

Automatic emergency calls in France

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Abstract

An eCall device has been mounted on some vehicles in France since 2003. It is an integrated car radio/GSM/GPS system that can be used with a SIM card. When an accident occurs, a call can be sent manually or automatically made to a telephone call centre. Knowing the geographic location, the vehicle identity and the possibility of a direct communication with the people involved enables the nearest emergency services to be called out. In this context, the LAB / CEESAR have set up a study aimed at evaluating the effectiveness of this system. The purpose of this paper is to detail the E-call system evaluation method of effectiveness used and give a global synthesis of the results.

INTRODUCTION

For many years now, car manufacturers have devoted enormous efforts in order to improve the safety level of their vehicles. The first action line was primary safety, which purpose is to prevent the accident from happening. The second line of action, secondary safety, addresses the vehicle's occupant protection during a crash. These two action lines are still the ones receiving the most attention for safety reasons, but recently, solutions regarding the post-accident period are emerging: the eCall is at the forefront of tertiary safety. The emergency call service is now available in ten western European countries on both PSA Peugeot and Citroën passenger cars (except Peugeot 107, 4007 and Citroën C1, C-crosser) fitted with a telematic unit either as a standard or as an option. By mid 2010, the service is operational in 10 countries of Europe and more than 700 000 vehicles fitted with this device, have been sold in these countries.

MANUAL AND AUTOMATIC EMERGENCY CALL

The procedure of the telematic device can be triggered manually or automatically. In an emergency situation, the occupant of the vehicle presses the SOS button on the telematic terminal for at least two seconds. As soon as the button is pressed, the telematic terminal sends an SMS message to the call centre assigned to cover the area in which the vehicle is located. This SMS message contains vital information for dealing with the emergency. As soon as the call is intercepted, these details appear immediately on the call centre operator's control screen, in the form of a customer sheet, location on a digital map, etc. In this way, the call centre operator has useful data available even before establishing direct telephone voice contact with the occupant of the vehicle.

Once voice communication has been established with the driver, the call centre operator analyses the situation more closely. Then he analyses the situation, he checks the location on various types of map, and if necessary informs the emergency services responsible for the area in which the vehicle is currently located, giving them all the information about the situation.

Depending on the situation, but only in France, the call centre operator can also call on one of the emergency doctors permanently stationed at the call centre, using a three-way conferencing system with a view to assess the situation more accurately or to give advice while waiting for help to arrive. The three-way conferencing system can also be used to take care of people travelling outside their own country. Communication can be in their own language from the call centre in the relevant country, while the local public services will, if necessary, be informed in their own language by the national centre which covers the accident's location. At that stage the procedure continues "on field" with the intervention of the emergency services at the scene of the accident until the people involved are taken care of face-to-face. After a severe impact, if the vehicle's pyrotechnic equipment has been triggered (airbag or seat belt

pretensioner), the vehicle itself sends out the SMS message containing the basic information mentioned previously and the request for voice contact.

In all cases, if there is no response from the accident victim, the established protocol requires the call centre operator to try to make contact with the vehicle within a limited time: when the set time has elapsed, the operator has to transmit the alert to the emergency services on the basis of the information contained in the SMS message: type of vehicle, owner's name, GSM telephone number, GPS coordinates of the vehicle.

TELEMATIC PLATFORM DEVELOPMENT AND SETTING UP AN EFFICIENT BACK OFFICE

The "Telematic Project" began at the end of the 1990s in the PSA motor vehicle research and innovation department and finally in 2002 a working motor vehicle telematic platform was launched. It provides a navigation system with on-board map database, GPS satellite and dead reckoning location module, GSM telephone module, integrated voice recognition and text to speech, and radio-CD player. A backup battery is also included.

Although it integrates all these technologies, and in particular those relating to GPS and GSM, the terminal's telematic functions appear simply as dedicated marked buttons of different shapes on the front panel:

- a red button, marked with "SOS", to contact the emergency call service, exclusively for emergency assistance to people;
- a button marked with the vehicle brand's logo to contact the commercial telephone call centre of Peugeot or Citroën, immediately able to provide the motorist with technical assistance services or help to continue their journey.

