounded information.

The improvement of the process is weighed on three criteria:

1. Does the improvement of the process lead to fewer fatalities and to less permanent injured people?
2. Does the improvement of the process lead to less waiting time for the other traffic because of congestion due to the accident?
3. Does the improvement of the process lead to less secondary effects of congestion, such as extra accidents because of congestion and extra use of fuel consumption and extra emissions because of this extra fuel consumption?

In none of the four in-depth studies a statistically proven relationship is found between improvement of the timeframes wherein the European rescue services operate and a diminishing of fatalities or casualties. It can be expected that the greatest benefit to crash victims can be rendered when eCall substantially improves rescue time (e.g. by 15 minutes or more). The improvement is found mostly in the sparsely populated areas where accidents, especially single vehicle accidents, can remain unreported for a long time. However, the number of extremely long unreported times (hours) are very rare. The overall impact on fatalities of the reduced rescue time as a result of eCall is estimated from expert testimony and is different in different countries (due to geography, rescue service performance etc.). In Finland it was estimated as saving 4-8% of road fatalities and in the UK just 1%. Similarly, a range of estimates concerning ultimate medical outcomes of surviving crash victims was made.

The answer to the second question can be calculated and depends on the amount of accident related congestion and the estimated time saving from eCall. In Finland almost all congestion is the result of accidents. An improvement of the timeframe to rescue or clear accidents leads direct to a reduction of congestion and secondary effects. In UK and the Netherlands there is more congestion because of the amount of traffic, weather conditions and road works. Nevertheless, the congestion is still lower than in the situation without eCall. The saving in accident related congestion is estimated between 3% (UK) and 17% (Netherlands and Hungary). This benefit is large in economic terms, and for some countries larger than the safety benefit. However, related to the total amount of congestion (from other incidents and general traffic load) the effects of eCall are much smaller.

The impact on fuel consumption and emissions is a very small one compared with the total use of fuels or the total emissions (Hungary calculated 0.005% of the total CO_2 emissions, 12002499 tons in 2005). In countries like UK and Netherlands the reduction is small because of the marginal impact of eCall on secondary congestion. In countries like Finland and Hungary the impact is small because of the low number of congestion at all.

All four countries which are involved in the in-depth studies do have PSAPs. The costs to implement eCall are relatively low. It is mainly an adaptation to internet communication instead of (only) phone calls. In the Netherlands this adaptation in calculated to be a € 150 000 investment (1 first PSAP). The cost for training of personnel are pro memory (the total cost of running the ambulances in the Netherlands cost approx. € 350 million per year). The response on the questionnaires or the other in-depth studies gave no significant differences.

The questions about improvement of the processes in the PSAPs gave no indication of severe improvements of efficiency. There could be some improvement per call via eCall but there could also be some loss of efficiency if the system brings additional or more false calls for rescue.

6 Other Country Studies

6.1 Approach and Methods used

The aim of this chapter was to collect data from the EU-27 and associated countries. This task followed the approach laid out in the chapter on Method for European analysis to collect the specified data in order to scale up the findings of case countries to the EU-27 and associated states.

Data was collected from several assessment topic areas:

- Information about operating environments for forming the country clusters
- Safety
- Congestion
- Environment
- Energy
- Incident and rescue management chain
- Other benefits
- Investment costs
- Other costs
- Financial aspects
- Institutional issues
- Technical issues

The data was collected from all 27 EU-countries and some non-EU-countries. Included non-EU-countries were Switzerland, Croatia, Iceland, Macedonia the former Yugoslav Republic of, Norway and Turkey. Liechtenstein was excluded as there was almost no information available from it. When available, the data from year 2007 was used. In case of missing or deviant data, the needed data was created or interpolated on the basis of comparison with similar countries.

Information was mostly gathered from statistics which could be reached by Internet and questionnaire sent to different stakeholder groups (automotive manufacturers, mobile network operators, service providers, member states, PSAPs, eCall suppliers and insurance companies).

<u>Used sources of information:</u>
SafetyNet's Annual Statistical Report provides the basic characteristics of road accidents in 19 member states of the European Union for the period 1997–2006, on the basis of data collected and processed in the CARE database, the Community Road Accident Database with disaggregate data (Council Decision EEC 93/704 final). (http://www.erso.eu/safetynet/content/safetynet.htm).

Eurostat
Eurostat is the Statistical Office of the European Communities. It provides general statistics at European level. By harmonising statistics from the European statistical system (ESS) to a single methodology, the statistics are made comparable. (http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL)

The International Road Traffic and Accident Database, IRTAD
The IRTAD database includes accident and traffic data and other safety indicators for 29 countries (Includes both EU- and non-EU-countries, like Japan and Korea. Most of the needed safety figures were available only for 18 countries from our list). http://www.internationaltransportforum.org/irtad/coverage.html

DG TREN's "Energy and transport in figures" covers the European Union and its 27 Member States and, as far as possible, the current EU candidate countries and the EFTA countries Iceland, Norway and Switzerland. The content of the Statistical pocketbook is based on a range of sources including Eurostat, international organisations and national statistics. The transport part of the publication covers both passenger and freight transport as well as other transport-related data.
http://ec.europa.eu/energy/publications/statistics/statistics_en.htm

The eIMPACT accident database for EU25 (base year 2005) was not usable in this project as the data in eIMPACT is not in country level but on cluster level (three clusters). The clusters are not same as used in this study.

6.2 Results

6.2.1 Clustering data

This data was collected in order to cluster the EU-countries based on their similarities in operating environment. The clustering of the countries was done, because the hypothesis was that countries within one cluster would have a similar enough operating environment for eCall and hence similar impacts, costs and implementations issues.

The characteristics defining operating environments for eCall were (source and year of used data is represented in brackets):

Population density [inhabitants per km²]

- Information available from all countries (Eurostat, 2006)

Traffic management level (the percentage of the highway network that is monitored by loops, cameras etc.)

- Information available only from some countries -> Expert evaluation using scale 1 to 5, where 5 is highest level of traffic management.
- Data used as background information: eSafety Forum Implementation Roadmap Working Group (2005) including e.g. share of Trans-European Road Network equipped with dynamic traffic management, the TEMPO Programme's Euroregional Projects' final reports from 2007, EASYWAY Expert Group's status reports due in January 2009.

Length of motorway [km]

- Information available from all countries (Energy and Transport in Figures, 2005)

Length of non-motorway network [km]

- Information available for all countries (Energy and Transport in Figures, Eurostat, European road statistics, 2004–2005: the biggest number from these sources was chosen to indicate the length of all other roads than motorways)

Level of urbanisation (% of sparsely populated area)

- [Densely-populated area (at least 500 inhabitants/Km²), intermediate urbanized area (between 100 and 499 inhabitants/Km²) and sparsely populated area (less than 100 inhabitants/Km²)] -> for the clustering the % of sparsely populated area was used
- Information not available from 8 countries, missing data was filled in based on expert opinion of similar countries (see Table 45) (Eurostat, 2008)

Average Annual Daily Traffic on motorways / main roads / secondary roads

- AADT on motorways available only from some countries, for other roads no information was available for other than case countries

- As consistent data on AADT was not available with sufficient coverage, this variable could not be used. On the other hand, it is reflected in the traffic management level.

Rescue service level

- Information available only from some (8) countries based on answers to questions 26–36 in PSAP questionnaire -> As consistent data on rescue service level was not available with sufficient coverage, this variable could not be used.

Mobile phone subscriptions [Mobile phone subscriptions per 100 inhabitants]

- Information available for all countries, expect Macedonia (Eurostat, 2006). Same value as for Croatia is used for Macedonia.

Proportion of fatalities occurring outside urban areas (including only cars and taxis)

- Information not available from 14 countries, missing data was filled in based on information on percentage of all fatalities occurring outside urban areas and expert opinion of similar countries (see Table 45) (Safetynet, 2004–2006)

Fatalities per million passenger-kilometres (cars and powered two-wheelers only)

- From European road statistics (2006) the data was available for all EU27 countries. For Norway, Switzerland and Iceland the information about road fatalities per billion vehicle kilometres was available from IRTAD (2006).
- For Croatia, Macedonia and Turkey no information was available.

Table 45: Filling in the missing clustering and safety data. Non-EU countries are marked with *

Country	Level of urbanization, Sparsely populated area (less than 100 inhabitants/Km²)	Fatalities of car or taxi, outside urban areas	% of motorcycle fatalities
Bulgaria		Slightly more than Poland (and Croatia, Slovenia, …)	Same as Spain
Switzerland*	Same as Austria	Same as Austria	Same as Austria
Cyprus		Slightly more than Poland (and Croatia, Slovenia, …)	
Germany		Same as Belgium	
Croatia*	Same as Bulgaria	Same as Poland	Slightly more than Bulgaria and Romania
Ireland	Slightly less than Finland		
Iceland	Slightly more than Finland	Based on information of information of all fatalities occurring outside urban areas. Slightly more than Norway.	Slightly more than Finland
Lithuania	Same as Latvia	Slightly less than Finland	Slightly more than Finland
Latvia		Slightly less than Finland	Slightly more than Finland
Macedonia, the former Yugoslav Republic of*	Same as Bulgaria	Same as Poland	
Norway*	Same as Finland	Based on information of information of all fatalities occurring outside urban areas. Slightly more than Finland	Slightly more than Finland
Romania		Slightly more than Poland (and Croatia, Slovenia, …)	Same as Spain
Sweden	Some data was marked as unknown, the unknown data was divided so that there was slightly less sparsely area than in Finland		
Slovenia		Based on information of information of all fatalities occurring outside urban areas. Same as Hungary	Slighly more than Croatia
Slovakia		Same as Czech Republic	Same as Czech Republic
Turkey*	Same as Spain (they have quite same population density)	Same as Poland	

6.2.2 Clustering

The first attempt to cluster the countries was done with Self Organizing Map with several above mentioned variables as an input. The problem with most of trials was that no clear and logical clusters were formed. This was mainly because the amount of variables and observations was too low for the model. Also simpler clustering was tried, eg. clustering based on just some of the variables like traffic management level & amount of mobile phones and length of all motorways & percentage of sparsely populated areas. The problem with these was that they gave too little discrimination between groups as e.g. the mobile phone density is already high in most countries. Ideally situation, one of case countries was in each grouping but in many clustering trial it was noticed that there was much similarity between Netherlands/UK and Finland/Hungary and they tend to be at the same cluster.

After several different trials, the clusters were created based only on population density and fatalities per million passenger-kilometres (cars and powered two-wheelers only). Scatter plots of normalized data were used. No real algorithm was used as the amount of variables and observations was so low. It was estimated that the rescue chain quality is one of the most important factor in determining the potential eCall impact. However, information about rescue level was not available or was not possible to determine for most of the countries. The fatality rate was estimated to correlate with the rescue chain quality and possibly the traffic management sophistication.

The chart in Figure 44 shows how the data was distributed into clusters. It can be seen that some countries stick out from the others based on high population density (Malta, Netherlands and Belgium). In the new EU countries the fatality risks were often higher than in the old EU countries.

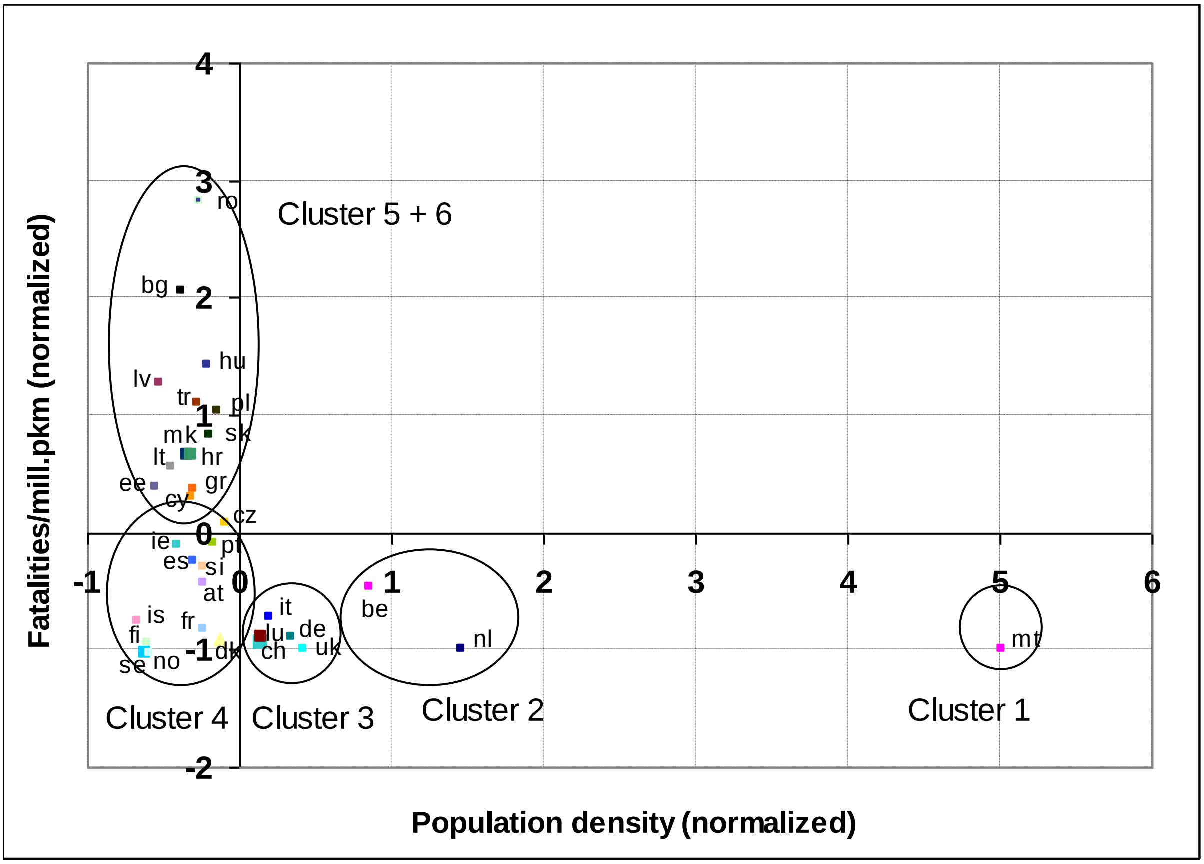


Figure 44: Clusters based on population density and fatalities per million passenger-kilometres (cars and powered two-wheelers only)

In total six clusters were determined (**Table 46**). Malta (Cluster 1) was separated as a one cluster as it differs from all other countries (extremely densely populated). Netherlands and Belgium (Cluster 2) are densely populated countries with high level of safety. Originally Italy and Germany were grouped in the Cluster 3 as shown Figure above, but they will be treated in the CBA analysis as part of Cluster 2 due to their accident statistics characteristics. United Kingdom, Luxembourg and Switzerland (Cluster 3) are countries with medium population density and a high level of traffic safety. Cluster 4 is the biggest one with Norway, Sweden, Finland, Denmark, France, Iceland, Austria, Slovenia, Spain, Ireland, Portugal and Czech Republic. These countries have low population density level and high level of safety. Cluster 5 includes countries with low-density level and low level of traffic safety. Many of the countries in this cluster are new or quite new EU countries. The cluster includes Cyprus, Greece, Estonia, Lithuania, Slovakia, Poland, Latvia, Hungary, Bulgaria and Romania. As no reliable information about fatalities per million passenger-kilometres was available from non-EU countries of Turkey, Macedonia and Croatia, these countries were separated into one cluster. It was also estimated that these countries have a similar operating environment for eCall.

Table 46: Determined clusters. Non-EU countries are marked with *

Clusters	Country
Cluster 1: Very small country with very few fatalities and severe injuries; eCall implementation will not change current safety situation dramatically; outlier in county data, treated as a separate "Cluster"	Malta
Cluster 2: Countries with relatively small geographical area and developed rescue systems; low estimates of impact on reduction in fatalities and severe accidents. Italy and Germany are treated in the CBA analysis in this group due to accident characteristics	**Netherlands** Belgium Italy German
Cluster 3: Countries where estimated impact of eCall on accidents is small; in most cases explained by short distances between accidents and rescue service points; also by level of emergency services	**United Kingdom** Luxembourg Switzerland*
Cluster 4: Most countries already have low fatality and severe injury numbers	**Finland** Austria Denmark Sweden Norway* Iceland* Ireland France Portugal Spain Slovenia Czech Republic
Cluster 5: Accident levels tend to remain above EU average; eCall will produce rapid improvements in safety situation due to savings in accident costs	**Hungary** Cyprus Greece Estonia Latvia Lithuania Poland Slovakia Romania Bulgaria
Cluster 6: Non-EU countries, where accident levels are above EU average	Croatia* Macedonia, the former Yugoslav Republic of* Turkey*

The figure below shows the population density across the EU (and more) countries per region. When comparing the average density per country with the clustering results, the similarity is quite obvious. However the figure also makes clear how the densities vary within countries. A recommendation would be that of refining the clustering from instead of looking per country into looking more into the various regions across the EU.

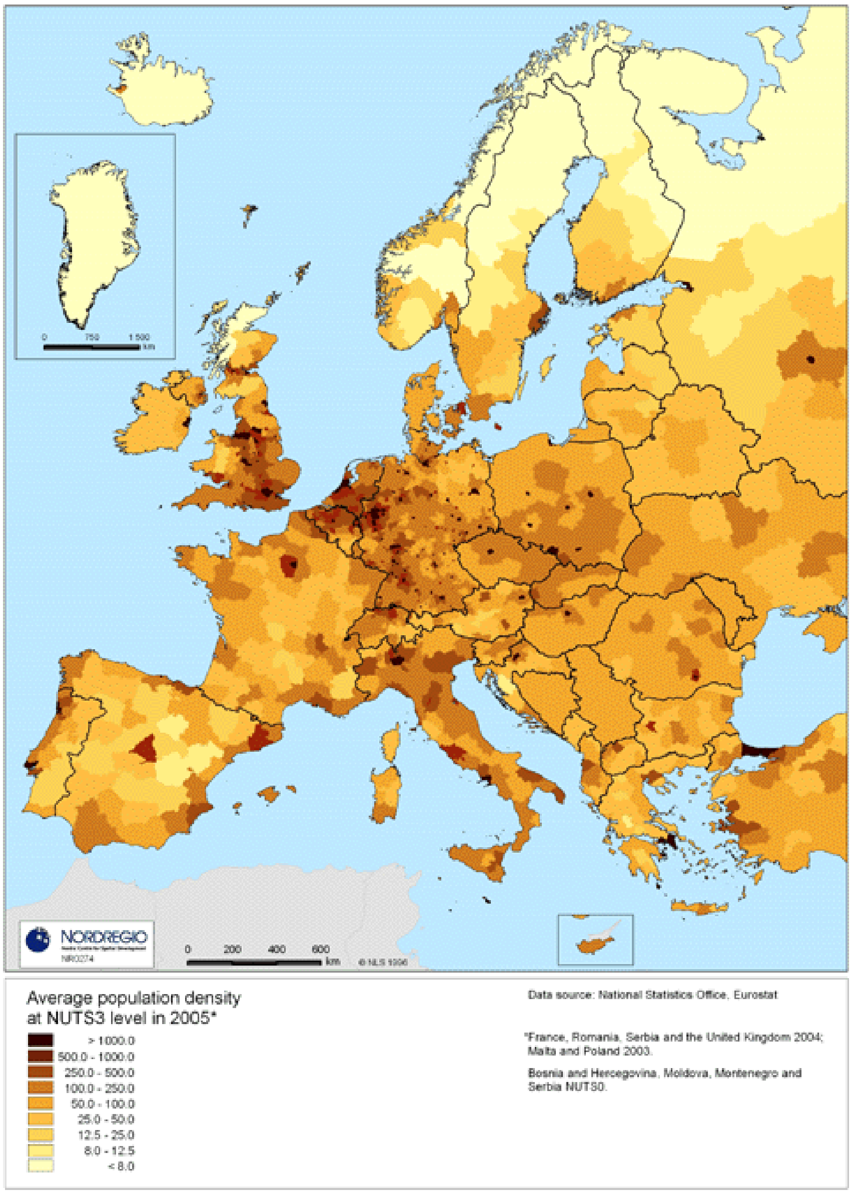


Figure 45: Population density per region across the EU

6.2.3 Other data

Safety

Number of road fatalities [fatalities / year], (death within 30 days)

- Information available for all countries (Eurostat, IRTAD and Energy and Transport in Figures, 2006–2007)

Number of road injuries [injuries / year]

- Information not available from 13 countries, but missing data was filled for 11 of these countries based on information about number of injury accidents in that country (the average ratio between injuries and injury accidents was calculated from countries where both information was available). For two remaining countries (Turkey and Macedonia), the number of road injuries was calculated based on other countries (ratio between fatalities and injuries). (Eurostat, IRTAD and Energy and Transport in Figures, European Road Statistics, 2006–2007)

- Based on data found, distribution to severe and slight injuries was not possible to do. On the basis of eIMPACT, we estimated that ca 19% of injuries are severe, on average in Europe. Hence, this figure was used in the calculations.

Number of secondary accidents [accidents / year]

- No source of information was found
- Estimations needed for the cost-benefit analyses were done on the basis of two case countries, where the information was available.

Percentage of single vehicle accidents

- No source of information was found for other than case countries, however, this was not needed in the cost-benefit analyses

Percentage of fatal accident occurring in the dark

- No source of information was found for other than case countries, however, this was not needed in the cost-benefit analyses

Percentage of motorcycle fatalities

- Information not available from 12 countries, missing data was filled in based on expert opinion of similar countries (Safetynet, 2006)

Percentage of agricultural Tractor fatalities

- Information not available from 13 countries. As the share of these fatalities varied only slightly between countries, the missing values were filled in by average value of the cluster in question.

Congestion

In improving the response time for accidents, eCall will reduce the amount of delay to other road users caused by these accidents. The reduction in congestion was estimated for each country in Europe on the basis of the link between congestion and GDP and assuming that the reduction in congestion arising from eCall would be the same in Europe as has been estimated for the UK. This approach was selected because it provides a uniform basis for comparing the figures for each country.

In several European countries congestion costs average between 1% and 2% of GDP, so an 'average' figure of 1.5% was used.

Table 47 shows the estimates of congestion and savings arising from eCall for each of the 27 EU Member States.

Table 47: Estimates of annual time in congested traffic and estimated savings

Country	Hours in congestion (billion)	Hours in congestion	Hours saved
Austria €	0.477445	477,445,000	313,233
Belgium €	0.603939	603,939,000	396,221
Bulgaria	0.23703	237,030,000	155,506
Cyprus €	0.071541	71,541,000	46,935
Czech Republic	0.695998	695,998,000	456,617
Denmark	0.300948	300,948,000	197,440
Estonia	0.106091	106,091,000	69,602
Finland €	0.305654	305,654,000	200,528
France €	3.44191	3,441,910,000	2,258,104
Germany €	4.941108	4,941,108,000	3,241,670
Greece €	0.785685	785,685,000	515,458
Hungary	0.593803	593,803,000	389,571
Ireland €	0.26935	269,350,000	176,710
Italy €	3.07783	3,077,830,000	2,019,245
Latvia	0.181869	181,869,000	119,317
Lithuania	0.274327	274,327,000	179,975
Luxembourg €	0.04818	48,180,000	31,609
Malta €	0.01747	17,470,000	11,461
Netherlands €	1.021054	1,021,054,000	669,874
Poland	2.584613	2,584,613,000	1,695,665
Portugal €	0.588661	588,661,000	386,198
Romania	0.746451	746,451,000	489,718
Slovakia €	0.420979	420,979,000	276,188
Slovenia €	0.139547	139,547,000	91,551
Spain €	2.829341	2,829,341,000	1,856,221
Sweden €	0.5578	557,800,000	365,951
United Kingdom €	3.439328	3,439,328,000	2,256,410

Environment

The reduction in congestion arising from eCall will reduce total exhaust emissions. The reductions in emissions have been estimated for each country. An example of the calculations is shown below for the UK.

Environmental effect for the UK

For the UK, it has been predicted that the use of eCall will save 2.26 million hours of congested traffic per year (see Section 5.2.5). To evaluate the effect this will have on emissions, the following assumptions have been made:

- All of this congested traffic will disappear (though, in reality, this may change into a shorter period of uncongested traffic).
- The average speed of traffic in congested conditions is 20 km/h.
- National UK fleet compositions for 2009 have been used.

The fleet-weighted emissions for various vehicle categories, operating at an average speed on 20 km/h, are listed in Table 48 and Table 49. The emissions factors used are the latest ones developed for the UK's Department of Transport (Boulter et al, 2009). The first table shows the emission rates in g/km. In the second table, the emission rates have been converted to grammes per hour. The bottom line of each table gives the overall fleet weighted emission rates.

Table 48: Emissions rates for 2009 fleet at 20 km/h

Vehicle	Fleet Proportion	CO g/km	HC g/km	NO_x g/km	PM g/km	CO_2 g/km
Cars	81.7%	1.7346	0.1425	0.3774	0.0172	222.12
Vans	11.6%	0.5389	0.0653	0.6387	0.0418	226.65
Rigid HGV	3.1%	1.7471	0.3381	6.0862	0.1368	769.89
Artic HGV	2.9%	2.4143	0.5144	10.9320	0.2323	1432.61
Buses	0.7%	2.4402	0.5047	10.8848	0.2417	1181.87
Overall	100.0%	1.6213	0.1530	0.9664	0.0316	281.59

Table 49: Emissions converted to hourly rates

Vehicle	Fleet Proportion	CO g/h	HC g/h	NOx g/h	PM g/h	CO2 g/h
Cars	81.7%	34.692	2.850	7.549	0.345	4442.4
Vans	11.6%	10.778	1.307	12.774	0.836	4533.0
Rigid HGV	3.1%	34.942	6.762	121.724	2.737	15397.8
Artic HGV	2.9%	48.287	10.288	218.641	4.646	28652.3
Buses	0.7%	48.804	10.095	217.697	4.835	23637.3
Overall	100.0%	32.426	3.061	19.328	0.633	5631.7

To calculate the savings in emissions due to the reduction in congestion, the overall emission rates from Table 49 were multiplied by the estimate of the annual reduction in congestion once full scale eCall deployment has been achieved. The resulting reduction in NOx, PM and CO2 emissions are shown in Table 50.

Table 50: Savings in emissions

	NOx tonnes	PM tonnes	CO2 tonnes
Emission reduction	43.6	1.43	12.71

Environmental effect for the EU27 countries

The time of congested traffic savings for the UK is 2.26 million hours compared to an annual total congested traffic time of 3.439 billion hours. This represents a reduction of 0.066%. This percentage was applied to the annual congested traffic hours of the other EU27 countries to derive the time savings likely in each country, as shown in Table 47.

Using these hours saved, the calculations were repeated for each country, as per the UK described above, to derive the emission reductions for each country, as listed in Table 51. Note that these estimates are based on the composition of the vehicle fleet in the UK and do not take account of variations in the composition of the vehicle fleet between different countries; they serve to indicate the scale of potential savings in emissions.

Table 51: Annual reduction in emissions for each EU27 country

Country	NO_x tonnes	PM tonnes	CO_2 tonnes
Austria	6.0542	0.1982	1,764.05
Belgium	7.6582	0.2507	2,231.41
Bulgaria	3.0056	0.0984	875.77
Cyprus	0.9072	0.0297	264.33
Czech Republic	8.8255	0.2889	2,571.55
Denmark	3.8161	0.1249	1,111.93
Estonia	1.3453	0.0440	391.98
Finland	3.8758	0.1269	1,129.32
France	43.6447	1.4289	12,717.06
Germany	62.6551	2.0513	18,256.24
Greece	9.9628	0.3262	2,902.92
Hungary	7.5296	0.2465	2,193.96
Ireland	3.4155	0.1118	995.19
Italy	39.0280	1.2778	11,371.87
Latvia	2.3062	0.0755	671.96
Lithuania	3.4786	0.1139	1,013.57
Luxembourg	0.6109	0.0200	178.01
Malta	0.2215	0.0073	64.55
Netherlands	12.9473	0.4239	3,772.56
Poland	32.7739	1.0730	9,549.54
Portugal	7.4644	0.2444	2,174.97
Romania	9.4653	0.3099	2,757.96
Slovakia	5.3382	0.1748	1,555.42
Slovenia	1.7695	0.0579	515.59
Spain	35.8771	1.1746	10,453.76
Sweden	7.0731	0.2316	2,060.94
United Kingdom	43.6120	1.4279	12,707.52
Total EU27	364.6616	11.9391	106,253.93

Energy

The reduction in fuel consumption has been calculated in a similar manner as the exhaust emissions, though in this case the petrol and diesel vehicles were segregated. Table 52 shows the fuel consumption rates for the various vehicle types. The values are shown in l/100km, and then segregated into petrol and diesel in l/km and g/km.

These consumption rates are shown converted in l/h and g/h in Table 53, together with the fleet-weighted overall fuel consumption rates for petrol and diesel.

Table 52: Fuel consumption rates at 20 km/h

Vehicle	Fleet Proportion	All l/100km	Petrol l/km	Diesel l/km	Petrol g/km	Diesel g/km
Petrol car	67.5%	8.188195	0.08188		59.774	
Diesel car	14.2%	11.04546		0.11045		93.886
Petrol LGV	1.2%	10.95592	0.10956		79.978	
Diesel LGV	10.4%	11.02225		0.11022		93.689
Rigid HGV	3.1%	28.51068		0.28511		242.341
Artic HGV	2.9%	53.05271		0.53053		450.948
Buses	0.7%	43.76694		0.43767		372.019

Table 53: Fuel consumption rates converted to 'per hour'

Vehicle	Fleet Proportion	Petrol l/h	Diesel l/h	Petrol g/h	Diesel g/h
Petrol car	67.5%	1.63764		1195.476	
Diesel car	14.2%		2.20909		1877.728
Petrol LGV	1.2%	2.19118		1599.564	
Diesel LGV	10.4%		2.20445		1873.783
Rigid HGV	3.1%		5.70214		4846.816
Artic HGV	2.9%		10.61054		9018.961
Buses	0.7%		8.75339		7440.379
Overall	100.0%	1.13090	1.09051	825.557	926.938

These emission rates have then been multiplied by the congested time saving rates from Table 45. The resulting annual saving in fuel is listed in Table 54.

As for emissions reductions, these estimates are based on the composition of the vehicle fleet in the UK and do not take account of variations in the composition of the vehicle fleet between different countries; they serve to indicate the scale of potential savings in fuel consumption.

Table 54: Annual fuel savings for each EU27 country

Country	Petrol million litres	Diesel million litres	Petrol tonnes	Diesel tonnes
Austria	0.3542	0.3416	258.59	290.35
Belgium	0.4481	0.4321	327.10	367.27
Bulgaria	0.1759	0.1696	128.38	144.14
Cyprus	0.0531	0.0512	38.75	43.51
Czech Republic	0.5164	0.4979	376.96	423.26
Denmark	0.2233	0.2153	163.00	183.01
Estonia	0.0787	0.0759	57.46	64.52
Finland	0.2268	0.2187	165.55	185.88
France	2.5537	2.4625	1,864.19	2,093.12
Germany	3.6660	3.5351	2,676.18	3,004.83
Greece	0.5829	0.5621	425.54	477.80
Hungary	0.4406	0.4248	321.61	361.11
Ireland	0.1998	0.1927	145.88	163.80
Italy	2.2836	2.2020	1,667.00	1,871.71
Latvia	0.1349	0.1301	98.50	110.60
Lithuania	0.2035	0.1963	148.58	166.83
Luxembourg	0.0357	0.0345	26.10	29.30
Malta	0.0130	0.0125	9.46	10.62
Netherlands	0.7576	0.7305	553.02	620.93
Poland	1.9176	1.8491	1,399.87	1,571.78
Portugal	0.4368	0.4212	318.83	357.98
Romania	0.5538	0.5340	404.29	453.94
Slovakia	0.3123	0.3012	228.01	256.01
Slovenia	0.1035	0.0998	75.58	84.86
Spain	2.0992	2.0242	1,532.42	1,720.60
Sweden	0.4139	0.3991	302.11	339.21
United Kingdom	2.5518	2.4606	1,862.79	2,091.55
Total EU27	21.3367	20.5747	15,575.76	17,488.51

Incident and rescue management chain

PSAP questionnaire was sent to 21 countries. The response rate was quite low; only 8 answers were received directly from stakeholders. Answers were received from Norway, Slovak Republic, Finland, Slovenia, Lithuania, Sweden, Hungary and Switzerland. From the Netherlands and UK answers for some of the questions were received from the in-depth study. Most of the PSAPs that answered the questionnaire don’t receive calls from private “eCall” centres. Only in UK the coverage of private emergency call services was estimated to be approximately 3 000.

The number of PSAP 1s varied between countries from 7 to 180. In most of the countries the number of PSAP 1s was 35 or below. Only Norway and Lithuania had more than 35 PSAP 1s. About half of the countries answered that they don’t have separate PSAP 1s and PSAP 2s, but they work as a same unit and same staff is providing both services. In other countries the number of PSAP 2s varied from 5 to 220. The range of citizens that a PSAP serves varied from 4 000 to 1.7 million. Biggest ranges were in Norway, in Sweden and in Switzerland.

Most of the respondents estimated that the average time occurred between a traffic accident and the emergency call reporting the accident is 1–5 minutes. It was also mentioned that this can of course vary a lot; from 10 seconds to more than 24 hours. In Hungary the delays were analysed from a set of fatal and severe injury accidents (approximately 500 cases were analysed, of these relevant data was available only for 174 cases). They estimated that in 40% of the relevant cases the emergency call was made less than 5 minutes after the accident, in 56% of the cases the call was made 5–15 minutes after the accident and in 4% the delay was longer than 15 minutes (of these the delay was over hour in 1% of the cases). Slightly over 50% of the respondents of PSAP questionnaire estimated that sometimes there are notification delays that have materially affected the medical outcomes. Other respondents estimated that these kinds of notification delays occur only rarely.

In most of the PSAPs the average time to answer the emergency call is less than 10 seconds. For most of the others the phone answering time is 10 to 20 seconds. Only in Hungary the average time for PSAP to answer the call was 20–30 seconds, but also in there the ambulance centre answers the calls less than 10 seconds. The average time an emergency unit is dispatched after the reception of the emergency call at the emergency service was less than 3 minutes for all PSAPs. In most cases this time was 1 to 3 minutes and in some cases even less than 1 minute.

The average time between the dispatching of the emergency unit and the arrival of the emergency rescue at the accident scene varied between 5 to 20 minutes. Slightly over 50% of the respondents estimated this time to be 10–20 minutes and slightly less than 50% estimated 5–10 minutes. The respondents highlighted that there is an enormous range between cities and rural areas. Answers to the question "How often time is lost locating the actual crash scene?" varied: 2 respondents estimated that this can happen quite often, 3 that sometimes and 2 estimated that only rarely time is lost locating the scene. However, 7 of 8 respondents estimated that even if time is lost, the typical range of this additional search time is less than 5 minutes. One respondent estimated that additional searching time is typically 5–10 minutes.

The average time to get incident clearance to the scene depended whether the incident place is cleared by the fire brigade or a special clearance unit. If a special clearance unit is needed, the time to get it at the scene was estimated to be from 10 to more than 30 minutes. For public roads this time was estimated to be longer than for motorways. The travel time of incident clearance was described to depend e.g. whether accident happens during the work-hours or not (after work-hours the travel time can be longer), what is the location of the accident / distance from the maintenance centre, what are the traffic, weather and road conditions and how many other accidents have happened at the same time. In many countries the clearance services are only dispatched after the police assess the scene.

The average time to clear the scene after incident clearance has arrived such that traffic can flow again was estimated by most of the respondents to be 30 to 60 minutes. However, the incident clearance time depends on the severity of the accident, extent of the accident scene, quality/quantity of the impurity of the road-surface, weather conditions, need of technical rescue, as well as the need and time of traffic engineering measures (deviation, closure of lanes, etc.) and needed of police investigation ("lost time": the clearance brigade is on the scene, but because of measures/investigations done by the police no possibility for the clearance). For public roads the time was estimated to be longer than for motorways.

The priorities of the emergency services going to the location of an accident were described to depend on the extent and consequences of an accident. The priority of emergency services action was usually answered to be 1) the emergency medical service (ambulance), 2) fire and rescue service, 3) the police. However, in many countries the PSAP dispatches all units together and in the same time, so the order of arrival depends mostly on travel time (who has longest driving distance from post place to the site).

Most respondents answered that health services apply when possible "stay-and-play" strategy, where the patients are first taken care of at the scene and then taken to hospital. However, there are lot of combination depending assessment and e.g. the size of the accident. In the question "How often is trauma assistance part of the emergency service?" the answers varied from always/almost always to rarely and no clear trend could be seen. This may be partly because respondents may have understood the trauma assistance in different way. It was also highlighted that in the big accidents which outlast and where are many people on the accident, the trauma unit will be needed.

The most common performance indicator at the PSAPs was mentioned to be the response time on emergency call (e.g. how many % of calls are answered in certain time or the average time the calls are answered). Also time necessary for dispatching the emergency service units was mentioned by several respondents as one of the performance indicators. Besides these in Slovak there were two other indicators: Successful caller localization and arrival of the emergency services at the site of accident. Two of the respondents indicated that they don't have national set of performance indicators for PSAPs.

The percentage of false emergency calls varied from Norway's, Finland's and Switzerland's about 20% to over 50% (Sweden, Hungary, Lithuania, Slovenia and Slovak). One respondent highlighted that the number of false calls depend what is meant by "false calls".

Other benefits

Other or new benefits from eCall are only qualitatively indicated, such as new jobs and higher return on investments when eCall is leading to new businesses. There is no quantitative estimation given.

eCall could lead to earlier warned other road users. So they would be able to choose alternative routes instead of running into the congestion at the blocked road. The effect of this suggestion is highly depending on the information channels to the road users. The information could be provided by traffic management centres (by radio or VMS), by navigation services or by radio between road users. There is no quantitative data available.

There is the possibility of using the eCall platform for other public or private added value services.

There are additional benefit that the occupants of the vehicles travelling abroad can have (because of ignoring exact location and automatic sending of messages helping in case of linguistic problems).

Investment and other costs

The other costs are estimated in several countries (4 in depth studies, 5 from the questionnaires).

The responses from those manufacturing the systems do not indicate significant reduction in prices. The cost per unit is estimated to be 60 euros per pre-installed unit and is not looking to go down. In this study we use also a lower 30 euro price for instalments to old fleet with the assumption that this is part of a larger e-package.

The cost for installing the systems on PSAP 1 and 2 are given in the following table, as are the yearly costs of training personnel and the yearly maintenance cost.

Table 55: Costs eCall for PSAPs

	UK	SF	H	NL	N	SK	SL	LIT	SOS S	IS ag
PSAP 1 system cost	100 – 220 k€	30 - 70 k€	13.3 million €	< 50 k€	-	50 k€	15 k€	100 k€	600 k€	
PSAP 2 system cost	In periodic upgrades	-	2.5 million €	< 50 k€	-	-	-	-	-	-
Training of the PSAP personnel	no extra cost	First year: 6700 €, after that no extra costs	360 k€ (40 people, 6 months training)	-	-	15 k€/yr/p	In yearly routine	500 €/yr/p	10 k€/yr	10 k€
Maintenance of the PSAP systems	110 k€/yr	1 – 3 k€/yr	120 k€ (40 people, 2 months training)	-	-	5 k€/yr	500 €/yr	400 k€/yr	100 k€/yr	5 k€/yr

Note on the costs of Hungary: These are the costs that they need to build 4 new PSAP centres and train the operators from the very beginning

No additional info on funding of PSAP investments is available for Netherlands and Hungary. In UK funding is by government and network subscriber income. In the Netherlands the government made a reservation of € 150 000 to implement eCall.

Institutional issues

Most countries in EU signed the MoU. There are no explicit contracts or commitments between PSAP-s, road operators or traffic management centres known. One would expect that when the MoU is signed by or in name of the government, the roll out could take place.

7 Ethical, Moral and Economic Issues

7.1 Cost-benefit analysis and political decision making

Road crashes are now the leading cause of death worldwide for children and young people aged between 10 and 24. Road traffic crashes can also disproportionately affect the poorest groups in society. In 1998, the lack of road safety was named for the first time as a global catastrophe by the Red Cross. Given the road injury statistics, it is clear that road transport systems represents a high risk of harm compared with other systems in society's every day use. These facts have prompted voices in society to ask themselves how such a system is accepted and why a more mature perspective on the risks of road transport has not yet been developed as it has in other transport modes.

Most of the current road transport systems place the responsibility for safety with the road users. Nevertheless research conducted over many years, suggests that however educated and skilled, people are prone to making intentional or unintentional errors while manipulating a vehicle. Thus, crashes cannot be completely avoided by investing in driver training and systems that counteract human error need to be put in place. Investment decisions concerning such systems are usually taken according to common practice economic methods such as cost benefit and socioeconomic analysis.

While Cost Benefit Analysis (CBA) is an important method for taking complex decisions related to investments and technology take-up, this approach has also been criticised when an important part of the analysis involves estimating the value of human life. Opponents of CBA have most of all criticised the idea of putting a value on human life and the methods to estimate these.

Cost Benefit Analysis is based on the principle of welfare economics and is one of a set of tools for assessing efficiency of investment decisions – i.e. identifying how to allocate scarce resources to obtain the maximum possible benefits from those resources. In order to make comparisons on a common basis, the benefits, as well as the costs, are stated in monetary terms. Assigning monetary values to life or injury is considered by some to be meaningless, or ethically wrong, because of the association between setting a 'price tag' and trading lives as a 'commodity'. However the purpose of assigning a monetary value to human life is to provide an indication of the amount of resources that is considered to be worth spending to prevent accidents or injuries, given that only a finite amount of resources is available and that those that are available cannot all be allocated to preventing accidents or injuries. Assigning monetary values provides a way of reflecting the complexity and diversity of needs and value systems and of views on the relative importance of preventing accidents and injuries compared with other possible ways of allocating resources, and enables an appropriate balance to be struck between safety and other social goals.

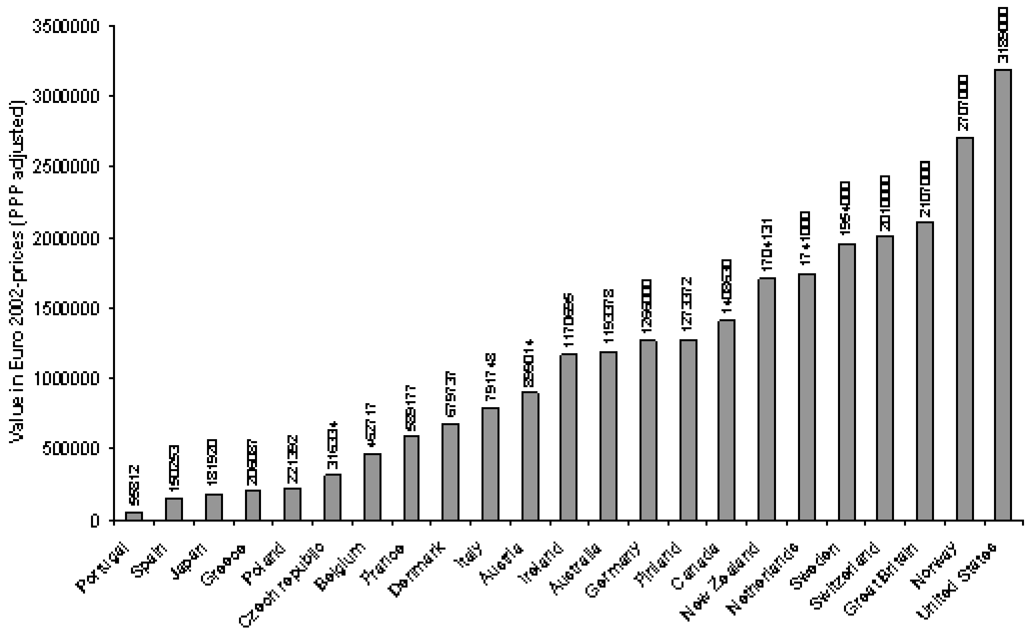
In carrying out Cost Benefit Analysis, economists do not make moral judgements about people's patterns of spending or their views on spending priorities; the principle of consumer sovereignty applies, so choices made by consumers are accepted without modification or qualification.

Initially, when Cost Benefit Analysis was applied to decisions on transport investment in the 1960s, the analysis of benefits was based on savings in travel time, vehicle operating costs and accidents. Benefits of preventing accidents were generally based on a 'human capital' approach whereby the value assigned to preventing a fatality or an injury was in proportion to the loss of production (i.e. the casualty's contribution to the economy). One of the implications of this approach is that there is no value in saving lives or reducing injuries among people who are not active in the economy, such as children and retired people, which is clearly not the case. In the early 1970s, therefore, a 'Willingness to Pay' approach was proposed as a way of valuing all members of society, using willingness to pay for reducing risk of injury to indicate the value of improving safety. Two approaches are used to assess willingness to pay: 'individual' and 'social'. Individual willingness to pay is assessed by obtaining information from individuals, either by studying their behaviour in situations where they have to make a trade off between reducing risk and obtaining other commodities, or through questionnaire surveys whereby such decisions are simulated. Society's willingness to pay to reduce risk is assessed by inferring values from public decisions on safety issues and safety investments.

Today, some countries continue to rely solely on the human capital approach, while others have adopted a willingness to pay approach but also include the human capital approach in their valuations, reflecting the fact that as well as the value of preventing the 'pain, grief and suffering' associated with death or injury in an accident, there is also an effect on the economy if working time is lost while recovering from the injury or because the injuries mean that the casualty is no longer able to contribute to the economy. A further element of costs is also included in valuations: the 'restitution' costs, which are the direct costs resulting from road accidents such as medical costs, damage to vehicles and other property and administrative costs.

The monetary valuation of preventing a road accident fatality varies widely between countries. One study compared the official valuations for 18 European countries, and five other developed nations and found that at the extreme, the highest valuations were around four times higher than the lowest (European Road Safety Observatory, 2006) – see Figure 46 below. Some of the countries with a good road safety record were found to assign a high monetary value to preventing a fatality, while some of those with a poor record assign low monetary values. Valuations were found to depend on the methods used, with those based on willingness to pay being about twice as high as those which do not take this into account, and also on countries' level of income, with lower values where GDP per capita is low and higher values where GDP is higher. It has also been observed that those countries including willingness to pay for preventing fatalities and injuries interpret the results of willingness to pay studies conservatively, to ensure that the various potential sources of error inherent in them do not lead to inflated valuations, which would place undue emphasis on policies and investment decisions aimed at saving lives rather than other goals.