In parallel with the engineering work to develop the in-car telematic platform, PSA Peugeot Citroën has set up a complete and efficient data routing and processing system capable of providing the required emergency call service. As soon as the emergency call is triggered, an SMS message is created and sent over the networks of existing mobile telephone companies by a first partner, an SMS aggregator. These SMS messages are sent via a unique subscriber number that all the companies have reserved, by means of an SMS gateway set up by the partner (which allows high priority processing and resulting short response time). Once decoded, the second partner immediately retransmits the data to the call centre via its own network. The secure transmission and decoding tasks only take a fraction of a second. At this point, the third and final partner comes into play in order to finalize the emergency call as described previously.

LIVES AT STAKE

According to a world report published regarding road safety prevention, each year, road accidents have killed nearly 1.2 million people around the World and have injured 25 to 50 million people. The World Health Organization evaluates that approximately 3 242 individuals are killed each day on roads around the world. Road accidents are the 11th main mortality and are responsible for 2.1 % of all fatalities registered in the world. In Europe, in 2007, we counted 1 300 000 injured accidents involving 42 500 fatalities at 30 days and 1 700 000 severely injured. The European Commission objective was to reduce by half the number of fatalities on European roads between 2001 and 2010. Even though in forty years, the number of fatalities in France was divided by four, while the car fleet doubled and the number of kilometers traveled was multiplied by three, France counted in 2008, 76 767 injured in accidents including 4 443 fatalities and 36 179 serious injuries [1, 15].

ACCIDENT ANALYSIS STUDIES

At the LAB/CEESAR

Road accident analyses studies cover three areas: primary, secondary accident and tertiary accident analysis. The last two types of studies more specifically concern the eCall system. They are based on studies carried out on selected accidents resulting in physical injury, following the general methodology used by the LAB/CEESAR for many years. The studies are carried out across the country on accidents selected for their value in terms of development of safety systems. They are selected from monthly files of traffic accidents supplied by the national police forces. These accident studies are compiled in a detailed report. For each case the researchers have to:

- obtain from the police all the information required to understand the circumstance of the accident
- inspect the vehicles involved
- obtain from hospitals the victims' medical reports

Specific survey

In this new context of the deployment of an automatic emergency call system, the LAB/CEESAR has set up a study to obtain experimental results about the system's operation and effectiveness and the feelings of people cared for by this means. This makes possible to compute the time saved in getting the emergency services to the scene and check the operation of the telecommunications systems and systems for locating the accident. A special questionnaire has been created for this study. It contains a score of very specific questions. The questions are in 4 sections:

- an accident analysis section to give details of the circumstances of the accident, place, time, number of occupants, injuries, how long the emergency services took to arrive, etc.
- a technical section to give information about how the system operated at the time of the accident, the communication between the people involved and the emergency centre, the telephone company used, etc.
- a section for the user/person involved to provide feedback.
- a section for the fire brigade to provide feedback from the accident

FIRST FEEDBACK

In France between January 2004 and mid 2010, 2 439 automatic emergency calls were recorded (originating from Peugeot and Citroën cars). 164 calls from vehicles fitted with it have been studied in depth. As explained above, this study includes not only detailed information about the circumstances of the accident, but also accurate assessments of occupants' injuries, expert reports on the vehicles involved and feedback from the fire brigades. The first results, presented here show that, by accurately locating the site of the accident, the system enables the emergency services to reach the scene very rapidly. The combination of GPS and the quality of current road maps is an essential tool. Another important point is that the emergency services can obtain the details of the vehicles on which they will have to work (type of vehicle and colour, type of fuel, vehicle configuration, etc.). Lastly, future development of the system should make it possible to assess the violence of the accident, the type of impact and the medical attention required. In addition this system reassures the victims and spares them additional stress, which is already very severe after the shock of the accident. Within a few seconds of the collision, they know they are being taken care of and that the emergency services will be able to reach them rapidly.

Accident case example

Here is an accident example that represents a real classic case for eCall utility because the accident occurred on a country road in the middle of the night with a single car involved. In this case, while the two passengers in the vehicle are unconscious due to the impact, the voice of the emergency call centre operator wakes the driver from his blackout. The driver answers and confirms to the emergency call centre the need of assistance.

Place	On a minor road, at the exit from a roundabout.
Time	At night.
Circumstances	Accident in a rural area, 90 km/h (55 mph). Road with 2 single lanes. The 407 Peugeot goes out of control at a roundabout, crosses the opposite lane, hits the kerb, then the bank, and rolls for a distance of about twenty metres.
Driver	Man aged 21, wearing seat belt.
Front Passenger	Man aged 21, wearing seat belt.
Help Given	Emergency call activated automatically.
Injuries	Driver: minor head injuries. Front passenger: seriously injured → fractured skull.