Figure 46: Official monetary valuation of a road accident fatality in selected countries (Euros at 2002 prices)



Source: European Road Safety Observatory 2008

These arguments have led some experts to denounce the morality of such calculations and implicitly of CBA. Applying this as a method for certain decisions has proved very controversial: how to argue against the high costs of saving the lives of premature babies or the health costs of a patient that has been in a coma for a long period of time?

These facts has prompted philosopher Steven Kelman (Kelman, 1981) to assert that "in areas of environmental, safety and health regulations, there may be many instances where a certain decision might be right even through its benefits do not outweigh its costs". Kelman emphasises that for a broad range of individual and social decisions, whether the benefits outweigh the costs is not a sufficient question to ask. He gives as an example situations where certain duties - such as not lying, breaking promises or killing - make an act wrong even if the benefits outweigh the costs. Furthermore, Kelman points out that certain decisions and principles - such as the freedom of speech or any human rights- are not subjected to a cost-benefit analysis.

The steep increase in mobility has translated into trading off health and safety against economic objectives. Safety experts have called in recent years for a change of thinking in order to compensate for these negative effects by making safety less dependent on economic incentives and regarding mobility as a function of safety and not vice-versa.

7.2 Questionnaire results

In order to solicit external opinions on the ethics of CBA in particular related to road safety and the eCall system, a series of questions were developed and included in the stakeholder questionnaire. As moral and ethical issues are usually complex, it was clear from the replies that many respondents had not previously thought deeply about these issues. Although there were a small number of replies and answers were sometimes unclear, it transpires from their reactions that CBA is considered as a valid method for decision making related to safety, but it should represent just one input to a broader political decision. Imitating the experts' debate about the moral implications of CBA, the respondents' opinions were split between thinking that a qualitative value can be placed on a person's life and thinking that this is impossible with slightly more people adhering to the latter view. The same difference of opinion was encounter when questioning whether the cost-benefit analysis of safety systems should be based on the quantification of a person's life. Nevertheless, there was a general consensus that a moral dimension related to road safety should be considered when making political decisions.

7.3 The "Vision Zero" policy

In conformity with the changing attitude toward the moral importance of road safety, the Swedish parliament decided in October 1997 that the long-term target for the road transport system will be that no one should be killed or receive long-term disablement by the system. Although clearly not a realistic target within the foreseeable future, the decision represents a message regarding the Swedish government's stand on road safety. More than anything, "Vision Zero" represents a revolutionary idea meant to change society's way of thinking about road safety and also to encourage further support for existing and emerging road safety systems and strategies by bringing the expectations of safety stakeholders to a higher level.

"Vision Zero" sets out certain ethical principles that should be followed when dealing with road safety and it represents the first road safety philosophy doing that. The vision is an expression of the ethical imperative that: "It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system". "Vision Zero" addresses only fatalities and those injuries where the victim does not physically recover within a certain time frame. It also changes the responsibility balance in road traffic safety. Before this idea was adopted, all road transport systems placed the road user at the centre of culpability for road accidents. "Vision Zero" explicitly states that the responsibility is shared by the system designers and the road users. In fact, the four principles guiding "Vision Zero" are the following (Racioppi et al. 2004):

- **Ethics**: human life and health are paramount; they take priority over mobility and other objectives related to road transport.
- **Responsibility**: providers, enforcers and users of the road transport system all share responsibility for road safety.
- **Safety**: humans make errors; road transport systems should minimize the opportunity for errors and the harm done when errors occur.
- **Mechanisms for change**: providers and enforcers of the road transport system must do their utmost to guarantee the safety of all citizens; they much work together, and each must be ready to change to achieve safety.

It becomes clear from these principles that the vision regards it as imperative that decisions related to road safety should go beyond the usual concerns regarding the economic aspects and also consider the moral obligation of saving lives.

In line with the principles set out by "Vision Zero", the European Parliament has made an influential political statement in the report regarding the priorities in EU road safety, issued in the year 2000. The statement reads that "no single death on the European roads can be justified and that therefore the long-term objective must be that no European citizen should be killed or seriously injured in the road transport system".

The respondents of the the questionnaire distributed by the present study were all aware of the vision and approved of its goals and principles. While the consensus was that such goals are impossible to achieve, they did agree that the message it sends is a strategically important one and agreed with it. Some of the respondents went a step further by referring to it as a "policy" rather than just a vision. The majority of the respondents also emphasised that an integrated approach to road safety is absolutely imperative and that individual initiatives and technologies are not the solution to the ultimate goal of considerably decreasing the number of fatalities and road injuries.

7.4 Moral and ethical aspects of the eCall decision

As a road safety application, the methods for deciding whether to invest in eCall are not sheltered from scrutiny and moral criticism. Cost-benefit calculations for eCall systems have been conducted showing different scenarios for the system's implementation. The two important questions in this decision are what costs and benefits should be included for this pan-European technology and whether the decision should be based on CBA or if moral and ethical issues should also be borne in mind.

For example, eCall will initially benefit people with a higher level of disposable income who will be able to afford to buy it when it first becomes available; it will become more affordable to a mass market as time goes on. This raises the question as to whether it is ethical for governments to investment in the infrastructure necessary to support eCall, when the benefits will not be distributed evenly across society, when the introduction of eCall is left to market forces. In case of mandatory introduction of the system, the take up rate would increase exponentially and thus issues related to infrastructure investments would be surpassed early in the deployment proces.

As eCall is a pan-European system usable outside a nation's border, a question being raised is whether the CBA should include the benefits gained by a country's nationals who travel abroad and having the eCall system on board as well as the benefits of foreigners who travel in that particular country and who could benefit from the eCall system and services. To a first approximation foreign travellers and foreign visitors "balance"; however, the majority of respondents to the eCall questionnaire agree that the socio-economic assessment of eCall should consider the benefits both at a European and national level.

Given the aspects presented in this section, the key question arising is whether the decision of investing in the eCall infrastructure and take up should be solely based on economic aspects or whether moral duty in regards to human life should also play a role. The research here suggests that considerations beyond the purely economic are often included in decision making; however, there is a complex interplay between economic, moral and political factors which vary depending on the topic under consideration and the context.

7.5 Basis for and Interpretation of Benefit Cost calculations

7.5.1 Introduction

The previous sections have analysed ethical and the appropriateness of social cost-benefit calculation in the context of eCall. This section starts from the premise, despite the previous arguments, that Benefit/ Cost calculation *will* be undertaken as part of the decision-making process on eCall policy. It examines the decisions that are made in developing a Benefit/ Cost calculation.

Essentially the process of CBA is well known and there are four essential steps:

1. Which costs are included and what is the value of those costs over time?
2. Which benefits are included and what is the value of those benefits over time?
3. How are the costs to be discounted back to current day value and what is the discount rate?
4. How should the Benefit:Cost ratio be interpreted?

A key difficulty arises in understanding which elements are scientific fact and/or based on a broad scientific consensus and where there are, essentially, choices determined as a result of local convention or policy. The authors are grateful to the IBEC discussion group (see www.ibec-its.co.uk), particularly Mark Cartwright, Andy Graham and Richard Hodges for their comment. Note also that much government economic thinking concerns investment decisions for major infrastructure projects (such as road building) and interpretation may be required for ITS infrastructure.

This project does not attempt a full analysis of the issues but aims to highlight the key factors which may substantially affect the calculations undertaken on eCall within this project.

7.5.2 Futures

The cost benefit calculation is undertaken by making assumptions about the future and these can significantly affect the outcome. In terms of crashes and fatalities, the existing trend is downwards and may be expected to continue even without eCall. Similarly, the congestion trend is upwards and can be anticipated to continue. On the other hand, technology such as cameras and image processing might be expected to identify crashes more quickly and other technology may assist in clearing incidents more quickly to get traffic moving again.

7.5.3 Costs

For eCall the main cost component is the in-vehicle equipment; other costs will not be considered here.

The main question concerning in-vehicle equipment cost is whether the cost to be considered should be cost of components, build cost to the manufacturer or market price to the consumer. Clearly there can be a factor of three or even 10 between these figures.

We are usually calculating the marginal benefit and marginal cost to society as a whole. Economic cost (ie total cost of ownership) acts as a proxy for all the costs of design, production, installation, maintenance, and disposal and includes profit. Traditionally, this final consumer cost would be the starting point for analysis of social benefit/cost for products. The final market cost would, in theory, reflect the build costs and the relative perceived value in the marketplace for the product or service (surrogate for a product quality rating).

However...

1. In previous European studies such as eIMPACT, the decision was taken to use manufacturers' costs. This has become a "standard" approach and continuing this way allows comparisons between studies and ITS services and functions. For eIMPACT, manufacturer's costs were the basis of the assessment because they are the most appropriate ways to represent resource consumption, excluding taxes and transfer costs which are flows within the economy. The 'cost price' or cost to the supplier, with a small mark-up for implementation costs, was considered to be the most appropriate. In cases where the analysis is from the user's point of view, then the market price is most appropriate because this is what the user will have to pay to purchase the system.

2. The "system" employs people who would otherwise not be employed in this way, and creates factories and other assets which would not otherwise be built. It then gets tangled with macroeconomics. In poor economic conditions, this might offset unemployment benefit costs; in boom times, it would impose opportunity costs (i.e. diverts productive capacity from other activity). There is also the question of how to assess the effect on trade (component import, system/service export).

3. The social cost-benefit approach may apply to the situation where fitting eCall is truly mandatory (in the same way as building a new road). However, if it is a voluntary system – or if the market has decided to fit it anyway - then it can be argued that the buyer has made their own "cost benefit assessment" when choosing to buy the device. The "true" economic case for purchase of a system using government values of time and accident costs might be actually poor, but people want to buy it anyway as they perceive it has a value that is greater than the purchase cost.

4. If people buy a system with their own money to achieve an outcome they want, they are not thinking of society or economic benefits and it is arguable as to whether the in-vehicle component would actually impose a cost on society. The societal cost is in the infrastructure (which is relatively inexpensive) and yet society gains the benefit of eCall in terms of lives saved. The argument that they should have spent their money on something else is unlikely to be popular!

A second issue concerning costs is how they will change over time. This is often commercially sensitive information but, generally, it can be expected that costs will depend on volume (economies of scale) and the state of maturity of the technical components involved. Costs generally fall over time as volumes increase and technological progress is made. As products become obsolete, costs may rise and disposal costs may also increase with time; however, the general trend is downwards. This is an area where judgement has to be exercised in order to develop the benefit/cost calculation.

A third, and more difficult issue, is one of "bundling"; that is, reducing the cost associated with a particular product or service because it will use components that are common to other services. As noted above, usually we are interested in marginal costs, so by this approach the first service bears the total cost of the hardware. If a platform exists, then it seems reasonable to only include the marginal cost of developing the new service. If several services are introduced simultaneously, it may be appropriate to split the costs of hardware and operation in some way. It becomes more speculative when one service or function is proposed as a platform for development of future services. Questions will include the certainty of whether further services will follow (and their take-up) and how to value or share these future potential benefits. So, there are different approaches to valuing bundles of services which may be taken using market judgement or policy conventions.

7.5.4 Benefits

A main benefit of eCall is the fatalities avoided. This is extensively discussed in this report. Whilst the definition of a fatality is relatively standard, the valuation is not (see section 7.1). Moreover countries themselves are not homogeneous, and benefits may arise to a greater extent in some areas than others.

Technically, fatalities of visitors to a country may need to be excluded from the costs with the exception of restitution costs (although rescue costs could be included) because other costs would be borne in their home country. However fatalities of national citizens abroad should be included (perhaps without rescue costs). Thus, a full treatment would include statistics on visitors in/out and the nationality of all fatalities, but this is not usually taken into account; the analysis would be difficult to undertake even if the information were available and is likely to only be a small factor in the overall assessment.

Concerning serious injuries, there are differences in interpretation of eCall impact. Some countries (such as Hungary) define the injury in terms of the trauma suffered during the crash. Other countries (such as the UK) define it in terms of the patient's outcome. This can lead to different interpretations of the impact of ITS functions and services.

Attempts have been made to quantify some other benefits including congestion saved, pollution saved and efficiency of the rescue operation. However, there are also other acknowledged benefits or costs for which quantification is problematic and generally not attempted. These include, for example, efficiency savings where the emergency caller is not a native speaker, peace of mind when travelling abroad, and the impact of eCall on false alarms.

7.5.5 Discounting

Discounting is used to adjust the future values of costs and benefits to the present, providing a common basis for cost benefit analysis of projects with different time horizons. The discount rate which is used in this process varies. European Commission guidance on cost benefit analysis of investment projects funded using EC funds including Structural Funds and the Cohesion Fund, recommends benchmark values for the real social discount rate of 5.5% for countries funded under 'Cohesion Funds' and 'Instrument for pre-Accession' (e.g. many countries in eastern Europe), and 3.5% for 'Competitiveness Regions' (e.g. western Europe) (European Commission Directorate General Regional Policy, 2008). Not all countries follow this and in the UK, for example, the rate used in public investment decisions is 3%.

Note that all these rates are much lower than commercial returns would need to be. The selection of a particular discount rate is really an economic/policy convention, but one that can change the outcome of a finely balanced B/C ratio.

In this study the Europe-wide B/C calculation in Section 9 takes a different approach with a "snapshot" of the years 2020 and 2030. This is (arguably) more valid in steady-state conditions than the discounting approach. Essentially, the cost of equipping the new additions to the fleet in 2020 and 2030 are balanced against the benefits of eCall in 2020 and 2030. This also produces higher B/C ratios than a full discounting approach as it considers infrastructure and IVU investments in previous years as sunk costs whilst still benefitting from that investment made in previous years.

7.5.6 Interpreting the Benefits: Costs ratio

Calculation of benefits and costs is not an end in itself and, whilst some agreement over the exact form of "the boxes" in the calculation flow is important, the important thing to remember is that the calculation is just one input to the decision of "do we implement system X or not?". It provides a mechanism for ranking options in order to assist decision-taking.

In general, government action is based on an assessment of how any proposed policy, programme or project can best promote the public interest. Within this there are two key questions:

- Is the rationale for intervention clear?
- Are the benefits of intervention expected to exceed the costs?

The second question is typically addressed by Member States through a national appraisal process. In the UK, for example, the process is called NATA (National Approach to Appraisal) which brings together all costs and benefits, whether monetised or not, in an 'Appraisal Summary Table', thus enabling decision takers to consider whether the benefits of a proposal are greater than the costs.

Some funding agencies may consider investing in schemes which have a benefit: cost ratio which is greater than one, while others will not consider investing unless the ratio is at least 1.5, or in some cases at least 2 (the 1992 Federal Infrastructure Plan for Germany specified a threshold of 3, for example). Setting higher thresholds is seen as a way of ensuring that funds are allocated to schemes which will clearly have a positive outcome.

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8 Liability and privacy issues in relation to eCall

8.1 Introduction

A question often raised in relation to the introduction of eCall is that of potential liability exposure of the different actors in the production and service chain. The aim of this section is to provide a short overview ('quick scan') of liability issues in relation to eCall.

The aim of an eCall-system is to automatically notify the emergency services in case of a serious accident with the purpose of reducing injuries by earlier arrival of trained and equipped assistance.

Potential liability questions primarily relate to:

1. damage as a result of an unsuccessful or corrupted eCall (aggravated injuries or death)
2. damage as result of false alarms (the costs of unnecessary dispatch of emergency services)

8.2 Liability for unsuccessful or corrupted eCall

Due to its technical and organisational complexity we can envision several possible causes for an unsuccessful or corrupted eCall (i.e. the eCall failed partially or completely), including:

1. incidental flaws in hardware and software component in the in-vehicle equipment or any other physical system component in the service delivery chain (manufacturing defects, software bugs)
2. threshold for triggering the automatic eCall was not met
3. faulty or incomplete data (e.g. wrong location)
4. the in vehicle equipment is damaged in a crash before an automatic eCall was triggered
5. in vehicle equipment not adequately installed or maintained
6. service provider or PSAP eCall equipment not adequately installed or maintained
7. lack of telecom service (due to lack of network coverage or other circumstances)
8. human errors somewhere in the service delivery chain

Depending on the reason(s) for the unsuccessfulness of the automatic eCall liability claims may be directed towards one or more of the actors in the production and service delivery chain, including:

1. dealer/system supplier
2. car/system manufacturer
3. private service provider
4. mobile network operator
5. PSAP's public safety answering point

It should be noted that this is a somewhat abstract and non-exhaustive typology of stakeholders. It may well be that in reality one stakeholder embodies more than one of the above mentioned stakeholder categories. Furthermore, it is also possible that, depending on the circumstances, other parties may be confronted with claims (e.g. installers, car rental companies, certification bodies, automobile servicers, fixed network provider, etc.).

There may be a variety of liability relationships between the different actors. These relationships may be based on tort law or contract law and the existence and details of such a relationship differ between national law regimes.

In this overview only Dutch and (to a lesser extent) English law are considered. The focus is primarily on liability for personal injury and death.

8.2.1 Tort liability: the general framework

Liability in tort is associated with compensating third parties who have suffered physical injury or property damage. It does not require any contractual link between the claimant and the defendant.

Liability rules are often categorized as fault liability rules or strict liability rules. In general, tort liability for personal injury and death is based on fault. To say that a person was at fault is to say that they should have behaved differently in some respect. Fault is generally considered to be a synonym for intentional or negligent conduct.

Strict liability is liability without intentional or negligent conduct. In this sense strict liability is also referred to as objective liability or risk liability, which means that liability is to be established independent from the tortfeasor’s conduct (Van Dam 2006, p. 255).

Strict liability is often provided for if fault liability does not lead to satisfactory results. Strict liability rules often apply to damage caused by moveable objects representing a higher than average risk, such as motor vehicles or defective products (Van Dam 2006, p. 256). Another reason to impose strict liability rules is that it may lead to more efficiency since extensive discussions on the required level of care and the level of care which was effectively maintained are no longer necessary. Rules of strict liability do not take the required level of care as a starting point but link liability, in principle, to the realization of a risk (Van Dam 2006, p. 257).

It should be noted that, in practice strict liability is far from a clear concept (Van Dam 2006, p. 264). First of all, elements of negligence often play a role in rules of strict liability (for example, strict liability for a defective product holds elements in the requirement of a defect that are akin to the elements of negligent conduct).

Furthermore, the concept of strict liability is even more blurred because not only does strict liability hold elements of negligence, but negligence liability also holds elements of strict liability. The courts use various techniques to make negligence liability stricter, such as applying an objective standard of care, increasing the required knowledge and ability to a high level, and substantially raising the required level of precautionary measures. The courts also make use of various subtle evidence rules in order to shift the burden of proof as regards negligence or elements of negligence to the defendant.

8.2.2 Contractual liability: the general framework

Liability under a contract is associated primarily with compensating a purchaser of goods or service ‘purchaser’ in respect of unfulfilled expectations.
In principle the parties themselves can decide what the purchaser of goods or service ‘purchaser’ is entitled to expect and who has to bear the consequences if these expectation are breached. However, especially in relation to consumer contracts, there

are many restrictions to the freedom of contract. These restrictions may apply to (consumer)contracts in general[12] or may be of a sector-specific nature.[13]

Under general Dutch contract law, it is provided that every failure in performance of an obligation shall require the obligor to repair the damage which oblige suffers there from, unless the failure is not attributable to the obliger (art. 6:74 of the Dutch Civil Code, hereafter BW). A failure in the performance cannot be imputed to the debtor (for example a private service provider or mobile network operator) if it does not result from his fault and if he cannot be held accountable for it by law, juridical act or common opinion either (art. 6:75 BW). Art. 6:75 BW provides when force majeur (non attributable non-performance) exists. It adopts a two-stage test: the non-performance cannot be imputed to the debtor if a) he is not at fault, and b) if the non-performance does not fall within his sphere of control. If both requirements are met, the debtor is freed and an action for damages is excluded. The first test is whether the debtor can be blamed if the non-performance has been caused by an event which he could reasonably prevent and of which he was unable to avoid the consequences (Asser-Hartkamp 6-I no. 344). Even isif the debtor is not at fault, the non-performance can still be attributable to him. Art. 6:75 BW mentions three different grounds attribution on the basis of risks. (Asser-Hartkamp 6-I no. 346).
a) Law. First, a specific provision ('by law') can create liability. The most important instances are the liability for third persons (if the non-performance is caused by the services of a third person, the debtor is, according to Art. 7:76 BW, liable for these as if it were his own) and the liability for 'things' being used in the performance of the contract (art 6:77 BW).[14] A prerequisite for the latter liability is that the object being used is not suitable for its purpose. b) Juridical Act. A second ground by which to bring non-performance within the sphere of the debtor's risk is b y a 'juridical act': the parties themselves can decide who has to bear the consequences of the failure to exclude or limit liability. c) Common Opinion. This refers to the communis opinion of society in general or of a specific part of society (trade, etc.) [15]

In principle the parties themselves can decide who has to bear the consequences of the failure by excluding or limiting liability. However, there are several restrictions to this principle. For example the Dutch Civil Code lays down a specific regulation with respect to terms not individually negotiated which qualify as general conditions (Section 6.5.3 BW).[16] This regulation provides for a rather elaborated system of general conditions and is intended for all types of contracts. General conditions can be annulled if they are unreasonably onerous to the other party. Art. 6:236 contains a 'blacklist' with clauses which if used against a consumer, are deemed to be unreasonable onerous. Art. 6:237 contains a grey list with clauses which, if used against a consumer, are presumed to be unreasonable onerous; the party making use of the clause retains the possibility to provide evidence to the contrary. The exclusion or limitation of one's liability for damages appears on the grey list (art. 6:237 (f) BW). The exclusion of liability personal injury or death will not be easily accepted (van der Kolk 2007).

[12] See for example Unfair Contract Terms Directive 93/13/EEC and Consumer Guarantees Directive (1999/44/EC

[13] See for example Directive 2002/22/EC (Universal Service Directive)

[14] Unless this would be unreasonable in view of the content and necessary implication of the juridical act from which the obligations arises, common opinion and other circumstances of the case.

[15] In general the following rules are accepted in Dutch law. The debtor is liable if the impediment could be foreseen at the time of the conclusion of the contract and when the non-performance is caused by the debtor's own financial position, illness or inexperience. See Asser-Hartkamp 6-I no. 353-361.

[16] Implementing Directive 93/13/EEC on unfair terms in consumer contracts.

In the context of English law, freedom of contract is, in certain circumstances constrained by provisions of statute law (Chitty on Contracts, Volume I, no. 14.001). For example, the Sale of Goods Act 1979 provides that contracts for the sale of goods (but not services) are subject to a number of implied warranties, such as that the goods comply with their description (s.13) and that they are 'of satisfactory quality' (s.14). The Unfair Contract Terms Act (1977), which regulates the use of exclusion or limitation clauses for the purpose of liability in both contract and law, provides that any contractual term which purports to exclude these implied warranties is void as against a consumer and, as regards a business-to-business sale, is valid only to the extent that it is 'reasonable'. Section 2(1) prohibits the exclusion or limitation of liability for personal injury or death caused by negligence.

The Unfair Contract Terms Act provides also that, in the case of contracts with a consumer or of contracts made on the standard terms of one of the parties, clauses purporting to exclude liability for loss or damage caused by breach of the express terms of the contract will be valid only if it is reasonable. A 'reasonable' term is defined in section 11 of the Act as a "term [that is] a fair and reasonable one… having regard to the circumstances which were, or ought reasonably to have been, known to, or in the contemplation of the parties when the contract was made. Criteria to be applied in testing a term for reasonableness are set out in Schedule 2 to the Act. They include factors such as the relative strength of the parties' bargaining positions and whether any inducement was offered to the customer to persuade him to accept a limitation of his rights.

8.3 Car dealer/system seller

The principal source of a dealer's or retailer's liability is usually in contract and for breach either of contractual promises or of the implied conditions of correspondence with description, satisfactory quality and fitness for purpose (non-conformity).
A seller of goods is generally held to 'warrant' that the goods sold are neither dangerous nor defective. If they cause injury to the purchaser, he or she can sue the purchaser without having to establish that the seller was personally negligent. Thus the liability imposed on the dealer or system seller is a fairly strict one (Miller & Goldberg 2004).[17] If a good actually causes damage or injury to the buyer, the seller can only escape liability in law by showing that the good was not defective (this strongly resembles the assessment of defectiveness under the Product Liability Directive, see section 7.4).

Also under Dutch law a seller of goods is generally held to 'warrant' that the goods sold are not defective (Asser-Hartkamp 4-I no. 355). However, the seller will not be liable if the breach of contract also constitutes a product defect in the sense of art. 6:185-193 BW (art. 7. 24 (2) BW).[18] In other words, in case of concurrence of breach of contract (between a seller and a consumer) and product liability (see section 8.4) the latter takes precedence.

[17] However, in most cases the seller will be able to pass a claim up the chain to the product manufacturer or the party who supplied him with the product.
[18] art. 7:24 BW stipulates that if a good is sold by a professional to a consumer and the defect falls under the scope of artt. 6:185 ff. BW, it is not the seller but (solely) the producer that is liable, unless the seller knew or should have known the defect, guaranteed the absence of the defect, or the claim consists of material damage which cannot be claimed under the products liability regulations.

8.4 Car/System manufacturer

Manufacturers may be held liable on a non-contractual basis if damage or loss is caused by products which fail to meet the standards claimed expressly or impliedly for them or which are dangerous or otherwise defective (‘product liability’). The primary cause of action under both Dutch and English law will be the liability regime that is based on the European Product Liabilty Directive.

Liability under the Product Liability Directive

Initially, product liability was entirely governed by national laws. In 1985 however, a European Council Directive on liability for defective products was introduced (Council Directive 85/374/EEC, OJ 1985 L. 210/29). The goal of this Directive is to harmonize product liability rules in Europe.[19]

The most important element of the European Directive is the notion of a defective product. According to the Directive the producer[20] shall be liable for damage[21] caused by a *defect* in his product (article 1). Article 6 (1) of the Directive provides a definition of a defective product:[22]

A product is defective when it does not provide the safety a person is entitled to expect, taking all circumstances into account including:

(a) The presentation of the product;
(b) The use the product could reasonably be put to;
(c) The time when the product was put into circulation.

From the wording of article 6 it can be concluded that the EC Directive defines "defect" in terms of consumer expectations..[23] Furthermore, the definition of a defective product makes clear that courts are allowed to take a broad range of circumstances into account when deciding product liability questions and therefore there are no clear and unambiguous answers when it comes to assessing product liability implications of eCall equipment.[24]

Liability for unsuccessful or corrupted eCalls

[19] The European Directive obliges the Member States to bring into force the laws, regulations and administrative provisions necessary to comply with the Directive (article 19). For example in Germany the Directive is implemented through the ‘Produkthaftungsgezets’ and in the UK through the ‘Consumer Protection Act 1987’. The European Product Liability Directive has been implemented in the Dutch Civil Code without substantial textual changes (art. 6:185-193 BW). Member States are furthermore not allowed to draw up new legislation that derivates from the European Directive

[20] ‘Producer’ effectively includes all those in the supply chain form the manufacturer down (including the manufacturer of a component part). Also included is any person who ‘presents himself as a producer ’by putting his name, trademark or other distinguishing feature on the product, as are other suppliers unless they can notify the consumer of the identity of the producer (art. 3).

[21] ‘Damage’ under the Directive is defined as personal injury and death, on the one hand, and damage to property used for private use or consumption, on the other (art. 9): ‘pure economic loss’ and business losses are thereby excluded. Contracting-out through excluding or limitation clauses is prohibited (art. 12).

[22] See art. 6:186 BW and art. 3 of the Consumer Protection Act

[23] However the reference to the reasonable expectation of the use of the product, the time it was out into circulation and the reference to the safety ‘a person’, not necessarily the ultimate consumer can be read as incorporating elements of a risk-utility test (Miller & Goldberg 2004, p. 355).

[24] There is some room for discussion whether non-working products can be considered defective in terms of the Directive, however it is quit generally agreed that this is the case. (Dommering-van-Rongen 2000, p 61).

Key question in relation to eCall is whether an unsuccessful or corrupted eCall can render the system defective in terms of the Directive. To answer this question it is useful to distinguish between manufacturing defects and defects that can be considered to be inherent system limitations.

Manufacturing Defects
A manufacturing defect exists when a product (an eCall-system or component) does not meet the manufacturers' own product specifications. In other words, the product deviates from the product-line-standard. For example, it could happen that by accident some badly produced sensors or electronics have been used in one or more eCall-devices. In such cases it can relatively easy be argued that the eCall system is defective in the sense of the Directive because the system does not meet the manufacturer own product standards.[25]

However, even if it was to be concluded that an unsuccessful eCall was caused by a manufacturing defect, this does not necessarily mean that the manufacturer could be held liable towards vehicle occupants. For the manufacturer's liability to be established it must also be shown that the unsuccessful eCall contributed to the damage (aggravating the injuries or causing death due to longer rescue time). In other words the claimant in principle has to prove the damage and the causal link between the defect and the damage. This means that the claimant in principle has to prove that, and to what extent, his injuries were aggravated due to the unsuccessful eCall. In many cases this question cannot be answered easily and will require the help of medical experts.

Closely related to the concept of causation are theories of contributory negligence (claimant's own negligent conduct leads to a decrease of the damages to be paid by the tortfeasor) and contributory risks (other causes for which the claimant has to answer can reduce the amount of the awarded damages). For example, if a driver caused the accident by reckless driving, he may not claim full compensation or any compensation at all. In practice, questions of contributory negligence are of major importance (Van Dam 2006, p. 334).

Design and Presentation Defects

An unsuccessful (or corrupted) eCall may also be the result inherent limitations of the eCall system. The eCall may be unsuccessful as a result of specific accident situations (e.g. threshold for triggering the automatic eCall not met, vehicle under water), inadequate coverage of mobile phone network, eCall equipment damaged in the crash, etc.

It will be clear that manufacturers in principle cannot be held liable for services independently delivered through the in vehicle equipment. It is only for defects in the in-vehicle equipment for which the manufacturer is responsible under the Directive.[26]

It will be evident that it will be impossible to provide a system that functions under all imaginable conditions. Therefore the perfect system will not be the product liability benchmark.

However, manufacturers have a duty to market reasonable safe products. This means inter alia that they need to inform the public of the inherent limitations of the system

[25] It is broadly assumed that the fact that such incidental defects cannot always be detected and prevented, not even with the most advanced control measures, this will not exclude the producer from liability (Spier et. al. 2006, p. 139; Miller & Goldberg, 2004 p. 395). See also A v. National Blood Authority [2001] 3 All ER 289.
[26] Of course, if the car manufacturer also offers an additional eCall service he may also be liable in his capacity of service provider (see section 8.4)

(for example trough instruction manuals) [27] and should not overstate its performance capabilities.[28]

Questions of what is reasonable safe are most problematic when these relate to trade offs in design between the level of safety and other factors. For example there may be a trade off between triggering the eCall in a way that it does not miss any serious accident in which the dispatch of emergency services is wanted and avoiding false alarms. Another example may be the fact that an eCall system may be switched off for acceptability or privacy protection reasons. And of course there is always the trade off between enhancing product performance (for example in terms of crashworthiness of the device) and additional costs.

One important factor that courts will take into account is the availability, cost, and practicability of a safer design. We may expect that courts in judging these trade-offs will value the evident benefits of eCall in favour of accepting inherent system limitations that cannot be easily avoided (in terms of costs and practicability) through an alternative design or adequate instructions. Furthermore, the fact that eCall does not create any substitute risks - is in fact only aiming at reducing damage that was caused by another factor than the product itself – may be taken as a relevant factor in the assessment of the defectiveness of the system.

Another relevant factor, which is especially important in design defect cases, is whether or not the product complies with relevant performance and safety standards, for example those laid down by Standards Institutes. For example, within CEN progress is being made in the standardization of the "Pan-European eCall Operational Requirements".[29] Compliance with such standards may be evidence that the product is not defective, helping to determine the "safety a person is entitled to expect". However it should be emphasized that although the fact that a product complies with written safety standards is relevant, it does not provide an automatic defense. Standards will be regarded as to lay down only a minimum requirement which the product should fulfill. (Schepel & Falke 2000, p. 233).

If it would be decided that eCall will be made **mandatory** equipment for all new type approved vehicles than system requirements and conformance test procedures must be available to enable type approval authorities to assess whether the equipment can be approved as being in consistency with European Directives.[30] The system standards and service requirements that are now being developed by ETSI and CEN may be incorporated into the relevant European Directives/ UNECE regulations.

eCall solutions may also be based on retrofitted or nomadic devices. The manufacturers of these devices are also subject to liability regime of the Product Liability Directive and what have been explained above equally applies to these producers. However, the fact that vehicle and eCall device are not produced by the same companies may complicate product liability issues if this affects system reliability.

[27] Adequate instructions are of particular importance if users themselves can influence system performance.
[28] Inadequate presentation (through instruction manuals, advertisements statements, etc.) may render a product defective that could otherwise be regarded safe enough.
[29] See for an overview 'Standards Development Organisations and status of work items related to eCall, Status: 17 February 2009'. It should be noted that some questionnaire respondents expressed concerns about the equipment to be required according to the final standard may turn out to be subject of intellectual property rights. This may result in additional costs for licences.
[30] Directive 2007/46/EC. Furthermore, eCall may also become a new item for periodical inspection (Directive 96/96 EC)

8.5 Private Service Provider

Within the concept of TPS-eCall a Private Service Provider receives the eCall and reports it to the appropriate PSAPs. In those cases the vehicle will dial a private number to contact a call centre, which will filter the call and transmit the MSD/FSD and the call to Public Safety Answering Points.

Private eCall services are currently offered by several parties, including automobile manufacturers, telecom operators and automobile clubs. We can envision several arrangements. The car may be equipped by the OEM which also provides the eCall service. Or a car may be retrofitted or a nomadic device may be used and a third party service provider offers an eCall service by subscription. Another possibility is that the private service provider also provides the in vehicle equipment. Furthermore, as far as the service provider absorbs the role of seller/manufacturer of the equipment or the MNO may be held liable under the applicable liability regimes.

Under Dutch law the service provider will be liable in case of attributable non-performance according to rules described in the general framework for contractual liability. Furthermore, as far as he absorbs the role of seller of the equipment or the MNO may be held liable under the applicable liability regimes. A service provider may be liable for the consequences of an unsuccessful eCall if this is the result of faults of his employees within its organisation, if this is caused by an attributable non-performance in the services of a third party used in the performance of the contract (e.g. a MNO) or equipment used not being suitable for its purpose.

The parties involved may deviate from these rules and may decide to what extent service providers are accountable for service failures (trough exonerations to limit liability or expending it by (implied) warranties). In practice service providers will often use this possibility to limit their liability through exonerations. Such an exoneration might for example be formulated as follows: "The service provider is not responsible for any delay or failure in performance if such failure or delay could not have been prevented by reasonable precautions. The service provider is not responsible if such failure or delay is caused by acts of nature, or forces or causes beyond reasonable control including public utility electrical failure, government actions, terrorism, or equipment failures including internet, computer, telecommunication or other equipment failure." However, there are several restrictions to the use of this instrument. For example, the Dutch Civil Code stipulates that that the exclusion or limitation of one's liability for damages by way of general conditions, are presumed to be unreasonable onerous. The party making use of the clause retains the possibility to provide evidence to the contrary. Factors that courts will take into account valuing this evidence include the nature of the damage, the cause of the damage, the insurability, the nature of the contract, the nature of the agreed obligation, the agreed counter obligation (price) and the state of technology (in case performance of the obligation is strongly dependent on technical equipment). In valuing the evidence courts are able to balance the interests of the parties involved as well as the societal benefits of eCall services.

8.6 Mobile network operator

The Mobile Network Operator (MNO) enables the GSM Voice call and transport the data message from the on-board telematics unit to the service provider. It is also possible that MNO operates as the eCall service provider towards the end user.
This MNO is in principle not liable for interruption of failure of service if the non-performance has been caused by an event which he could not reasonably prevent and of which he was unable to avoid the consequences. The quality of, and availability of the network, can be impaired by factors which cannot be influenced by MNOs, including local physical obstacles (buildings, tunnels, mountains) and atmospheric conditions. As long

as the service provider/MNO refrains from giving warranties and as long as he makes reasonable effort (inter alia given the state of technology), to provide coverage also in adverse conditions, he will be able to invoke a force major defence. However, the MNO will in principle be accountable if non-performance was caused by faults of his employees or services of a third person or if equipment used was defective or not fit for its purpose.

Concerning the possibilities for MNOs to limit their liability through exonerations the situation is the same as was explained in the previous section. An exclusion or limitation of one's liability for damages by way of general conditions, are presumed to be unreasonable onerous. The party making use of the clause retains the possibility to provide evidence to the contrary. Factors that courts will take into account valuing this evidence include the nature of the damage, the cause of the damage, the insurability, the nature of the contract, the nature of the agreed obligation, the agreed counter obligation (price) and the state of technology (in case performance of the obligation is strongly dependent on technical equipment). In valuing the evidence courts are able to balance the interests of the parties involved as well as the societal benefits of eCall services.

Furthermore there are certain legal obligations imposed on MNOs in relation to emergency calls. For example, the Universal Service Directive provides that "Member States shall ensure that, in addition to any other national emergency call numbers specified by the national regulatory authorities, all end-users of publicly available telephone services, including users of public pay telephones, are able to call the emergency services free of charge, by using the single European emergency call number "112".[31] This provision has been implemented through art. 7.7 (1) of the Dutch Telecommunication Act (Tw). It means that if eCall is based on 112 MNOs have to process these calls free of charge (also without an subscription) and without obstacles. In addition, under the Dutch Tw, they must take the necessary measures to ensure the access of emergency numbers in case of congestion in their telephone network (art 7.7(3)). However, this statutory provision is silent on other possible causes of interruption of services.

The Universal Service Directive furthermore provides that Member States shall ensure that undertakings which operate public telephone networks make caller location information available to authorities handling emergencies, to the extent technically feasible, for all calls to the single European emergency call number "112". This provision has been implemented through art. 11.10 of the Tw.

This obligation of the MNOs may also be the basis for the service side of **mandatory eCall** deployment. All new vehicles are equipped with eCall equipment and the MNOs have a legal obligation to deliver the eCall to the emergency services free of charge and without obstacles. It has been argued that posing such types of obligation on MNOs may be an argument to restrict their liability for failure of service (Huijsjes 2002, p. 135) or to consider providing statutory liability limitations (Huijsjes 2005).

8.7 Public Safety Answering Points

Under both Dutch and English law public entities, such as PSAPs, are subject to the same tort liability rules as and may be held liable in tort in the same way and extent as private persons and organisations. (Asser-Hartkamp 4-III no. 266; Deakin et. al. 2008, p. 397).

[31] This provision has been implemented through art. 7.7 (1) of the Dutch Telecommunication Act (Tw): MNOs providing publicly available telephone networks have a legal obligation to enable all end-users to call the emergency services free of charge and without obstacles. .

They may for example be exposed to tort liability if unsuccessful eCalls are caused by faults of staff (e.g. not correctly handling an eCall) or for inadequately installing or maintaining equipment. Performance standards/standards of conduct may differ between countries because they are the responsibility of each member state. The fact the public entities fulfil a public duty/task may influence the negligence standards or legal causation tests courts will apply in relation to such organisations. (Spier et. al. 2006, p 178)

If eCall is to become **mandatory** in vehicle equipment than we may expect that also the PSAP side of eCall will be regulated, in the sense that Member States will be obligated under the Universal Service Directive[32] to be able to adequately handle emergency calls made by eCall systems.

8.8 Liability for false alarms

The situation of false alarms differs from unsuccessful or corrupted eCall in terms of consequences (unnecessary dispatch of emergency services) and potential claimants (government entities responsible for emergency services).

It should be noted that normal PSAP operation already includes a high number of false alarms.

An end user may be held liable in tort for intentionally misusing an emergency number and as such an eCall system[33]. However, in other cases recovery of costs will be problematic because providing emergency services is a typical public task and seeking recovery of costs through a civil law claim may be regarded inadmissible because it conflicts with public law (Bierbooms 1998 p. 148) and because of the potential hurdle it would create for people to call the emergency services.

The same principles will apply to service providers making emergency calls to PSAPs, although it could be envisioned that the standard of conduct will be somewhat different because a service provider is a professional organisation.

8.9 Scenarios

Scenario 1: defective sensor
Driver A is driving a vehicle equipped with eCall in a rural area at 2:00 a.m. Due to burst tire A loses control over the vehicle and crashes into the crash barrier. A is unconscious.

A is found after three hours by a passing motorist. This motorist calls the emergency services. The emergency services arrive 15 minutes later. A is brought to a hospital and doctors diagnoses is that he will be seriously handicapped for the rest of his live.

[32] Art. 26 (2) of the Directive states that Member States shall ensure that calls to the single European emergency call number "112" are appropriately answered and handled in a manner best suited to the national organisation of emergency systems and within the technological possibilities of the networks. See also Commission Recommendation on the processing of caller location information in electronic communication networks for the purpose of location-enhanced emergency call services (2003/558/EC).
[33] Intentional misuse is furthermore a criminal offence under Dutch law (art. 142 (2) Dutch Penal Code) and probably under other jurisdictions as well.

Furthermore the doctors state that if adequate medical aid was offered within 30 minutes after the accident A would probably have fully recovered from his injuries.
Although it is clear that under the crash circumstances an automatic eCall should have been generated, technical investigation reveals that no eCall was generated due to poor quality of the sensors used (resulting from of a flaw in the production process).

In this scenario a claim seems most likely to be directed to the manufacturer (see section 8.3). Due to badly produced sensor the eCall-system does not meet the manufacturers' own product specifications (see section 8.4). In other words, the product deviates from the product-line-standard. In such cases it is relatively easy be argued that the eCall system is defective in the sense of the Product Liability Directive because the system does not meet the manufacturer own product standards. However, it could also be argued that the incidental occurrence of such product line standard deviations, given circumstance as the clear benefits the system, should be accepted and does not lead to the conclusion that the eCall system did not provide the safety a person is entitled to expect. It should be noted however, that it is broadly assumed that the fact that such incidental defects cannot always be detected and prevented, not even with the most advanced control measures, will not exclude the producer from liability.

For the manufacturer's liability to be established the claimant must also prove a causal link (on the balance of probabilities) between the omission of the eCall and the injury in question. Both Dutch as English law apply a *condicio sine qua non*[34] test.[35]

According to the *condicio sine qua non* test, also known as the but for test, 'cause in fact' or factual cause, one should, in order to determine whether an act or omission was a cause of the loss, eliminate the act or omission mentally and consider whether or not the loss would still appear. In other words the claimant in principle has to prove that, and, if yes, to what extent, his injuries were caused due to the unsuccessful eCall. This will require the complex help of medical experts.[36]

Scenario 2: inherent system limitation
Scenario 1 is changed in the sense that in this case the eCall was not being generated because the threshold for triggering the eCall was not met, due to the quite specific circumstances of the crash. This is a result of the manufacturers design choice in trying to find an optimum balance between detecting serious accidents and avoiding false alarms.

Questions of what is reasonable safe in the sense of the Product Liability Directive are most problematic when the alleged product defect involves such kind of design trade offs (see section 8.4).

An important factor that courts are likely to take into account is the availability, cost, and practicability of a safer design. We may expect that courts in judging these trade-offs will value the evident benefits of eCall in favour accepting inherent system limitations that cannot be easily avoided (in terms of cost and practicability) through an alternative design. Furthermore, if relevant product standards exist and are complied with this may taken as evidence that the eCall system is not defective.

[34] Condicio sine qua non literally means: condition without which the damage would not have occurred
[35] Van Dam 2006 p. 268.
[36] Difficulties of proving causation appear to have been reduced by the 'but-for' test being modified so as to make it easier for the claimant to prove the required causal link. (Miller and Gollberg, p. 705)

Scenario 3: failure of mobile phone network
Scenario 1 is changed in the sense that fact that no successful eCall was generated because of lack of telecommunication service as a result of extreme weather conditions.
The quality of and availability of the network can be impaired by factors which cannot be influenced by MNOs, including local physical obstacles (buildings, tunnels, mountains) and, as is the case in this scenario, atmospheric conditions. As long as the service provider/MNO refrains from giving warranties, complies with relevant government network performance regulations and makes reasonable effort, also in the light of the state of technology to provide coverage also in adverse conditions, the MNO will not be liable for interruption of services (see sections 8.5.and 8.6).

Scenario 4: false alarm
B is driving a vehicle equipped with eCall. Due to an icy road B loses control and crashes into the crash barrier. B is uninjured as a result of the deployment of his airbag. he immediately jumps out of his car because he is afraid that the car may catch fire. An automatic eCall is generated and the service provider/PSAP is not able to verify a proper need for dispatching emergency services over the voice link because B has left the car.

The situation of false alarms differs from unsuccessful or corrupted eCall in terms of consequences (unnecessary dispatch of emergency services) and potential claimants (primarily emergency services) (see section 8.7)

A claim against driver B will not be successful. Under these circumstances the Driver will not have committed an unlawful act towards the rescue services.

8.10 Conclusions

It must be emphasized that this quick scan does not address all the possible elements and nuances that dominate the domain of liability law. Furthermore, only Dutch and - to a lesser extent - English law served as a basis for this short analysis. Apart from that, the technical and organisational embedding of future eCall service chains and associated consensus on responsibilities of the actors involved have not yet crystallised, restricting the ability to make clear an unconditional statements.

Nonetheless this short overview gives an impression of the potential liability implications of eCall.

In summary it can be concluded that:

1) All actors in the production and service delivery chain are exposed to potential liability for negligence (breach of a duty of care) or attributable non-performance.
2) Potential claims are most likely in cases where no other road user may successfully be held liable for the damage (particularly in one vehicle accidents).
3) Some actors are exposed to liability risks based on (more) strict liability standards (for example manufacturers in relation to so called manufacturing defects) or are more likely to be confronted with potential claims (e.g. service providers because of their direct relationship with the end user). Their possibilities to exclude or limit liability for damages are restricted. This being said, it can, however, also be concluded that the relevant liability regimes often allow some room for the evident (public) benefits of eCall to be taken into the balancing of interests of the parties involved as well as the society at large.