Table 1. Case example

The impact was extremely violent (photos 1 and 2) and resulted in the partial ejection of the passenger's head through the right-hand side window, causing serious injuries to his skull. It is absolutely certain that the rapid arrival of the emergency services saved the passenger's head injuries from getting worse.



Photo 1.



Photo 2.

METHOD AND DATA SOURCES

Data sources and cases selection

In depth accident case studies show that the fact of being involved in a single accident, or at night, or in a rural area is part of relevant situations for the use of eCall [6]. Nevertheless, it seems even more relevant to take into account combinations of two or three of these typologies of accidents. In each of these

typologies, we shall select only the accidents involving at least a passenger car, because by now only these types of vehicles can be equipped with eCall systems.

Regarding data, unfortunately, we shall not be able to use our specific database regarding tertiary survey. Its sample is still too small and not enough representative for accidents in France. Another database coming from fatal accidents reports (called PVM2000) in France for years 2002 and 2003 is available. It contains an in depth passive and active analysis and also a very reliable representation of the road reality where two thirds of the victims are car occupants.

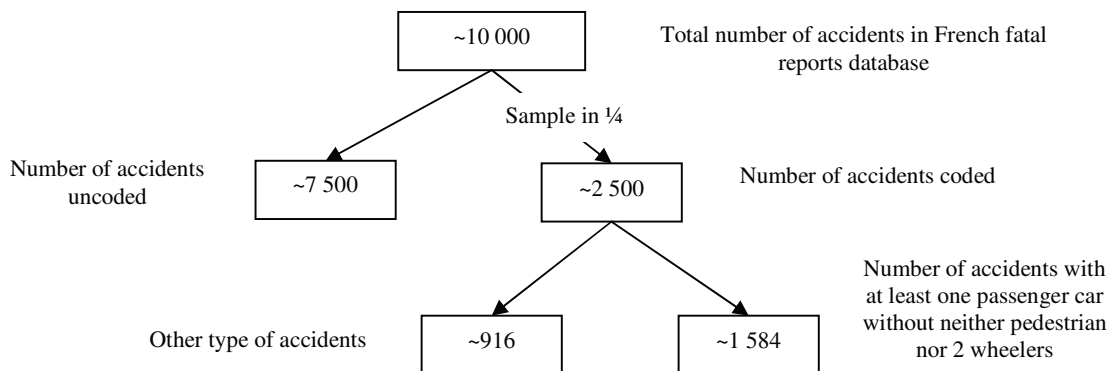


Figure 1. Sample distribution

The database contains about 10 000 accidents from which arises a 1/4 sample, representing 2 500 accidents, among which 1 584 accidents with at least a passenger car involved without neither pedestrian nor 2 wheelers. In this database, we find variables such as accident time and emergency alert time. They allow us to calculate the average alert time. Other more general variables such as accident circumstances, accident location or number of injured people can bring indications to express an expert advice regarding utility or not of an eCall system after a crash (advice given by the safety expert which studied the accident report). These judgments allow calculating the percentage of accident cases for which the ECall system would have been useful (indeed necessary).

Available methods

Several effectiveness calculation methods called “*a priori*” and “*a posteriori*” could be used to evaluate the benefit of the eCall system. The “*a priori*” method is a predictive evaluation type. The data used in this evaluation is previous to the estimated system implementation. In our case, it concerns either “the eCall utility” or “the reduction of alert and localization time” of the accident. The “*a posteriori*” method deals with events that took place in the past. It consists in studying results, effects, and consequences of safety countermeasure implementations. In this evaluation, the only way to calculate possible effectiveness is focusing on “the reduction of alert and localization time”. Regarding questions of data availability and representativeness, only the “*a priori*” method is applicable.

Method used

- 1) Carry out accident case samples based on the PVM database with filters like: single vehicle accident, or rural accident, or accident at night or either a combination of 2 or 3 of the previous criteria.
- 2) Study individually each accident cases (police report) previously selected.
- 3) Build a template with all accidents typologies (8 typologies) and classify the accident cases according to these criteria. Then make an expert judgment regarding the eCall effectiveness for each accident situations.
- 4) For each previous typology of accidents, calculate the percentage of accident cases where the emergency call is relevant.
- 5) Calculate the real effectiveness of the emergency call, by multiplying the percentage of fatalities with the percentage of cases where the emergency call is considered as relevant.
- 6) Calculate the number of fatalities that eCall can save per year in France if 100% of the fleet is equipped with this system.