4) The responses from the questionnaires showed that there is awareness that liability issues need proper consideration; however they did not reveal that liability concerns are generally perceived as a threat to their involvement in the deployment of eCall.[37]
5) (Further development of) equipment performance standards, standardisation of eCall handling protocols and agreed service performance levels (SLA's) for the different actors involved (laid down in standards, contractual agreements or regulations) will help clarify which standards of conduct actors have to meet (and therefore how they may avoid liability risks) and to allocate risks within the production and service delivery chain.

8.11 Privacy and data protection issues

The deployment of eCall has privacy and data protection implication because it involves the processing of personal data (e.g. mechanism/procedures that allow the identification and tracking of cars). This means that in the technical and organisational set up of eCall services the principles laid down in the relevant European Directives [38] and national data protection laws have to be applied.

The principles formulated in these Directives (which Member States are obliged to implement in their national law regimes) however do not provide specified conditions under which data processing is permissible. This leaves considerable room for discussion (what type of information may be processed and under which conditions to be in conformity with these principles?) This was reason for the Article 29 Working Party (WP 29)[39] to adopt a working paper on the issue.[40]

In this working paper data protection and privacy concerns arising in connection with the planned introduction of a harmonized pan-European eCall service that builds on the single European emergency number 112 are outlined.

WP 29 took into consideration two options for implementation of eCall:[41]

- eCall on a voluntary basis (de facto embedded in the vehicle);
- eCall as a mandatory service.

8.12 Voluntary basis

In case eCall is deployed on a voluntary basis as a kind of advanced service supporting road safety, an easy way of activation/de-activation must be introduced. This does not mean that the service cannot be activated automatically when the engine is armed, but that the user should be free to deactivate/activate it at any moment, according to WP

[37]. Contacts with service providers and a PSAP did not reveal any experiences with being held liable for personal injury or death in relation to an alleged failure to correctly process an eCall or an emergency call in general. In this context it can also be noted the extent to which eCall does introduce 'new' risks is limited in the sense that potential failures to successfully process an eCall often do not differ substantially from failures that may occur in 'normal' emergency calls.

[38] Mainly the Data Protection Directives 95/46/EC and 97/66/EC.

[39] This Working Party was set up under Article 29 of Directive 95/46/EC. It is an independent European advisory body on data protection and privacy. It is composed of a representative of the supervisory authority or authorities designated by each Member State and of a representative of the authority or authorities established for the Community institutions and bodies, and of a representative of the Commission.

[40] WP 29, Working document on data protection and privacy implications in eCall initiative, 26 September 2006.

[41] The European Commission has for the time being chosen a self-regulatory approach together with the Member States and industry. However, if the eCall roll-out fails to progress according to the agreed roadmap, it may consider further measures, including regulatory actions.

29. The user, who is not necessarily the owner of the vehicle, shall at anytime have the possibility to switch on or off the system without any technical or financial constraint. This possibility of choice could be offered, for instance for instance by means of electronic switches (for example a dedicated and easy to use button/switch similar to that of the passenger airbag), smart cards or other devices allowing the voluntary activation of the eCall device and also, if desired, enabling the communication of data beyond the MSD.

This position of WP 29 is based on the fact that one of the central criteria for making data processing legitimate is Article 7 (a) of the Data protection directive which allows processing to take place if the data subject has unambiguously given his consent to the processing. [42] Such consent shall be "freely given" and should also allow the data subject the opportunity to withdraw consent. Consent would not be freely given if the data subject has to accept a clause in this regard in the framework of a contract of non-negotiable clauses (as is generally the case with car sale contracts). Furthermore, the Article 29 Working Party considers as illegal situations e.g. pressure from car insurance companies or car rental companies to keep the eCall tool activated. A similar obligation might be put on employees using company cars, where a consent to use eCall could be directly or indirectly forced.[43]

Although in many cases the data processing may be in the vital interest of the data subject, and then the eCall deployment might be supported by Articles 7 (c), (d) and (e) of the Data protection directive, it will not be so in every case. For instance, there may be cases where an accident occurs, and the eCall is triggered automatically but there is no need for the emergency services.
The Working Party understands, on the basis of the information that is currently available on configuration of the eCall system, that it will be possible to geolocalize the relevant vehicle, which however will not be permanently tracked – that is, the system will be booked into the communication network only when an accident occurs or when it is manually triggered. The Working Party welcomes this feature and would like to stress that it would not be acceptable, from a data protection viewpoint, to have such devices permanently connected and vehicles thus permanently be trackable in view of the possible activation of eCall devices. This means that, for instance, it might be acceptable to retain, in the eCall device memory, the three vehicle locations last detected by GPS/Galileo systems (where available on board and interfaced with the eCall device), without communicating any data in the absence of a triggering factor (i.e. accident or manual activation). In such a case, it would be necessary to clearly limit the scope of the

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[42] Article 7 lists a number of criteria for the legitimacy of personal data processing. Member states shall provide that personal data may be processed only if:

a) the data subject has unambiguously given his consent;
b) processing is necessary for the performance of a contract to which the data subject is a party;
c) processing is necessary for compliance with a legal obligation to which the controller is subject;
d) processing is necessary in order to protect the vital interests of the data subject;
e) processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller or in a third party to whom the data are disclosed; and
f) processing is necessary for the purposes of the legitimate interests pursued by the controller or by the third party or parties to whom the data are disclosed, except where such interests are overridden by the interests for fundamental rights and freedom of the data subject, such as data relating to racial or ethnic origin; political opinion; religious or philosophical beliefs; trade union membership; and health or sex life.
[43] The Article 29 Working Party also emphasizes that if the eCall system cannot be activated or especially de-activated on the spot anytime without making additional efforts and free of charge, users will be afraid of possible privacy implications and may choose not to make use of it. Therefore an easy and costs-free de-activation must be introduced also in this respect.

collected data and prevent any further use of the information – i.e. for purposes other than ensuring road safety.

8.13 Mandatory basis

If the eCall service is to be obligatory, the system would de facto be embedded in the vehicle and its activation would be mandatory. This option would need to be enforced by a dedicated EU-wide regulation. Such regulation would have to be properly justified in terms of data protection.

If eCall would be a mandatory tool then all privacy limitations while applying principles set out by the Data Protection Directive, such as among others, the principle of proportionality must be spelled out clearly in the law. Privacy enhancing technologies should be embedded in the eCall system in order to provide eCall users with the desired level of privacy protection. Also safeguards that will prevent surveillance and misuse have to be developed and integrated.

WP 29 summarizes:

If the eCall is optional, a user-friendly solution taking care of self determination of car users by introducing the technical possibility to switch off/on eCall on a case-to-case basis must be introduced, for instance by means of electronic switches, smart cards or other devices allowing the voluntary activation of the eCall device and also, if desired, enabling the communication of data beyond the MSD.[44] If the eCall is mandatory, rules have to be embodied in a dedicated law, taking into account data protection principles. A system of proper data protection safeguards has to be introduced.

In both the voluntary and the obligatory approach national data protection authorities should be consulted in order to provide advice regarding the best possible practices.

8.14 Value added services

Regardless of whether the eCall would be mandatory or optional, the possibility is anticipated of having an extended system with service providers providing value added services. Such a service may be based on adding to the exchanged "basic" information included in the MSD, additional information held by a third party providing added value services, e.g. insurance companies, automobile call centers, medical companies, lawyers, motor clubs, etc. This will require a contract between the owner of the vehicle and the service provider.

In this scenario the user would allow the service provider to receive the additional data related to the incident or the vehicle occupants, for providing i.e. insurance company assistance, motor club support or linguistic support, etc. This extended service is expected to be developed by the market forces.

WP 29 starts by stating that there is no reason to oppose such a scheme as a matter of principle. However, it recognizes that the issues here are more complex and require a more thorough assessment. These services should fully comply with the relevant regulations on data protection and privacy.

[44] It should be notes that the ACEA in response to the questionnaire did expressed itself not in favor of a switch off/on modality

In this context the Article 29 Working Party recalls the basic principles to be taken into account by third party providers, including:

1. The purposes for which the data may be used are to be clearly spelled out in the individual contracts. The contracts should also clearly set out that the third party service provider is the controller of the relevant data and is bound by all the data protection and privacy obligations that pertain to data controllers under both the Data protection directive and national laws.
2. Only such data which are "necessary" and "relevant" for the specific purposes may be transmitted, i.e. it must be ensured that each third party provider only receives those data that are required for the purposes of the respective contract.

8.15 References

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8.16 Annex

Short Summary of questionnaire results

Are there any issues of potential liability exposure or liability concerns (for example in relation to unsuccessful eCalls) that you consider a threat to your involvement in the deployment of eCall? Please specify if possible.

ACEA is of the opinion that vehicle manufacturer's liability shall be restricted to pure technical product functionality, which is under their responsibility. Vehicle manufacturer's liability shall not extend, according to ACEA, to exceptional circumstances, e.g. vehicle under water, no sensor being triggered off due to very unique accident situations or circumstances that are beyond vehicle manufacturers' control, e.g. eCall switched off by driver, inadequate coverage of mobile phone network or Bluetooth connection not correctly activated.

Service providers generally do not consider liability a threat, but rather a factor that needs to/is managed though instruction manuals, terms and conditions undersigned by the owner of the car and SLA’s of OEM’s.

More in general it is recognised that eCall is a complex system involving many parties raising questions about responsibilities and liability allocation. In this context nomadic devices are labelled as particularly problematic and more complex in terms of potential liability exposure of the different actors.

PSAP’s envisage the possibility of being confronted with claims from rescue services in relation to false ecalls. Some service providers envision that they, in their turn, may be confronted with claims from PSAP’s.

A PSAP from Norway seems to suggest that liability issues are being researched at this moment.

Are there concerns about potential liability of parties in the production and service chain? Examples might include unintentional false alarms/ unsuccessful eCalls/faulty or incomplete data (e.g. wrong location/the lack of updating eCall soft and hardware). Do these hinder the deployment of eCall? Please specify if possible.

NB This question was only directed to the Member States

Most mentioned is the issue of false alarms, but it is often unclear whether this issues is also being linked to liability for the consequences (for example costs associated with the dispatch of rescue services) or to acceptability of the system in a broader sense.
There is one exception, highlighting the risk of an unsuccessful eCall.

Have you used the RESPONSE Code of Practice or other tools to manage liability issues?

Only three respondents answered this question. The answers were rather unclear or referred to the future

Are there other legal issues which, in your view, are slowing down eCall deployment? Please specify if possible.

Some respondents emphasise that other then legal/institutional issues are more important for a successful introduction of eCall, technical and organisational issues, financing, problems of localising calls from mobiles).

Other issues
- Data protection and privacy
- Lack of (binding) harmonization
- Legal framework needed for eCall enhanced PSAP
- Other emergency numbers allowed
- routing of 112 calls
- Intellectual property rights regarding In Band Modem

Is your country considering measures to ensure eCall service reliability, e.g. vehicle inspection, certification/homologation procedures?

Many respondents state that the EU is leading in setting standards in this domain or refer to the possibility of implementing eCall as a new item for periodical inspection. One respondent refers to a yearly quality monitor of 112 overall

Do any issues of data privacy remain, in your view, concerning eCall?

Most respondents do not expect major issues, particularly as long as it will be based on the use of 112. One respondent states that if in case another emergency number is used, then there should be turn off functionality. Others state that it is not possible in this stage to asses.

9 Socio Economic Assessment of Policy Options

9.1 Introduction

The objective of this work was to provide a socio-economic assessment of eCall in EU-27 + associated countries (Norway, Switzerland, Iceland, Macedonia; the former Yugoslav Republic of, Croatia and Turkey) and, thereby, to compare three main policy options: Do nothing, Voluntary approach and Mandatory introduction. The assessment covered all assessment criteria, qualitative as well as quantitative indicators, and will also include a stakeholder analysis.

Three methods were applied: cost-benefit analysis to cover the monetary benefits and costs, stakeholder analysis to understand the allocation of the benefits and costs, and multi-criteria analysis to cover also other benefits, impacts and costs that those expressed in monetary terms.

From the point of view of the cost-benefit analysis, the eCall has some distinctive features. "eCall… does not alter the vehicle collision probability, but instead affects the severity of the accident by reducing the rescue time. This means that fatalities could be avoided and that the consequences of such accidents might be reduced to severe injuries. In case of severe accidents, the effect of the reduced rescue time might be diminished accident consequences, resulting in only slight injuries. Finally, the faster arrival of emergency medical services on the accident scene could lead to the fact that some slight injuries can be avoided. (SEiSS 2005)". Thus, the assessment of costs and benefits presented here will focus on the estimated reduction on accident costs as a consequence of the reduced rescue time. The quicker notification of accidents with accurate positioning will also make incident management and clearance more efficient, which will reduce accident related congestion and its costs and impacts such as secondary accidents. These effects will also be taken into account.

9.2 Previous studies

eCall has been subject to several EU-wide studies in the past, notably in SEiSS (Socio-Economic impact of intelligent Safety Systems, 2005), STORM (Stuttgart Transport Operation by Regional Management, 1991), E-MERGE (2004), LAB study from France (Appel d'urgence automatique en France, 2005) and eIMPACT (Socio-economic Impact Assessment of Stand-alone and Co-operative Intelligent Vehicle Safety Systems (IVSS) in Europe, 2008). Also CODIA (Co-Operative systems Deployment Impact Assessment, 2008) aimed to provide an assessment of direct and indirect impacts, costs and benefits of five co-operative systems in EU-level, but eCall was not included into selected systems as such although it included a related system, post crash warning.

These studies have given a reasonably solid understanding of the basic scenario of the implementation of eCall Europe-wide. For instance, the results from eIMPACT and CODIA werewere used to generate reliable vehicle and accident forecasts used in the analysis. However, this study used the previous studies as a platform of departure for more in-depth analysis, with more updated information on several important areas, such as the costs of installation and penetration rate.

9.3 The methodological approach and the underlying assumptions

Socio-economic assessment was provided for three scenarios for eCall implementation. The scenarios were defined as:

1) Do nothing: Just left to the market with no further action from the Commission/eSafety Forum.

2) Voluntary approach: All European vehicle manufacturers, all member states and the EC agree by mid-2010 to provide eCall by signing an MoU (Memorandum of Understanding) on eCall deployment by 2015. The MoU sets specific responsibilities and timelines for the stakeholders signing the MoU.

3) Mandatory introduction: EC will produce an EU directive mandating eCall devices in all new vehicles by the end of 2014 and the member states to set up facilities for receiving and processing eCalls at PSAPs by the same date.

EU member States and the group of associated countries (Norway, Switzerland, Iceland, Turkey, Macedonia and Croatia) were bundled into clusters, which were used as a basis of calculating the EU-27 and associated countries CBA ratios. In calculations, the results from the in-depth case country studies were scaled up to EU-level based on the clustering. For each cluster results of one case country (the Netherlands, the United Kingdom, Finland and Hungary) were used.

Due to the nature of the eCall investment, which is a once-off installment into the vehicle, the annual cost-benefit calculations for 2020 and 2030 provide a snapshot of the profitability of the eCall for the years in question, taking into consideration the impact of previous years eCall installments through penetration rate and the impact on accidents due to the higher penetration rate. In more conventional CBA rate calculations, where discount rates are used to analyse the profitability of an investment project, the investment is expected to take place over multiple years, whereas eCall investments take place during a given year. Therefore, if discounting method was used it would exclude possibility of some of the vehicle with eCall installed having already left the fleet (due to accidents, breakdown of the equipment or other reasons), thus the calculations presented here give the accurate state of the costs and benefits for 2020 and 2030, given the fleet of vehicles (including motorcycles) and the true installation costs.

The calculations presented in this work chapter benefited from more accurate information on unit costs of the eCall installation and from data collected from participating member states and previous studies. For the EU-27 level calculations, averages of accident, emissions and vehicles forecasts were applied. Where assumptions have been used to update the current data, background and justification has been provided in the beginning of each section.

9.4 Clustering of countries

Based on the characteristics of the countries (population density and accident data), EU-27 and associated countries were grouped into six clusters. The clusters are described in chapter 6.2.2.

It should be noted, that most of the countries are not uniform in terms of traffic volumes and population density within the country, so the clustering is based on national averages, not other features that could lead to different clustering. Malta is an outlier from the rest of the data due to its specific characteristics and it was separated as a cluster 1. For the cluster 6 (Macedonia, Croatia and Turkey), where no country was subject to more detailed information gathering, data from cluster 5 was used in the CBA calculations.

For each of the clusters the CBA ratios will be presented in the connection of the EU-27 CBA ratio. It should be noted that anomalies across the Clusters are clearly shown: The higher the current and future accident rates, the greater the monetary benefits from reduction in accident costs, the lower the impact of eCall on accidents, the less the savings in accident costs and the less the number of vehicles, the lower the costs of eCall on installation.

9.5 The costs of the eCall system

Assumptions used in the calculations:
Do nothing scenario:
-OEM eCall will cost approximately 1000 euros for new vehicles
-Nomadic eCall will cost approximately 30 euros if purchased as part of a service package such as in-vehicle navigation system
-Aftermarket (retro) eCall will cost approximately 200 euros
-eCall will cost approximately 100 euros for installation to motorbikes (most likely in helmets)
Voluntary approach:
-OEM eCall will cost approximately 450 euros for new vehicles
-Nomadic eCall will cost approximately 30 euros if purchased as part of a service package such as in-vehicle navigation system
-Aftermarket (retro) eCall will cost approximately 200 euros
-eCall will cost approximately 100 euros for installation to motorbikes (most likely in helmets)
Mandatory introduction:
-OEM eCall will cost approximately 60 euros for new vehicles
-Nomadic eCall will cost approximately 30 euros if purchased as part of a service package such as in-vehicle navigation system
-Aftermarket (retro) eCall will cost approximately 70 euros
-eCall will cost approximately 100 euros for installation to motorbikes (most likely in helmets)

The total costs and benefits of the eCall implementation depend on the penetration rate of the system. The first step in determining the costs of eCall system was to estimate the amount of vehicles that would have eCall installed in each of the scenarios. Basically, this is done using estimation of penetration rate for new vehicles, adopted from eIMPACT but adjusted timing-wise to the current eCall implementation agenda. For vehicles in use, we have introduced a penetration scenario, which assumes a positive trend in penetration rate until the new vehicles start to replace those vehicles not equipped with eCall. This has given the penetration rate of both new vehicles and vehicles in use that will adopt eCall.

The calculations made focused on two years, 2020 and 2030, utilizing the fact that penetration rates had increased over time from 2014 onwards. However, regarding the installations, it was assumed that in 2020 and 2030 the installations would take place only through new vehicles with eCall as a mandatory equipment or through purchase of service packages, with only a fraction of purchases taking place at the after-market rate. Early years would have experienced a higher demand for separate eCall installations at 200 euros per installment, but by 2020 the choice of lower cost installation would have made separate installments unattractive. However, the penetration rates contain in the fleet of vehicles also those that have separate eCall installations. The fleet of vehicles data implicitly has a discount factor included, as the annual calculations for 2020 and 2030 take into consideration the existing eCall installations in the fleet.

The costs of eCall have been estimated for 2020 and 2030 following the three scenarios of eCall implementation. In the ‘do nothing’ scenario the total penetration rate is estimated at 6%, in the voluntary approach the penetration rate is estimated at 23%

and in the mandatory introduction scenario at 42% in 2020[45] (Figure 47). The average fleet of vehicles between 2014 and 2020 is estimated at around 330 million vehicles in the EU, including passenger cars, trucks and buses. These assumptions deviate from those presented in the previous studies by assuming a lower penetration rate than in the SEiSS, mainly due to slower implementation of eCall in the used cars segment, which are already in the market.

It was assumed that the investment in PSAPs will lead to the deployment of eCall not only in cars, but also in motorcycles; although at a later stage. This will not imply more costs for the PSAPs. For motorcycles in the 'do nothing' scenario the total penetration rate is estimated at 3%, in the voluntary approach at 14% and in the mandatory introduction 14% in 2020.

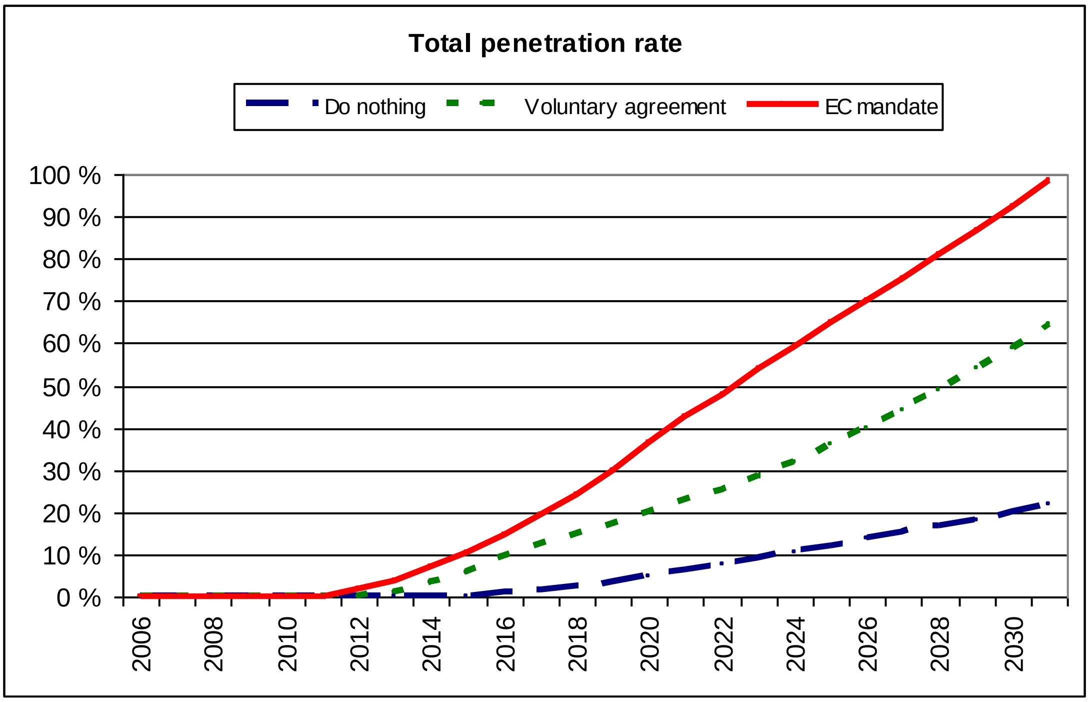

Figure 47: Total penetration rate for 2020 and 2030 following the three scenarios of eCall implementation (do not include motorcycles)

The penetration rates of different eCall types for 2020 and 2030 following the three scenarios of eCall implementation are shown in Table 56.

[45] The 42% penetration rate for mandatory introduction is based on the assumption that whilst the introduction requires all new cars to have eCall installed, the installations to older cars will progress slowly as in the other two scenarios and will not reach 100% even by 2030, but will in line with the 35–50% penetration rate that was estimated in eIMPACT. Currently annual sales of new passenger cars in European Union are around 16 million units per year.