RESULTS

Sample description

Three independent samples were built based on the fatal accident database reports:

- All accidents involved a single passenger car, without neither pedestrians nor two wheelers;
- All accidents occurred at night with at least one passenger car, without neither pedestrians nor two wheelers;
- All accidents occurred in a rural area with at least one passenger car, without neither pedestrians nor two wheelers.

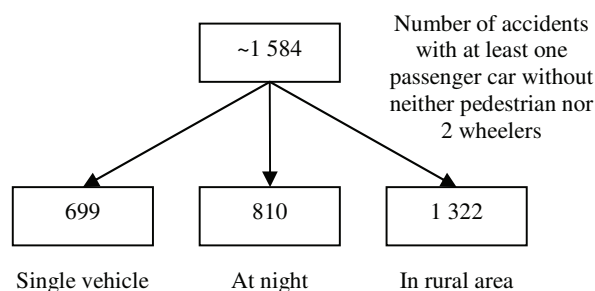


Figure 2. Distribution of accidents regarding typologies

The initial sample is established from 1 584 accidents among which 699 accidents involve a single passenger car, 810 accidents involve at least one passenger car at night and 1 322 accidents involve at least one passenger car in a rural area. Figure 3 shows accident distribution according to their typologies (single, at night and in rural area) and according to their associated combinations.

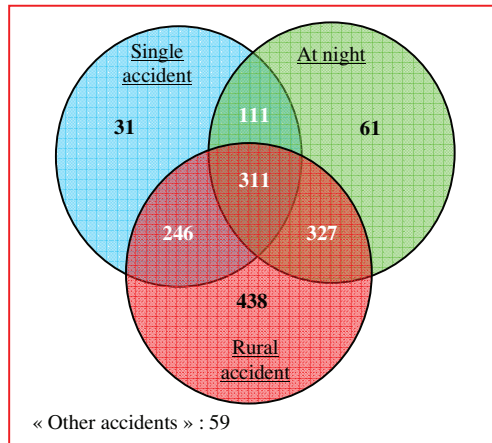


Figure 3. PVM2000 accident data base distribution (1 584 accidents).

Safety benefit calculation

Expert judgment (that is to say someone with enough background on tertiary safety studies) allows us to be able to estimate, with more reliability, the eCall utility for each accident. Under figure 4, shows that the emergency call system seems to be the most useful with a 28.6 % rate, in the very specific combination of single vehicle accident, at night and in a rural area. We also notice that in some accidents where only a single typology is taken into account, the utility of the emergency call turns out to be very weak and in some cases null. It is the case of accidents involving a single vehicle/at day/in a city, accidents involving several vehicles/at night/in a city, as well as accidents involving at least one vehicle/at day/in a city ("other accidents").

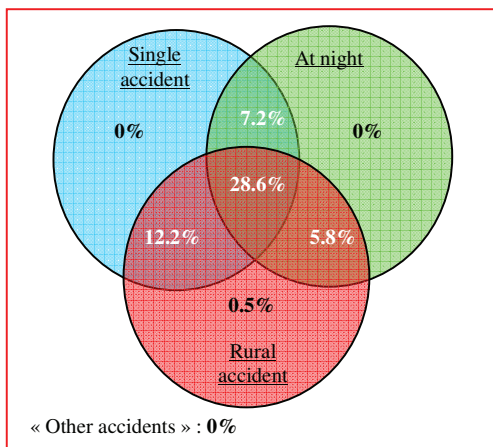


Figure 4. PVM2000 accident data base proportions where eCall was judged as relevant for each accident typologies (1 584 accidents).

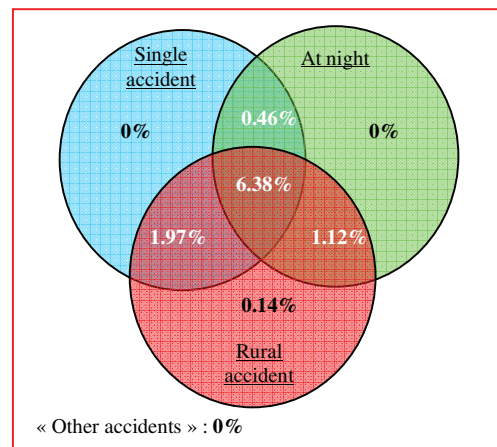


Figure 5. Real eCall effectiveness regarding fatalities in France in 2008 for each accident typologies. Source PVM2000 data base (1 584 accidents) and national data base ONISR 2008.