Table 56: Expected penetration rates

OEM (% of new vehicles)			Aftermarket (% of total fleet)		
Do not	Vol agr	EC man	Do not	Vol agr	EC man
9 %	33 %	100 %	2 %	2 %	5 %
26 %	85 %	100 %	1 %	1 %	5 %
Nomadic (% of total fleet)			Motorcycles		
Do not	Vol agr	EC man	Do not	Vol agr	EC man
3 %	14 %	14 %	3 %	14 %	14 %
4 %	16 %	16 %	4 %	16 %	16 %

For each scenario, the price of eCall is different for various installation options as the price depends on the quantity of eCall installations. The costs are highest in the do nothing situation, due to less users and thus higher unit prices. In the do nothing scenario, the OEM price is 1000 euros and in the voluntary approach 450 euros. For OEM eCall, the cost of installation to new car (in the manufacturing phase) is estimated at 60 euros in the mandatory introduction scenario. For the nomadic device 30 euros cost is expected in all scenarios, as it is assumed that it is part of a service package. Standalone price is expected to be approximately 200 euros. For aftermarket device 200 euros is estimated in the do nothing and voluntary approach and 70 euros in the mandatory introduction is expected if the eCall is part of a service package. These figures are based on data collected from eCall manufacturers during the stakeholder consultations. It is feasible to assume that eCall penetration rate in old vehicles is considerable higher when installed through a broader service package at a lower unit cost than when implemented through separate installment.

For each of the scenarios, using the data on vehicle fleet and estimated penetration rate developments we were able to calculate annual penetration rates and the associated costs, for both new and already in the use vehicles. For the future sales of new vehicles, we took the 2007 sales data as a basis and created a trend from 2014 onwards, which also allowed the data to be corrected on existing fleet by eliminating vehicles with eCall from the stock figure. In the calculations we have taken into consideration vehicles in the fleet which have eCall already installed in the previous years and adjusted the installed numbers to match the annual penetration rate. This has given the implicit discount rate of approximately 3.5 per cent over the period of calculations eCall from the stock figure.

In addition, PSAP costs must be factored in. For the do nothing scenario, the service for eCALL (which is not really equivalent to other scenarios) is provided by private operators through their call centers, which is more unreliable and robust system than using the 112 emergency operator services. In the SEiSS, the costs for PSAP were estimated at 30 to 50 million euros a year. However, when the SEiSS study was carried out, the in-band modem solution and the eCall flag had not been selected yet. The assumption in the calculations made in this study is that all physical installations of the system have taken place already by 2020. As this reduces drastically the costs of the PSAPs, we used the average of 0.5 million euros for each member in the clusters in 2020 and 0.25 million euros in 2030, which is based on estimation of annual maintenance/upgrading costs and training costs of operating staff.

9.6 Accident cost savings

Assumptions used in the calculations:

Each cluster Cluster has the estimated impact on reduction of fatalities and severe injuries
- Cluster 1: Fatalities 2%, severe injuries 1%
- Cluster 2: Fatalities 2%, severe injuries 1% (according to Netherlands case study)
- Cluster 3: Fatalities 1%, severe injuries 0.5% (according to UK case study)
- Cluster 4: Fatalities 6%, severe injuries 2% (according to Finnish case study)
- Cluster 5: Fatalities 3%, severe injuries 1% (according to Hungary case study)
- Cluster 6: Fatalities 3%, severe injuries 1%
- Impact on motorcycle accidents were calculated at a rate double the rate for other accidents

The unit costs of accidents in euros were also adjusted for 2020 and 2030:

	2020	2030
Fatality	1,600,000	2,560,000
Severe injury	220,000	352,000
Slight injury	25,000	40,000

As eCall does not prevent accidents from happening, the savings in accident costs come from shorter rescue times, which reduce number of fatalities and severe injuries and, therefore, lead to reduction in accident costs (the so-called Golden Hour principle of accident medicine). Each member state has its own accident cost estimates, but the aggregate EU-27 level analysis presented below utilized the EU-level accident costs. The current 2005 figures were considered not to be applicable in 2020, so calculations based on current figures would most likely have underestimated the accident cost savings. Other studies, for instance eIMPACT, have suggested that adjusting these figures by 60% to 2020 could produce more realistic valuation of accident costs. The values used for 2020 reflect such an adjustment and for 2030 a further adjustment was made, again to reflect the change in valuation over time.

For the cost reduction estimates we applied the same logic as in SEiSS, "For the monetary evaluation, it is necessary to use the differences between each type of accidents because fatalities will be changed to severe injuries and severe injuries will be changed to slight injuries. That means the avoidance of one fatality leads to cost savings of 1,380,000 € (the result of the difference: 1,600,000 € minus 220,000 €) and the avoidance of one severely-injured person leads to cost savings of 195,000 € (the result of the difference: 220,000 € minus 25,000 €)." This has led to quite diversified range of estimates on the impact, indicating different characteristics of each cluster.

It is assumed that the total number of road accidents will be be reduced between now and 2030. This will have impact on the estimated savings in accident costs. The annual number of accidents is estimated to go down from current level of 1.2 million injury accidents in the EU-27 to ca. 815,000 in 2020 and ca. 590,000 in 2030, partially due to implementation of in-vehicle technologies, but also due to the fact that safety campaigns and improvements in the road infrastructure contribute to prevention and mitigation of accidents. This will also adjust figures for fatalities and injuries accordingly. Regarding the level of fatalities and injuries in 2020 and 2030, we have used estimates from CODIA to generate the EU level estimates (Figure 48). The fatality and severe injury reduction trend was expected to be same for all clusters.

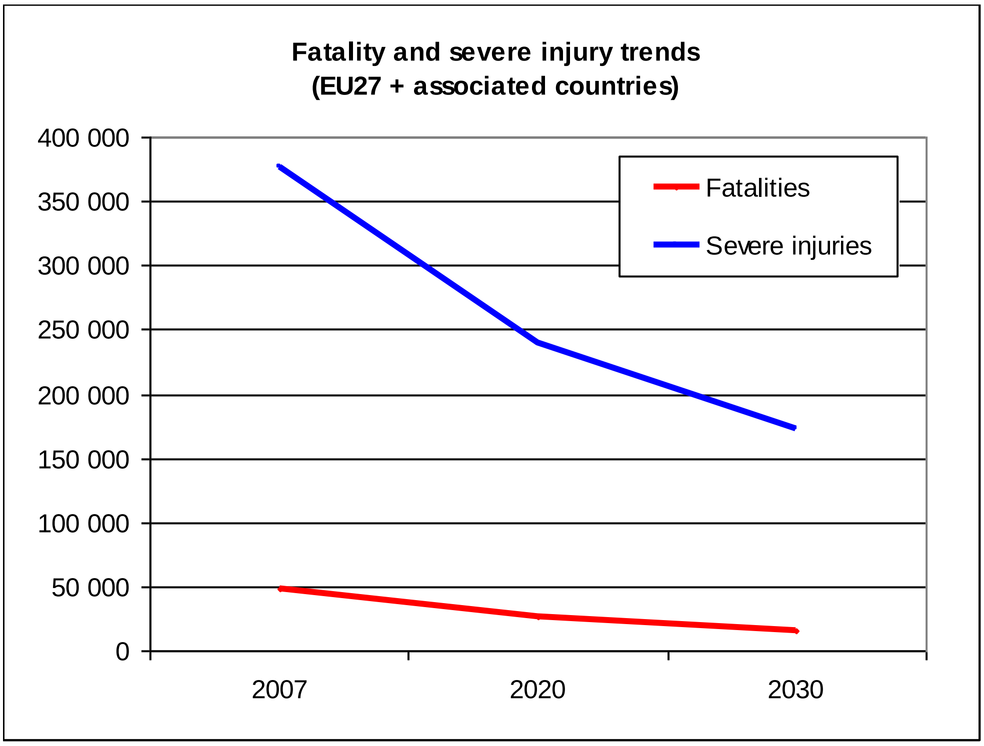

Figure 48: Fatality and severity trends for EU27 + associated countries for 2020 and 2030

With fatalities estimated at 26,414 per annum for 2020 and 15,422 for 2030 and severe injuries estimated at 240,190 for 2020 and 172,792 for 2030 we estimated the magnitude of impact of eCall on accident reduction for all the scenarios. Using these rates and the impact of reduced fatalities and severe injuries on accident costs we got annual reduction in accident costs for all the scenarios CBA calculations section.

9.7 Cluster and Congestion cost savings

A number of methods are available to estimate the benefits arising from reduced congestion. For individual countries an obvious approach is to use traffic models taking account of estimates of the number and nature of eCall-relevant incidents, eCall penetration and reduction in incident times. At a Cluster or Europe-wide level this is more difficult and here the approach adopted is that from eIMPACTS which assigns a congestion cost saving to each fatality and (a lower) congestion cost saving to each accident. Even taking account of the cluster estimates of accident-related congestion reduction, the relatively “broad-brush” nature of this assumption may under- or over-estimate the contribution of congestion to the overall benefit of eCall. Note that the reduction of accident related congestion costs (17%, 3% etc) relate to national congestion levels rather than European average congestion.

Assumptions used in the calculations:
- Congestion time saving per fatality: 60,000 euros
- Congestion time saving per injury: 16,000 euros

Reduction of accident related congestion costs according to the case studies:
- Cluster 1: 17%
- Cluster 2: 17% (according to Netherlands case study)
- Cluster 3: 3% (according to UK case study)
- Cluster 4: 10% (according to Finnish case study)
- Cluster 5: 15–20% (according to Hungary case study), 17% used in calculations
- Cluster 6: 15–20%, 17% used in calculations

In addition to its effect on accidents, eCall will also have an impact on travel time delays due to congestion caused by accidents. This is because the quicker accident notification with accurate positioning makes incident management and clearance more efficient. The fact that eCall will reach an equipment installation ratio of 7% to 42% in all vehicles by 2020 leads to the conclusion that the congestion caused a proportion of accidents in all scenarios could be affected. It should be noted that this impact is dealing with all accidents, and not just those where eCall would have an impact on their severity.

According to CODIA, the unit congestion costs due to accidents are ca. 60,000 € for a fatality and 16,000 € for an injury, on average in the EU. Note that these figures also included as embedded the costs due to property damage only accidents, the number of which is not available in the official statistics.

9.8 Emission cost savings

Assumptions used in the calculations:
- Cluster 1: 0.0005%
- Cluster 2: 0.0005%
- Cluster 3: 0.0005% (according to UK case study)
- Cluster 4: 0.07% (according to Finnish case study)
- Cluster 5: 0.005% (according to Hungary case study)
- Cluster 6: 0.005%

Emission values used in the calculations:
- CO_2: 60 e/ton
- NOx: 2,000 e/ton
- PM_2: 100,000 e/ton

Emission cost savings have not been estimated in the previous studies concerning eCall. They have been reported insignificant. However, at the EU level the total level of emissions is significant on the road transport sector and the information collected from partners in the project suggests that emission costs do play a role in the cost-benefit analysis. It is assumed that the total amount of emissions will be reduced between now and 2030 (Figure 49).

Impact of eCall on emissions was estimated on the basis of the information gathered from the partner states. The impact of emission reductions is small relative to accident savings and installation costs.

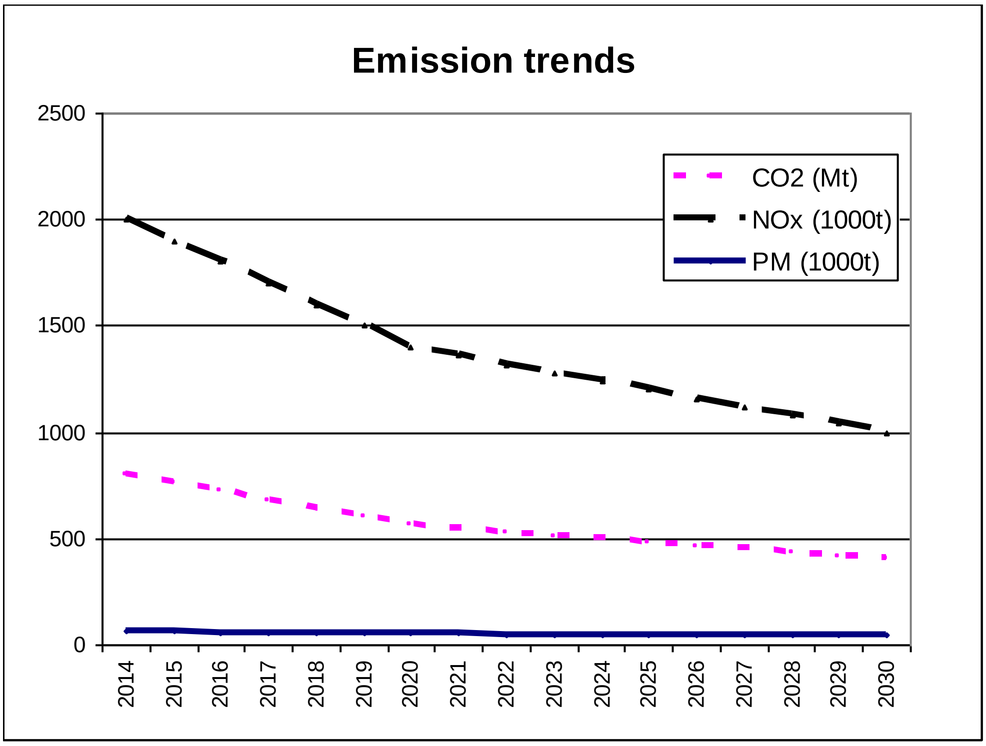

Figure 49: Expected emission trends

9.9 Cost-benefit ratio (CBA) results for clusters

For Cluster 1, Malta, the situation is relatively non-profitable, due to small amount of accidents except for the mandatory introduction scenario in 2030. In all the scenarios except the mandatory introduction in 2030 the CBA ratio remains below 1.

Table 57: Results for Cluster 1

CBA	**Cluster 1**	**2020**	**2030**
Costs	Do nothing	1 492 120	1 885 651
	Voluntary approach	2 122 168	2 778 893
	Mandatory introduction	1 433 644	474 893
Benefits	Do nothing	151 770	411 987
	Voluntary approach	572 645	1 227 699
	Mandatory introduction	1 048 169	1 876 470
CBA rate	Do nothing	0.10	0.22
	Voluntary approach	0.27	0.44
	Mandatory introduction	0.73	3.95

For Cluster 2, the Netherlands, Italy, Germany and Belgium, the situation in 2020 is not particularly beneficial, but improving for 2030 in mandatory scenario. This is as a result of increased penetration rate that has made the impact on accidents greater. CBA rate does not exceed 1 in any scenario in 2020 or 2030.

Table 58: Results for Cluster 2

CBA	**Cluster 2**	**2020**	**2030**
Costs	Do nothing	2 508 875 800	6 498 357 131
	Voluntary approach	4 159 371 069	9 736 690 809
	Mandatory introduction	2 046 740 561	1 777 108 663
Benefits	Do nothing	104 749 582	285 241 798
	Voluntary approach	395 047 515	849 678 660
	Mandatory introduction	723 895 159	1 299 362 290
CBA rate	Do nothing	0.04	0.04
	Voluntary approach	0.09	0.09
	Mandatory introduction	0.35	0.73

For Cluster 3 (UK, Luxembourg, Switzerland), none of the scenarios reaches a significant CBA rate. This is due to the high costs of installation relative to the estimated benefits, both of impact on accidents or on congestion.

Table 59: Results for Cluster 3

CBA	**Cluster 3**	**2020**	**2030**
Costs	Do nothing	382 477 209	840 551 324
	Voluntary approach	583 532 201	1 238 362 007
	Mandatory introduction	317 402 688	203 215 404
Benefits	Do nothing	12 501 900	36 418 686
	Voluntary approach	47 458 298	108 935 739
	Mandatory introduction	85 622 068	165 652 454
CBA rate	Do nothing	0.03	0.04
	Voluntary approach	0.08	0.09
	Mandatory introduction	0.27	0.82

For Cluster 4 (Finland, Austria, Denmark, Sweden, Norway, Iceland, Ireland, France, Portugal, Spain, Slovenia, Czech Republic), CBA results improve by 2030 from 2020, resulting in an above average CBA rate in the mandatory introduction by 2030. Mostly low rates are due to low accident rates in the countries.

Table 60: Results for Cluster 4

CBA	**Cluster 4**	**2020**	**2030**
Costs	Do nothing	1 072 487 854	2 366 675 348
	Voluntary approach	1 652 485 049	3 488 020 033
	Mandatory introduction	875 970 650	569 179 007
Benefits	Do nothing	81 257 154	241 138 717
	Voluntary approach	310 539 456	724 033 301
	Mandatory introduction	551 293 825	1 095 344 217
CBA rate	Do nothing	0.08	0.10
	Voluntary approach	0.19	0.21
	Mandatory introduction	0.63	1.92

For Cluster 5 (Hungary, Cyprus, Greece, Estonia, Latvia, Lithuania, Poland, Slovakia, Romania, Bulgaria), the CBA rate is greater than 1 in mandatory introduction in both 2020 and 2030, with a high CBA rate in 2030 resulting from relative high accident figures for Cluster 5 countries.

Table 61: Results for Cluster 5

CBA	**Cluster 5**	**2020**	**2030**
Costs	Do nothing	249 922 563	389 095 347
	Voluntary approach	375 113 554	586 372 282
	Mandatory introduction	246 100 625	118 775 752
Benefits	Do nothing	44 203 689	122 892 003
	Voluntary approach	168 622 113	368 730 637
	Mandatory introduction	300 680 907	558 363 767
CBA rate	Do nothing	0.18	0.32
	Voluntary approach	0.45	0.63
	Mandatory introduction	1.22	4.70

For non-EU (Macedonia, Croatia and Turkey), Cluster 6, the CBA ratio is extremely beneficial in all scenarios, as shown in table below. This is due to high number of accidents that will generate savings in accident costs through eCall implementation.

Table 62: Results for Cluster 6

CBA	**Cluster 6**	**2020**	**2030**
Costs	Do nothing	94 421 027	177 122 304
	Voluntary approach	142 088 132	261 277 219
	Mandatory introduction	81 697 803	43 269 271
Benefits	Do nothing	35 140 482	96 368 412
	Voluntary approach	133 140 129	287 945 483
	Mandatory introduction	241 309 592	438 506 919
CBA rate	Do nothing	0.37	0.54
	Voluntary approach	0.94	1.10
	Mandatory introduction	2.95	10.13

9.10 CBA results for EU-27 and associated countries

Based on the cluster level calculations, the average figure of CBA rate for EU27 + associated countries was calculated (Table 63). Results show, that in none of the three scenarios for 2020 the CBA ratio is above 1 and in 2030 only the the CBA rate for mandatory introduction is above 1. This is due to the fact that most significant clusters of core-EU countries in terms of their weight have underlying assumptions of low impact of eCall on fatalities and injuries, which results in relatively modest overall CBA ratio.

Table 63: Results for EU-27 + associated countries

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey)

CBA		2020	2030
Costs	Do nothing	4 309 676 572	10 273 687 104
	Voluntary approach	6 914 712 172	15 313 501 244
	Mandatory introduction	3 569 345 970	2 712 022 990
Benefits	Do nothing	278 004 577	782 471 604
	Voluntary approach	1 055 380 155	2 340 551 519
	Mandatory introduction	1 903 849 720	3 559 106 117
CBA rate	Do nothing	0.06	0.08
	Voluntary approach	0.15	0.15
	Mandatory introduction	0.53	1.31

The calculations above are based on the weighted costs and benefits for each of the clusters, which differ for all the scenarios and also between 2020 and 2030.

Table 64: Percentage share distribution of costs and benefits across clusters, 2020

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey) 2020

	Do nothing		Voluntary approach		Mandatory introduction	
Cluster	Share of benefits	Share of costs	Share of benefits	Share of costs	Share of benefits	Share of costs
1	0.05	0.03	0.05	0.03	0.08	0.04
2	37.7	58.2	37.4	60.2	38.0	57.3
3	4.5	8.9	4.5	8.4	4.5	8.9
4	29.2	24.9	29.4	23.9	29.0	24.5
5	15.9	5.8	16.0	5.4	15.8	6.9
Non-EU	12.6	2.2	12.6	2.1	12.7	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 65: Percentage share distribution of costs and benefits across clusters, 2030

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey) 2030

	Do nothing		Voluntary approach		Mandatory introduction	
Cluster	Share of benefits	Share of costs	Share of benefits	Share of costs	Share of benefits	Share of costs
1	0.05	0.02	0.05	0.02	0.05	0.02
2	36.5	63.3	36.3	63.6	36.5	65.5
3	4.7	8.2	4.7	8.1	4.7	7.5
4	30.8	23.0	30.9	22.8	30.8	21.0
5	15.7	3.8	15.8	3.8	15.7	4.4
Non-EU	12.3	1.7	12.3	1.7	12.3	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

9.11 Sources of benefits

The time saving in accident notification arising from eCall is expected to have benefits which can be identified as follows:

- Benefits arising from accident savings (i.e. fatalities averted and injury outcomes improved)
- Benefits arising from savings in congestion (arising from quicker road clearance)
- Benefits arising from environmental improvements

Table 68 below identifies the contribution to overall benefits from the three sources.

Table 66: Contribution to eCall benefit from accident, congestion and environmental savings

		Do nothing		
		Accidents	Congestion	Environment
Finland Cluster	2020	61%	38%	1%
	2030	67%	32%	1%
Netherlands Cluster	2020	20%	80%	0%
	2030	26%	74%	0%
UK Cluster	2020	40%	60%	0%
	2030	48%	52%	0%
Hungary Cluster	2020	49%	50%	0%
	2030	55%	44%	0%
Malta Cluster	2020	18%	82%	0%
	2030	24%	76%	0%
Cluster 6	2020	30%	70%	0%
	2030	36%	64%	0%
		Voluntary agreement		
		Accidents	Congestion	Environment
Finland Cluster	2020	62%	37%	1%
	2030	67%	32%	1%
Netherlands Cluster	2020	20%	80%	0%
	2030	26%	74%	0%
UK Cluster	2020	40%	60%	0%
	2030	48%	52%	0%
Hungary Cluster	2020	50%	50%	0%
	2030	56%	44%	0%
Malta Cluster	2020	19%	81%	0%
	2030	24%	76%	0%
Cluster 6	2020	31%	69%	0%
	2030	36%	64%	0%
		EC Mandate		
		Accidents	Congestion	Environment
Finland Cluster	2020	60%	39%	1%
	2030	67%	32%	1%
Netherlands Cluster	2020	19%	81%	0%
	2030	25%	75%	0%
UK Cluster	2020	39%	61%	0%
	2030	47%	53%	0%
Hungary Cluster	2020	48%	52%	0%
	2030	55%	45%	0%
Malta Cluster	2020	18%	82%	0%
	2030	23%	77%	0%
Cluster 6	2020	29%	71%	0%
	2030	36%	64%	0%

As can be seen, the contribution provided in terms of environmental benefit is small. However, the contribution provided by congestion reduction is extremely significant and is greater than the accident related benefit in for many clusters. This arises from the assumed congestion benefit figures of €60,000 and €16,000 (per fatality and per injury) used in a previous study (CODIA). The congestion benefits are almost certainly an over-estimate and sensitivity analysis is discussed in the next section. For cluster 3, for example, the UK study (Table 13) suggests that congestion benefits contribute €19.5M or 11% of the total benefits rather than in excess of 50%.

9.12 Sensitivity analysis

A set of sensitivity analysis was carried out, where parameters were changed for testing the assumptions made for CBA analysis. A summary of impacts can be seen in the following Table 67.