On figure 4, we are able to extract the real efficiency reported among fatalities in France in 2008 for accidents involving at least one passenger car without neither pedestrians nor two wheelers. For that purpose, for every accident typology, we multiplied the portion of fatalities by the percentage of cases where the eCall was considered useful (results in figures 5). In this typology alone, at night and in a rural area, the real efficiency of the system, reported to the concerned population, shows that 6.38 % of these fatalities might have been saved by the eCall in France in 2008, if all the French fleet were equipped with it. Besides of this real efficiency, we can also calculate the total number of fatalities the system would have been able to save by multiplying the number of fatalities by the real efficiency for every category of accidents.

Figure 6 shows that 225 fatalities would have been saved in 2008 in accidents involving at least one passenger car, without neither pedestrians nor two wheelers. It represents approximately 5.1 % of the total fatalities registered in 2008 in France (based on 4 443 persons killed in accidents).

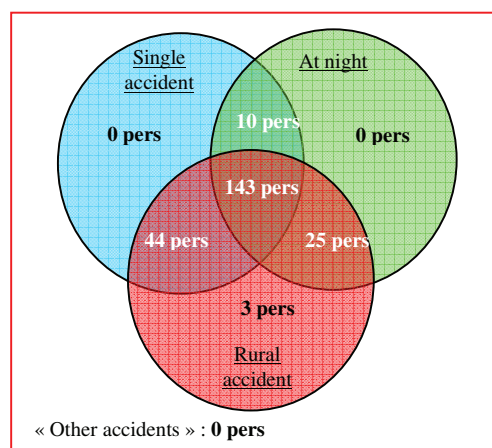


Figure 6. Number of fatalities that may have been avoided in France in 2008 with eCall for each accident typologies. Source PVM2000 database (1 584 accidents) and national data base ONISR 2008.

OUTLOOK AND DISCUSSION

Even though several evaluation methods of benefit calculation were perfectly defined during this study, we collide with the problem of representativeness and quality of the data available both at national and at in depth level. The data relative to emergency interventions is crucial for the evaluation of an eCall system and is not however available for all of France. The database on fatal reports “PVM”, contains certain errors (death time of the victim previous to that of the accident) and sometimes data is unknown. Besides, those various methods need to return to the police report for each case and variables should be coded for the method we want to apply. This makes a long and boring study. Researches are going to be led to try to obtain statistics that are more precise on alert time and intervention time (in urban zone and in rural zone) from French emergency services. On the other hand, all the collected cases improve this new tertiary accident analysis database and thus it is hoped to have a statistically representative database available soon. This will then enable us to calculate more accurately how many lives such a system could save [11, 12].

Regarding existing publications, it is important to remind that the first estimation realized at the beginning of the 2000s by the French government was about 250 lives saved per year, which represented at that time a 5 to 6% efficiency of the system. In a second step, the European commission mentioned a figure of about 2 500 lives saved per year in Europe with 100% of vehicles equipped with the system. A more

scientific approach was done during the TRACE project [21]. Based on the General Motors's On-Star device, this study used traffic accident statistics from Australia and established an effectiveness of 10 % if all vehicles were equipped with. On about twenty systems evaluated in the TRACE project, eCall arrived in 3rd position of the most promising systems. This last evaluation seems to be a little bit overestimated but gave a first real scientific result. An other scientific approach was done by the eImpact project that established an effectiveness of 6 %. All these surveys allow us to define a realistic effectiveness interval of this device between 5% and 10%.

CONCLUSION

This new study allows to refine the eCall system effectiveness with a 5.1 % benefit. This result based on accidentologic data is nearly similar than the figure initially estimated in the 2000s which was about 5 to 6 %. Besides, this evaluation only concerns passenger cars with an equipment rate at 100 %. We did not take into account the possible equipment of light trucks, heavy trucks or 2 wheelers. It now represents an additional weapon in the fight against road deaths and injuries, in particular for accidents at night in rural areas involving a single vehicle. As we have seen above, it is in these circumstances that the implementation of this system is expected to have the greatest benefits.

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