Table 67: Effects covered by different studies. Impact of various changes in assumptions on CBA calculations

Assumption	Increase	Impact	Decrease	Impact
Penetration rate	Increases accident cost savings	Improves the CBA ratio	Reduces accident cost savings	Lowers the CBA ratio
Impact of eCall on accidents	Increases the impact of eCall	Improves the CBA ratio	Reduces the impact of eCall	Lowers the CBA ratio
Installation costs for vehicles	Increases the total investment costs	Lowers the CBA ratio	Reduces the total investment costs	Improves the CBA ratio
Changes in congestion	Leads to less benefits from eCall	Lowers the CBA ratio	Leads to more benefits from eCall	Improves the CBA ratio
Changes in emissions	Leads to less benefits from eCall	Lowers the CBA ratio	Leads to more benefits from eCall	Improves the CBA ratio
Level of accidents	Leads to more accident cost savings	Improves the CBA ratio	Leads to less accident cost savings	Lowers the CBA ratio

As an example, changing the assumption achieved accidents levels (fatalities and injuries) by 50 per cent (indicating less improvements in accident reduction than currently expected) would change the calculation in all scenarios and all clusters, as shown below by the EU-27 level CBA results in Table 68.

Table 68: Results from EU-27 calculations with 50 per cent higher level of accidents

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey)

CBA		2020	2030
Costs	Do nothing	4 309 676 572	10 273 687 104
	Voluntary approach	6 914 712 172	15 313 501 244
	Mandatory introduction	3 569 345 970	2 712 022 990
Benefits	Do nothing	484 919 417	1 358 668 202
	Voluntary approach	1 839 176 182	4 061 767 332
	Mandatory introduction	3 325 139 811	6 181 222 950
CBA rate	Do nothing	0.11	0.13
	Voluntary approach	0.27	0.27
	Mandatory introduction	0.93	2.28

As another example, changing the accident cost savings in terms of fatalities and severe injuries increases the B/C ratio for all Clusters and all years. The table below illustrates a 2% and 4% increase; i.e. Cluster 1 changes from 2% to 4% and 6% in terms of fatalities and from 1% to 3% and 5% in terms of severe injuries (and the same for all Clusters). Note that a change from 2% to 4% represents a doubling of the estimated effect i.e. a 100% increase (not a 2% increase!) in the estimated variable.

Table 69: Results from EU27 calculations with 2% and 4% higher accident cost savings

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey)

Benefit Increase		0%		2%		4%	
Year		2020	2030	2020	2030	2020	2030
CBA rate	Do nothing	0.06	0.08	0.11	0.11	0.11	0.14
	Voluntary approach	0.15	0.15	0.22	0.22	0.26	0.29
	Mandatory introduction	0.53	1.31	0.72	1.90	0.90	2.48

The following table shows how the C/B ratio increases per Cluster (for the 2030 year and Mandatory Introduction) with the 4% additional fatality and severe injury benefit increase. Clearly the increase in B/C ratio is greatest for the Clusters that have the lowest initial rates. It might initially be surprising that the EU-27 total is not higher given the individual Cluster ratios, but, as seen from Table 64, the largest contributor to the overall rate is Cluster 2 (and Cluster 4) which is relatively low compared with several other Clusters.

Table 70: Results for all Clusters in 2030 with 0% and 4% additional accident cost saving

Benefit increase	**0%**	**4%**
Cluster 1	3.95	6.95
Cluster 2	0.73	1.31
Cluster 3	0.82	3.28
Cluster 4	1.92	3.30
Cluster 5	4.70	9.07
Cluster 6	10.13	18.18
EU-27 and non-EU	1.31	2.48

In the analysis, the congestion savings unit costs were applied from the CODIA study, which resulted in quite significant cost savings for all the clusters; in some cases more than half of the benefits being derived from congestion cost savings. To illustrate the impact of congestion cost savings, the table below presents the case for cluster 3 with both congestion and no congestion savings impact.

Table 71: Comparison of impact of congestion cost savings in cluster 3 for 2020 and 2030

CBA	**Cluster 3**	2020 with congestion savings	2020 without congestion savings	2030 with congestion savings	2030 without congestion savings
Costs	Do nothing	382 477 209	382 477 209	840 551 324	840 551 324
	Voluntary approach	583 532 201	583 532 201	1 238 362 007	1 238 362 007
	Mandatory introduction	317 402 688	317 402 688	203 215 404	203 215 404
Benefits	Do nothing	12 501 900	4 969 368	36 418 686	17 331 142
	Voluntary approach	47 458 298	19 176 166	108 935 739	52 255 213
	Mandatory introduction	85 622 068	33 251 785	165 652 454	78 606 440
CBA rate	Do nothing	0.03	0.01	0.04	0.02
	Voluntary approach	0.08	0.03	0.09	0.04
	Mandatory introduction	0.27	0.10	0.82	0.39

As the in-depth country studies in Chapter 5 had applied a different methodology for congestion cost savings calculation (based on modelling and extrappolation), it is not surprising that the figures differ in the analysis. The use of EU-wide unit values naturally leads to over and underestimation at the cluster level analysis, so there may be a need to estimate more accurate country level figures in the future.

As a further example of sensitivity analysis, the results for EU27 and non-EU countries is presented below using the eIMPACT unit values for congestion benefits (which are 25% of the CODIA values).

Table 72: Results from EU-27 calculations with 25% of congestion unit costs

EU27 and non-EU countries (Norway, Switzerland, Iceland, Macedonia, Croatia and Turkey)

CBA		2020 with CODIA congestion savings	2020 with eIMPACT congestion savings	2030 with CODIA congestion savings	2030 with eIMPACT congestion savings
Costs	Do nothing	4 309 676 572	4 309 676 572	10 273 687 104	10 273 687 104
	Voluntary approach	6 914 712 172	6 914 712 172	15 313 501 244	15 313 501 244
	Mandatory introduction	3 569 345 970	3 569 345 970	2 712 022 990	2 712 022 990
Benefits	Do nothing	278 004 577	150 868 675	782 471 604	462 865 945
	Voluntary approach	1 055 380 155	578 027 493	2 340 551 519	1 391 481 402
	Mandatory introduction	1 903 849 720	1 019 931 415	3 559 106 117	2 101 590 184
CBA rate	Do nothing	0.06	0.04	0.08	0.05
	Voluntary approach	0.15	0.08	0.15	0.09
	Mandatory introduction	0.53	0.29	1.31	0.77

With the reduced (eIMPACT) unit costs none of the scenarios produce a B/C ratio that reaches 1. On the one hand, there are good reasons, presented in cODIA for using higher values than eIMPACT; however, the higher unit costsappear to over-estimate the congestion contribution. This is an area where more research would be beneficial to refine the estimates.

Overall, the biggest factors in calculations are on benefits side the assumptions on penetration and impact rates. The higher these are, the more beneficial eCall will be, despite the increasing installation costs in the case of higher penetration rate. This is because, proportionally, the impact on accidents starts to generate more savings as a larger proportion of the vehicle fleet is equipped with eCall, whether or not the impact rate is changed. On the costs side, the biggest item is the installation cost. If for any reason the figures reported by manufacturers change either way this would automatically change the outcome of the CBA calculations as shown above.

9.13 Stakeholder analysis

In this section, the analyses will focus on identified stakeholders, e.g. the authorities, the road users, car manufacturers, system designers and producers and insurance companies. The analyses presented here will focus on the impact of the three scenarios on these stakeholders.

The authorities: For the public authorities the benefits of eCall are mostly demonstrated to be the reduction of a) the medical consequences of a crash, b) the risk of further accident on the scene, c) the impact of an accident on the traffic.

The fact that eCall will reduce the amount of fatalities and serious injuries is clearly the biggest advantage for the authorities. Rescue operations will become more effective thanks to the better information on the context, and, alongside with overall reduction in accidents across the member states, the ability to respond to accidents will improve. For the authorities, biggest challenge will be to work on national implementation of eCall, particularly in the case of cars already in use, where the installation costs will be lower but require installation of larger packages of software and programmes. This will most likely result into some additional costs through campaigns on raising the awareness of road users. This is particularly relevant, if penetration rates need to be raised for improved impact and cost-effectiveness. Moreover the costs could vary depending on the kind of implementation the local authorities will decide to deploy. Currently two different architectures are under discussion in many EU Member States:

1. Centralized solution where all eCalls will be routed to a dedicated eCall Emergency Call Centre. This is the solution currently under investigation for instance in Spain.

2. De-centralized solution where every region in the country will be able to handle the eCall emergency calls.

On the other hands side benefits should be taken into account, like the use of the eCall service within the Traffic Management Centres, which is under deployment in some countries, like The Netherlands and which will bring to a better related traffic management, and also the raising of the rescue productivity due to the improved accident activities management.

In the do nothing scenario, authorities can at best advise people of the advantages of eCall, compared to mandatory introduction of EC mandate scenario where their role is to monitor the implementation of the regulation.

The road users: Penetration rate and the profile of those applying the eCall will play a key role in the impacts. Obviously, as benefits of eCall cannot be assigned to an individual road user but come through the change in the probability of an individual user to become net beneficiary of the system. The higher the penetration rate, the more likely a user will benefit from eCall in the case of an accident, also in cases where one of the other parties has eCall installed. Costs of eCall, as assumed here, will not be a major factor, particularly in the case of new vehicles where the price is included in the purchase price and will be insignificant part of the total price of a new vehicle.

Car manufacturers: Adding eCall to a new vehicle is a cost that the manufacturer will pass to the consumer price. However, as it will be relatively small part of the total price, it is likely that the price increase will get lost in the annual price inflation. Car manufacturers can use the technology in the marketing, particularly in the early years when manufacturers are likely to only gradually start introducing eCall in the vehicles.

For the car industry it is important to remind that the introduction of the public Pan-European eCall in all new vehicles, being on voluntary basis or mandatory, is going to open new opportunities for the deployment of additional value-added services using the eCall telematics platform, including GNSS, computing and communication capabilities. Indeed it is going to be crucial for the different car manufacturers to develop a business case for telematics around eCall as the business model for eCall only solution is very weak and would become a cost of doing business without even offering the opportunity to use eCall service as a marketing tool to differenciate the brands.

We can distinguish two types of services on which car makers can build positive business models and improve their benefits:

- eCall related value-added services, which will use the Full Set of Data to offer services related to the accident itself, like medical data about drivers and passengers, more details on the car type (brand, colour), information on the number of passengers, details on the accident severity (presence of fire, number of deployed airbags, etc.), insurance details and many others.
- Additional value-added telematic services, which will use the ecall features, in particular the navigation platform and the communication unit, to offer services like breakdown assistance, Point of Interest, Pay as You Drive insurances, Road Charging schemes, fleet management, etc. Undoubtedly, using the eCall GPS receiver and the GSM link for other telematic services will allow the vehicle

manufacturers to recover the equipment costs by offering additional revenue-generating services. In this respect several economic analysis on the impact of ecall introduction in Europe have even presented the public eCall as the "enabler" for the take-off of many other commercial services which are ready to be offered into the market but still need a killer application to be successful.

System designers and producers: The advantage of eCall being available through programme packages is likely to push down the unit costs. Most likely several suppliers will emerge, ensuring further control of consumer prices. With car manufacturers companies are likely to enter multi-year, multimillion unit deals that are likely to shape the market according to production costs and availability of reliable supply. As the technology will utilize existing technologies, further innovations or deviations from standard are not considered to become a costly process for producers.

Insurance companies: Behaviour of insurance companies with respect to eCall is not known. Direct benefit of eCall to insurance companies is the savings in claims due to reduced fatalities and severe accidents. Moreover, post accident reports showing accident details could be beneficial for insurances companies as they can help settling the claims faster and better. This could potentially serve as an initiative to reduce insurance premiums on vehicles that are equipped with eCall. Morover, the insurances sector is one stakeholder who can benefit from the eCall telematic platform to introduce or fine-tune additional services/premiums like Pay Per Use or Stolen Vehicle Tracking for instance.

Given the price of eCall and the period of 8 or more year for utilization, installation costs could be internalized by the insurance companies if they found the benefits in claim savings greater than the price of lowering insurance premiums. Particularly for motorbikes, it would appear that insurance companies would have an interest in reducing the accident levels. The automated eCall notifies that a specific car with an identifiable owner has been involved in an accident. This will increase the reporting of accidents also to the insurance companies, which may have a considerable economic impact.

9.14 Multi-criteria analysis

In the cost-benefit analysis, the major impacts of eCall in terms of monetary valuation were assessed. In multi-criteria analysis, other factors such as social cohesion and well-being factors can be added to the evaluation of positive and negative impacts of an investment project.

Whilst no proper multi-criteria analysis was carried out, through the thorough CBA calculations and the stakeholder analysis some further criteria can be established. First, the calculations point to the fact that eCall will lead to savings in fatalities and in severe accidents, thus this will have positive impact on well-being of people, both those involved in the accidents and those whose family members, relatives or friends were involved in an accident. Regarding social cohesion, the fact that eCall does lead to reduction in congestion costs improves, even if slightly, the mobility of road users.

Another feature of the eCall is that potentially it can service as a platform for other telematics applications, both commercial and non-commercial, which will make access to such services less costly. In fact, partially this is taken into consideration in the CBA calculations, where the other way around eCall is assumed to be available as part of more broad service package.

There are very few negative aspects to be considered in the multi-criteria analysis, which means that the multi-criteria analysis overall improves the "profitability" of eCall. One of the potential negative aspects is that a vehicle becomes easier to trace, if the eCall system is activated, resulting in less privacy for an individual. However, as the system is considered for emergency rescue operations use, chances for using the system for purposes other than that will be minimized through controlling the access to data from vehicles.

9.15 Conclusions

The calculations of CBA rate for eCall have depended on several assumptions that are crucial in determining the outcome of calculations. However, the trends are very clear and indicate that more firm commitment to eCall implementation will increase associated benefits and contribute to greater profitability from the associated benefits. The fact that eCall can improve congestion situation in all types of accidents has been a new finding and has also revealed benefits that are significant for EU in terms of overall traffic management. For some countries the economic benefits in congestion reduction exceed the economic safety benefits.

By 2030 the penetration rates will be high enough to bring improved CBA rates across Europe. Incidentally, in countries where traffic safety is at relatively high levels, the benefits are less than in countries where situation is worse. This highlights the importance of eCall system from the EU-wide perspective, as it can speed up the convergence of countries with worse situation towards those where traffic safety has already reached significantly lower accident statistics.

eCall can bring new stakeholder groups to discussions, as the case of insurance companies shows. These stakeholders can internalise some of the costs of the system, reducing the consumer price and enhancing the quicker penetration rate. There are no firm policies regarding the role of these stakeholders in the eCall implementation, indicating the need to review the eCall holistically taking all beneficiaries into consideration.

9.16 References

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10 CONCLUSIONS

10.1 Review

The existence of the positive safety effects has not been questioned in any of the studies reviewed in this report. All studies in which safety effects were estimated reported reductions in the number of fatalities.

The cost side of the equation is most sensitive to the unit cost of eCall in-vehicle system. Some studies such as SEISS and eIMPACT have explicitly specified the costs of the system rather than its price to the end user, whereas some studies evidently use the price of the system in the cost calculations. As the price may be two to three times higher than the cost, this will cause major differences in the calculations. Costs on the PSAP side were marginal compared to the costs of in-vehicle equipment in scenarios of large or full-scale deployment of eCall.

10.2 Analysis Methodology

The analysis methodology was innovative and successful. The approach was broad and not constrained by pre-existing ideas of where the main costs, benefits and impacts of eCall would be found. It developed an extensive list of "Indicators" both qualitative and quantitative to be addressed both by the four in-depth national studies and at a European level. This approach exposed where there was missing data and prompted search for data, interpolation or estimation to develop best estimates. Motorcyclists and road users beyond the car mode were considered throughout.

The methodology also developed clusters based on a range of indicators thought to be indicative of eCall impact. Of course, countries are not homogeneous (e.g. they may have cities and more remote regions) so this is an approximation but with these indicators six clusters of countries were made:

1. Malta;
2. Belgium and the Netherlands;
3. United Kingdom, Germany, Italy, Luxembourg and Switzerland;
4. Norway, Finland, Sweden, Greece, France, Spain, Portugal, Denmark and Switzerland, Iceland, Austria, Slovenia, Ireland and Czech Republic;
5. Cyprus, Greece, Slovakia, Poland, Estonia, Latvia, Lithuania, Bulgaria, Romania and Hungary;
6. Croatia, Macedonia and Turkey.

10.3 Questionnaire

Overall, approximately 1/3 of the questionnaires sent were completed to some degree:

	Sent	Received
Service Providers	34	10
Member States	42	19
PSAP	35	12
eCall Suppliers	28	11
Insurances	13	4
Automotive Manufacturers	1	1
Total	153	57

Of course, the degree to which questions were answered varied greatly. Some useful descriptive information about eCall in various countries was made available but little useful information was provided concerning the key benefits arising from casualty savings. Similarly, concerning costs, some information about infrastructure side was provided but the key commercial stakeholders deemed this sort of information difficult and commercially sensitive. Little new material was provided concerning legal issues although a few concerns were raised. For the ethical issues, many stakeholders felt unequipped to respond.

10.4 Country studies

A study on the impacts of eCall has been carried out in four in-depth studies: UK, Netherlands, Finland and Hungary. Each has a different population density, length of (non-) motorway network and traffic management level but all have a high rate of mobile phones per inhabitant.

In the UK interviews, traffic and environmental modelling, accident analysis including in-depth fatal case studies and cost-benefit calculations were made as well as a critical analysis of a previous UK study.

In the Netherlands, workshops and interviews were held and, contact with emergency services established. Traffic modelling and other studies were used to estimate congestion.

In Finland previous studies were re-visited and reanalysed to investigate impact on incident management, congestion and secondary accidents, impact on the rescue operations, processes and organisations, impact on injury reduction and other socio-economic impacts.

In Hungary detailed analysis of accident statistics and fatal case studies were analysed. Traffic and environmental modelling was used to estimate congestion saving and implementation issues were studied.

In none of the four in-depth studies a statistically proven relationship is found between improvement of the timeframes wherein the European rescue services operate and a diminishing of fatalities or casualties. It can be expected that the greatest benefit to crash victims can be rendered when eCall substantially improves rescue time (e.g. by 15 minutes or more). The improvement is found mostly in the sparsely populated areas where accidents, especially single vehicle accidents, can remain unreported for a long time. However, the number of extremely long unreported times (hours) are very rare. The overall impact on fatalities of the reduced rescue time as a result of eCall is estimated from expert testimony and is different in different countries (due to geography, rescue service performance etc.). In Finland it was estimated as saving 4-8% of road fatalities and in the UK just 1%. Similarly, a range of estimates concerning ultimate medical outcomes of surviving crash victims was made.

The effect on congestion depends on the amount of accident related congestion and the estimated time saving from eCall. In Finland almost all congestion is the result of accidents. An improvement of the timeframe to rescue or clear accidents leads direct to a reduction of congestion and secondary effects. In UK and the Netherlands there is more congestion because of the amount of traffic, weather conditions and road works. Nevertheless, the congestion is still lower than in the situation without eCall. The saving in accident related congestion is estimated between 3% (UK) and 17% (Netherlands and Hungary). This benefit is large in economic terms, and for some countries larger than the safety benefit. However, related to the total amount of congestion (from other incidents and general traffic load) the effects of eCall are much smaller. Related to total eCall benefits, the effects on emissions are marginal.

All four countries which are involved in the in-depth studies do have PSAPs. The costs to implement eCall are relatively low. In the Netherlands this adaptation in calculated to be a € 150 000 investment (1 first PSAP). The cost for training of personnel are pro memory (the total cost of running the ambulances in the Netherlands cost approx. € 350 million per year). The response on the questionnaires or the other in-depth studies gave no significant differences.

The questions about improvement of the processes in the PSAPs gave no indication of significant improvements of efficiency. There could be some improvement per call via eCall but there could also be some loss of efficiency when the system brings more false calls for rescue.

Data was collected from all 27 EU-countries and some non-EU-countries. Included non-EU-countries were Switzerland, Croatia, Iceland, Macedonia the former Yugoslav Republic of, Norway and Turkey. Liechtenstein was excluded as there was almost no information available from it. When available, the data from year 2007 was used. In case of missing or deviant data, the needed data was created or interpolated on the basis of comparison with similar countries.

Data was collected from several assessment topic areas:

- Information about operating environments for forming the country clusters
- Safety
- Congestion
- Environment
- Energy
- Incident and rescue management chain
- Other benefits
- Investment costs
- Other costs
- Financial aspects
- Institutional issues
- Technical issues

Information was mostly gathered from statistics which could be reached by Internet and questionnaire sent to different stakeholder groups (automotive manufacturers, mobile network operators, service providers, member states, PSAPs, eCall suppliers and insurance companies).

The results from the in-depth studies were scaled up to the 27 countries of the EU based on the clustering described above.

10.5 Economic & Ethical

Issues concerning macro economics and ethics were typically regarded as "too complex" for many Stakeholders to engage with and they see this domain as one for policy experts. Vision zero is an innovative philosophical approach which is highly recognised but most national governments still use social cost-benefit as a starting point for policy development for decision making. An ethical critique of SCB can be developed to argue that it is demonstrably unsatisfactory and there are, for example, wide national variations in treatment of costs and treatment of benefits. Many frameworks exist that explicitly recognise qualitative as well as quantitative factors and public acceptability is often a decisive factor in deliverability of policies. Ultimately, every public policy decision is political and depends on factors beyond the purely economic ones.

Even within social cost benefit calculation a number of different choices are made by different national approaches. The future is uncertain and judgement has to be used concerning trends in fatalities and in the price of consumer equipment. Economic factors include choice of discount rate, whether equipment costs should relate to build cost or sales price, and how much allowance can be made for shared services or infrastructure and for employment generated. Also, there is debate about which measures should be used for which decisions (e.g. using IRR in preference to B/C ratio and the "threshold" on B/C ratio which is acceptable for public investment).

10.6 Legal & Liability

In relation to the introduction of eCall potential liability questions primarily relate to damage as a result of an unsuccessful or corrupted eCall (aggravated injuries or death) and damage as result of false alarms (the costs of unnecessary dispatch of emergency services)

After examining legal liability issues from a Dutch and English law perspective, and some specific case studies, it can be concluded that:

1) All actors in the production and service delivery chain are exposed to potential liability for negligence (breach of a duty of care) or attributable non-performance.
2) Potential claims are most likely in cases where no other road user may successfully be held liable for the damage (particularly in one vehicle accidents).
3) Some actors are exposed to liability risks based on (more) strict liability standards (for example manufacturers in relation to so called manufacturing defects) or are more likely to be confronted with potential claims (e.g. service providers because of their direct relationship with the end user). Their possibilities to exclude or limit liability for damages are restricted. This being said, it can, however, also be concluded that the relevant liability regimes often allow some room for the evident (public) benefits of eCall to be taken into the balancing of interests of the parties involved as well as the society at large.
4) (Further development of) equipment performance standards, standardisation of eCall handling protocols and agreed service performance levels (SLA's) for the different actors involved (laid down in standards, contractual agreements or regulations) will help clarify which standards of conduct actors have to meet (and therefore how they may avoid liability risks) and to allocate risks within the production and service delivery chain.

eCall introduction may also have implications for privacy although the Article 29 working Party has concluded that suitable safeguards can be developed such that privacy is not an impediment to implementation.

Overall, it can be concluded that the legal issues appear to be manageable in terms of further development and roll-out of eCall such that they are not expected to be a barrier to deployment.

10.7 Assessment of policy options

In the work programme, the three scenarios for eCall implementation were defined as:

1) Do nothing: Just left to the market with no further action from the Commission/eSafety Forum.

2) Voluntary approach: All European vehicle manufacturers, all member states and the EC agree by mid-2010 to provide eCall by signing a MoU (Memorandum of Understanding) on eCall deployment by 2015. The MoU sets specific responsibilities and timelines for the stakeholders signing the MoU.

3) Mandatory introduction: EC will produce an EU directive mandating eCall devices in all new vehicles by the end of 2014 and the member states to set up facilities for receiving and processing eCalls at PSAPs by the same date.

In order to estimate impacts in each of these three scenarios, some assumptions/values have to be chosen. The costs and benefits of the eCall implementation depend on the penetration rate of the system. In the 'do nothing' scenario the penetration rate is estimated at 6%, in the voluntary approach the penetration rate is estimated at 23% and in the mandatory introduction scenario at 42% in 2020. The average fleet of vehicles between 2014 and 2020 is estimated at around 330 million vehicles in the EU, including passenger cars, trucks and buses.

In terms of costs, the most critical factor is the in-vehicle unit price. For each scenario, the price of eCall is different for various installation options as the price depends on the quantity of eCall installations. The costs are highest in the do nothing situation, due to less users and thus higher unit prices. In the do nothing scenario, the OEM price is 1000 euros and in the voluntary approach 450 euros. For OEM eCall, the cost of installation to new car (in the manufacturing phase) is estimated at 60 euros in the mandatory introduction scenario. For the nomadic device 30 euros cost is expected in all scenarios, as it is assumed that it is part of a service package. Standalone price is expected to be approximately 200 euros. For aftermarket device 200 euros is estimated in the do nothing and voluntary approach and 70 euros in the mandatory introduction is expected if the eCall is part of a service package.

Based on the casualty, congestion and other benefits identified for individual countries and the infrastructure costs for individual countries, an overall benefit-cost (B/C) ratio for the EU-27 and associated countries has been estimated for the three scenarios.

Benefit-cost ratio/Year	2020	2030
Do nothing scenario:	0.06	0.08
Voluntary approach:	0.15	0.15
Mandatory introduction:	0.53	1.31

According to this analysis and with the assumptions outlined above, only mandatory introduction scenario achieves a cost-benefit greater than 1 by 2030. Note that this is an overall European-level analysis and at a national level with these assumptions the Benefit-cost ratios may be substantially higher or lower.

Beyond the quantifiable benefits of eCall a number of additional potential benefits can be noted which have not (or not fully) been taken into account in the analysis.

- Mandatory eCall would mean that the public investment in eCall infrastructure was shared more equitably between citizens rather than the benefit of public investment falling preferentially on citizens who can afford optional in-vehicle equipment.
- The in-vehicle eCall equipment could form the basis for an in-vehicle platform that could support additional public or private telematic services giving further safety and economic benefits. For example, tracking of hazardous goods is one opportunity.
- eCall would reduce the amount of underreporting of crashes, which is a problem in some countries, thus increasing the robustness of accident statistics.
- eCall may have a positive or negative effect on false alarms. Automatically triggered eCall is likely to have a lower false alarm rate compared with conventional emergency calls. Also, future “consolidating” software could recognize eCalls as arising from the same incident with reference to geographic location. All this could increase PSAP efficiency.
- eCall provides benefit to road users travelling abroad who may be unfamiliar with the roads and their exact location. eCall also allows emergency calls to be made without language difficulties by virtue of the digital data. This is likely to reduce misunderstanding and stress. Thus. European implementation of eCall benefits foreign visitors.
- eCall may highlight the need for improved mobile network coverage along roads and cross-network co-operation to route emergency calls (some countries do not yet have such agreements between rival mobile network service operators).
- Implementation of eCall on a widespread basis would generate employment (or displace employment from other areas) involved in building and installing equipment. There may also be economic activity related to additional services on the eCall platform.
- European-wide implementation (rather than national initiatives) would involve economies of scale in terms of, for example, equipment costs and education campaigns.

10.8 Summary of Technical Recommendations

This section contains a number of recommendations for further investigations based on the work conducted.

The safety benefits of eCall which rest on more rapid response to accidents have been expressed in terms of average time saving. However, the frequency distribution of time between an accident and notification is likely to be skewed having a long “tail” of rare events with substantial time delays. To explore this distribution, and hence refine eCall safety impact estimates, further work is required. Three specific data sources are emergency services logs, accident investigation files and press reports. When more data is available, it would be appropriate to consider whether average values of time saving provide a complete picture of impacts and the extent to which infrequent accidents that remain unreported for hours need to be taken into account.

A sensitive factor in determining eCall safety impact is the effect that more rapid medical attention can have on injured road users. To date, sufficient significant data has not been examined and estimates have been made after discussion with emergency services personnel. However, this project has identified a case study approach that has the potential to much improve the robustness of the estimates. A substantial study of accident case studies is recommended building on the UK and Hungarian work reported here. It is recommended that a 500 case study review be initiated.

eCall is expected to have an impact on the clinical outcome of injuries sustained during a crash as a result of faster medical intervention. In order to better explain this impact, some international agreements would be beneficial. For example, some countries define severity of injury in terms of trauma sustained (which eCall cannot change) and some define severity in terms of outcome (which eCall can influence). One approach would be to use the AIS 6-point scale rather than "serious" and "slight" and to agree how to value the change in injury outcome as a result of eCall. It would also need to be investigated whether sufficient data currently exists and whether practical new data collection requirements can be identified.

Substantial congestion benefits from eCall have been identified for the first time in this study; there are, however, significant differences between countries. As this study has concentrated on safety effects, the congestion impacts are relatively unexplored and would benefit from further work. In particular, the UK congestion impacts appear anomously low compared with the other case study countries and should be further analysed. Also, at European level the unit cost of congestion approach needs to be compared with modelling studies to develop more robust ways of calculating the benefits arising from congestion reduction and refining the estimates provided in this study.

This study has revealed different approaches to social cost benefit calculations in different countries and at a European level so further analysis and agreement concerning the process of cost-benefit calculation is necessary. It is recommended that this is achieved through an expert team that develop a number of scenarios for discussion and then a workshop with government economists to agree an overall approach. It is suggested that this development does not refer to eCall directly but considers a range of investments to explore relevant issues. These could include, for example:

- The case to build a short section of road to reduce congestion
- The case to install in-vehicle equipment to increase safety
- The case for an in-vehicle platform for commercial services
- The case for a specific co-operative vehicle/infrastructure system

A refinement of eCall benefit calculations would take account of foreign road users and nationals travelling abroad. Foreign road users involved in an accident consume resources but should probably not be valued as highly as nationals in terms of economic loss to the economy. Similarly, overseas visitors can derive benefit from eCall when travelling abroad but their economic loss is attributed to their own country.

Annex 1

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
	General info for forming the Cluster				
1		Population density	inhabitants/square-km	Eurostat	
2		Traffic management level	% of Trans European network (TERN) equipped with dynamic traffic management	EasyWay	
3		Length of motorway network	road km	DG TREN statistics	
4		Length of non-motorway network	road km	DG TREN statistics	
5		Level of urbanisation	% of population living in urban areas	Eurostat	
6		Average Annual Daily Traffic on motorways/main roads/secondary roads	vehicles/day	DG TREN statistics	
7		Rescue service level	qualitative	Based on questions 26–39	
8		Mobile phone subscriptions	per 100 inhabitants	Eurostat	
	Safety				
9		Number of road fatalities	Fatalities / year	CARE, IRTAD	
10		Number of severe road injuries	Severe injuries / year	CARE, IRTAD	Important to know the used definition
11		Number of slight road injuries	Slight injuries / year	CARE, IRTAD	Important to know the used definition
12		Number of secondary accidents	Secondary accidents / year	Road Authorities	Secondary accident is hard to define (how close in time and place?)
13		Percentage single vehicle accidents not involving pedestrians	% of accidents	IRTAD, national statistics	Accidents classified to single and multiple vehicle accidents
14		Percentage of road fatalities in single vehicle accidents not involving pedestrians	% of fatalities	IRTAD, national statistics	
15		Percentage of fatal accidents occurring outside urban areas	% of accidents	IRTAD, national statistics	
16		Percentage of fatal accidents occurring in the dark	% of accidents	CARE, IRTAD, national statistics	
17		Percentage of fatal, severe and slight motorcycle accidents	% of fatalities/ severe injuries / slight injuries	?	
18		Percentage of fatal, severe and slight agriculture/construction machine accidents	% of fatalities/ severe injuries / slight injuries	?	
		Effect of eCall on road fatalities	%	WP4.1	Case country only
		Effect of eCall on severe road injuries	%	WP4.1	Case country only

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
		Effect of eCall on secondary accidents	%	WP4.1	Case country only
	Congestion				
19		Vehicle hours spent in congestion	Vehicle hours / year	Road authorities	Preferably classified by vehicle type (light / heavy)
20		Vehicle hours not spent in congestion	Vehicle hours / year	Road authorities	
		Effect of eCall on vehicle hours spent in congestion	%	WP4.1	Case country only
	Environment				
21		CO_2 emissions	Ton / year	Eurostat?	
22		PM_x emissions	Ton / year	Eurostat?	
23		NO_x emissions	Ton / year	Eurostat?	
		Effect of eCall on CO_2 emissions	%	WP4.1	Case country only
		Effect of eCall on PM_x emissions	%	WP4.1	Case country only
		Effect of eCall on NO_x emissions	%	WP4.1	Case country only
	Energy				
24		Fuel consumption (gasoline)	Million litres / year	Eurostat?	
25		Fuel consumption (diesel)	Million litres / year	Eurostat?	
		Effect of eCall on gasoline consumption	%	WP4.1	Case country only
		Effect of eCall on diesel consumption	%	WP4.1	Case country only
	Incident and rescue management chain				
26		Number of PSAP 1s / country	Number / country	PSAPs	
27		Number of PSAP 2s / country	Number / country	PSAPs	
28		How many citizen each PSAP serve	citizen / PSAP	PSAPs	Range asked
29		Coverage of private emergency call services			
30		Average time between the accident and the emergency call (reporting of accident)	minutes / accident	PSAP? Private services?	
31		Average phone answering time in PSAP	seconds / accident	PSAP	
33		Average time in which an emergency unit is dispatched after the reception of the emergency call at the emergency service	minutes / accident	PSAP	
34		Average time between dispatching the rescue services and police and their arriving the scene (travel time)	minutes / accident	PSAP? Rescue? Police	
35		Average time to get incident clearance at scene	minutes / accident	PSAP? Incident clearance services?	

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
36		Average time to clear the accident scene	minutes / accident	PSAP? Incident clearance services?	Definition to “cleared scene” added to the questionnaire
37		What are the priorities of the emergency services going to the location of an accident? Who must go first?		PSAP? Rescue Police Health care	
38		Which strategy do the emergency services apply? "play-and-stay" or "scoop-and-run"?		PSAP Rescue Police Health care	
39		How often is trauma assistance part of the emergency service?		Rescue Health care	
	Other benefits				
40	Cellular operators	Revenues due to new services enabled by eCall platform in vehicles	M€/year	operators	
41	eCall Private Service	Number of subscribers and the fees charged for the service.	M€/year	service providers	
42	eCall Private Service	Number of eCalls / year Number of false eCalls /year Number of failed eCalls / year	Number / year	service providers	
43	OEMs Maybe ask to suppliers?	Net benefit from eCall	M€/year	ACEA	
44	Suppliers	Net benefit from eCall	M€/year	CLEPA	
45	Third party service providers	Existence of the third party service providers		member states	
46	New business operations	Increase in employment	person years / year	member states and/or service providers?	
47	New business operations	Increase in turnover	million euros / year	member states and/or service providers?	
48	Other road users	Increase in being informed of the accident resulting congestion	personal occurrence / year	desktop or studies	
49	Other road users	Improvement in journey time resulting from faster incident clear up time	hour / traveller / year	desktop or studies	
50	Other road users	Improvement in journey time reliability resulting from faster incident clear up time	% change in reliability	desktop or studies	
51	PSAP1 and PSAP2	Estimation, how efficiency of PSAP operations would be improved/reduced by eCall	saved/increased person hours / year	PSAPs	
52	Rescue	Estimation of Improved efficiency of rescue operations	saved person (/vehicle hours) hours / year	Rescue operators	
53	Rescue	Improved efficiency of rescue operations	saved equipment costs/ year	Rescue operators	
54	Health care	Improved efficiency of	saved person	Health care	

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
		health care operations	(/vehicle hours) hours / year	operators	
55	Health care	Improved efficiency of health care operations	saved equipment costs/ year	Health care operators	
56	Police	Improved efficiency of police operations	saved person (/vehicle hours) hours / year	Police	
57	Police	Improved efficiency of police operations	saved equipment costs/ year	Police	
58	Incident clearance	Improved efficiency of Incident clearance operations	saved person (/vehicle hours) hours / year	Tow service operators	
59	Traffic centre	Improved efficiency of traffic centre operations	saved person hours / year	Traffic centres	
60	Traffic centre	Improved efficiency of traffic centre operations	saved equipment costs/ year	Traffic centres	
61	Private route operators	to be added later			
62	Insurance companies	to be added later			
	Investment Costs				
63		OEM device investment cost	Euros / device	ACEA	
64		Retrofit device + installation cost	Euros / device	CLEPA (for the production costs)	
65		Nomadic device + installation cost	Euros / device	TomTom	
66		PSAP 1 system cost	Euros / PSAP	PSAPs	
67		PSAP 2 system cost	Euros / PSAP	PSAPs	
68		Number of vehicles (automobiles/motorcycles/ agriculture or constr. machines)	Number of registered vehicles/ country	DG TREN statistics	
	Other costs				
69		Training of the PSAP personnel	Euros / PSAP/ year	PSAPs	
70		Maintenance of the PSAP systems	Euros / PSAP/ year	PSAPs	
	Financial aspects				
71		Funding of PSAP investment		member states	
72		Existence of possible incentives (tax, insurance, ..)		member states	
	Ethical and moral issues				
73	Equality	Is eCall ownership related to income level?		Member states	
74		Is eCall available also as a version a affordable for all?		Member states	
75		Does the service cover all parts of the country?		Member states	
76		Is the eCall available to all road users and vehicle types?		Member states	
77	Moral	Ways of quantifying		MS, EC,	

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
		the value of a person's life		Industry, Insurance Co.	
78		Acceptability of cost-benefit including valuation of life		MS, EC, Industry, Insurance Co.	
79		Form of socio-economic analysis for decision making		MS, EC, Industry, Insurance Co.	
80		Appropriateness of cost-benefit analysis for road safety decision making		MS, EC, Industry, Insurance Co.	
81		Acceptance of vision zero philosophy		MS, EC, Industry, Insurance Co.	
82		Moral balance between road safety and other national expenditure		MS, EC, Industry, Insurance Co.	
83		Consideration of European or national perspective		MS, EC, Industry, Insurance Co.	
84		Stakeholders with moral obligation to invest in road safety		MS, EC, Industry, Insurance Co.	
85		Ways of quantifying the value of a person's life		MS, EC, Industry, Insurance Co.	
	Legal issues				
86	Privacy	Does eCall raise serious privacy concerns among users?		FIA, national automobile associations	
87		Will eCall be fully in conformity with European and national data protection laws?		Member states, data protection authorities, data processors	
88	Liability	PSAP eCall: Have the privacy and liability issues been solved?		Member states	
89		Service provider: Have the privacy and liability issues been solved?		ACEA, CLEPA,	
90		May (uncertainty about) the allocation of liability among parties in the production and service chain (for example in relation to unintentional false alarms/ unsuccessful eCalls/faulty or incomplete data (e.g. wrong location/the lack of updating eCall soft and hardware) hinder the deployment of eCall?		Member States, The most essential parties in the production and service chain, Insurers +Industry (OEM, Suppliers, teleco)	
91		Has the RESPONSE Code of Practice been applied? Is this a sufficient tool to avoid or manage liability		Member states, ACEA, CLEPA, Tomtom	

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
		concerns, or what remains?			
92		Are there other legal issues that in your view may hinder or slow down the implementation/deployment of eCall		Stakeholders	
	Institutional issues				
93	Member states	Have they signed the MOU?		Member states	
94	PSAP	Have the national PSAPs committed themselves to receive eCalls?		Member states	
95		Have the PSAPs agreements with the road operators / traffic management centers / traffic information centers		PSAPs	
96		Have the PSAPs agreements with rescue services		PSAPs	
97		Have the PSAPs agreements with police		PSAPs	
98		Have the PSAPs agreements with incident clearance services		PSAPs	
99		Adequate training of the personnel		PSAPs	
100		Sufficient amount of personnel to respond to eCalls		PSAPs	
101	Retailers	Adequate training of the personnel			
102		Provision of correct information to customers			
103	OEMS	Have they signed the MOU?		ACEA / Information available on eCall toolbox	
104	Device suppliers	Have they signed the MOU?		CLEPA / Information available on eCall toolbox	
105	Vehicle inspection	Commitment to verify the function of eCall system		member states	
106		Commitment to verify safe fixation of the eCall device		member states	
107	Police	Commitment to enforce the safe fixation of the eCall device		member states	
	Technical issues				
108	OEMS	Safe fixation of the eCall device		ACEA	
109		Are they following fully the eCall standards?		ACEA	
110	Device suppliers	Safe fixation of the		CLEPA	

	CRITERIA	INDICATORS	Unit of Indicator	DATA from	Other
		eCall device			
111		Are they following fully the eCall standards?		CLEPA	
112		Feasibility of implementation on motorcycles, tractors etc.?		CLEPA	

Annex 2

eCall Assessment Study

Member State Questionnaire

Background

The in-vehicle eCall is an emergency call generated either manually by vehicle occupants or automatically via activation of in-vehicle sensors. When activated, the in-vehicle eCall system establishes voice and data connection either directly with the relevant Public Safety Answering Points, (in the Pan-european in-vehicle emergency eCall) or through a Third Party Support centre (in the TPS eCall).

In the Pan-european in-vehicle emergency eCall, illustrated in Figure1, eCall is a public 112-service where the voice and the Minimum set of Data (MSD) - including key information about the accident such as time, location and vehicle description – are sent to the relevant PSAP which is a public authority or a private eCall centre that operates under the regulation and/or authorisation of a public body.

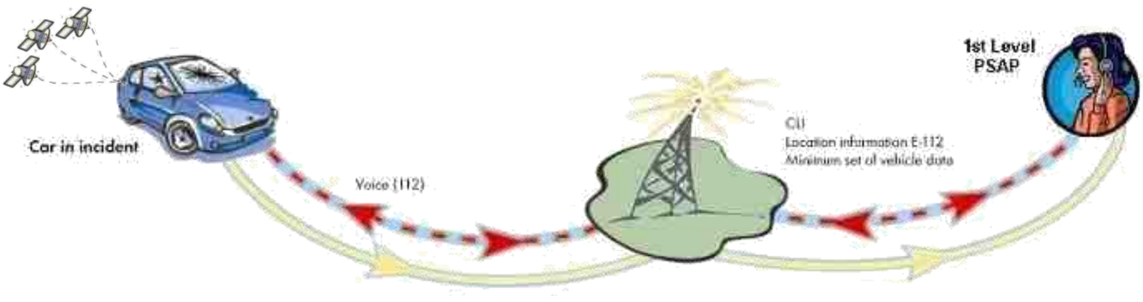

Figure 50 – Pan-european in-vehicle emergency eCall

In the TPS eCall, illustrated in Figure 2, voice connection is made using a specific number and MSD is transmitted using a private dedicated channel to a private Service Provider, which then transfers the accident data to the appropriate PSAP.

Figure 51 – Third Party Support eCall

Objectives of the questionnaire

The objective of this questionnaire is to collect data necessary to perform a qualitative eCall Assessment Study which aims to:

- assess all impacts and benefits of eCall, also fully covering the indirect benefits due to lessened congestion, fewer secondary accidents, improved operations of rescue services, traffic management, national economy, etc;
- assess all costs of eCall;
- assess all other key deployment issues related to eCall; and
- compare the three scenarios of do nothing/voluntary agreement/mandatory instalment with regard to their socio-economic profitability.

The longer term objectives of the work are to utilise the results in deciding on further steps to accelerate the deployment of pan-European eCall. In addition to this, the study will provide help to inform decision making by other stakeholders in the eCall service chain. For example better and more up to date information on the costs and benefits of eCall will help to inform those Member States which are not yet committed to eCall deployment.

Questions

A: Economic and financial issues

1. Are there Third Party Service Providers for emergency services in your countries? If yes, how many?

Now …………….
Estimation 2013[46] …………..
Estimation 2020 …………..

[46] eCall is expected to be a standard option in all new vehicle models

2. Do you expect the introduction of eCall will increase employment? If yes how many persons years/year?

Estimation 2013 ……………………………. persons years/year
Estimation 2020 ……………………………..persons years/year

3. Do you expect the introduction of eCall will increase your country GDP? (million euro per year)

Estimation 2013 ……………………………… million euro / year
Estimation 2020 ……………………………… million euro / year

4. How do you plan to finance the upgrade of PSAP necessary to handle the eCall?

5. Are you considering any incentive plans (tax reduction, insurances, ..) to promote eCall adoption? Please specify if possible.

B: Institutional and legal issues

1. Is your country considering measures to ensure eCall service reliability, e.g. vehicle inspection, certification/homologation procedures?

2. Do any issues of data privacy remain, in your view, concerning eCall?

3. Are there concerns about potential liability of parties in the production and service chain? Examples might include unintentional false alarms/ unsuccessful eCalls/faulty or incomplete data (e.g. wrong location/the lack of updating eCall soft and hardware). Do these hinder the deployment of eCall? Please specify if possible.

4. Are there other legal issues which, in your view, are slowing down eCall deployment? Please specify if possible.

F: Moral and ethical issues

1. In your opinion can a quantitative value be put on a person's life? If yes, should this calculation take into account:

a) The individuals' willingness to pay for a life saved
b) The average life income of individuals
c) The costs of the family's pain of losing someone dear
d) Other factors, such as ………………………………………………

2. In your opinion should the cost-benefit analysis of in-vehicle safety systems be based on the quantification of a person's life?

3. What aspects/methods of socio-economic analysis does your organisation use when forming its policy towards in-vehicle safety systems?

4. Do you consider that cost-benefit analysis is an appropriate tool for making decisions on issues such as road safety?

5. What is your opinion on the Vision Zero policy that Sweden has implemented?
Note: Vision Zero is based on the idea that everything should be done to prevent road deaths and serious traffic injuries. Human errors will occur. However, the severity of subsequent accidents can be decreased by taking measures targeting specific issues, e.g. the problem of driving under the influence of alcohol is sought to be solved through the introduction of alcolocks.

6. Do you think that there is a moral dimension to road safety and how would you balance spending on vehicle safety systems with spending on famine relief or medical research?

7. Given the cross-border character of transport, should the socio-economic assessment of systems such as eCall consider the benefits from a national perspective or a European one?

8. In your opinion which are the stakeholders that have a moral obligation to invest in road safety technologies:

1) National government & road administration
2) European authorities
3) OEMs
4) The users themselves (in-vehicle safety technologies)