

## Event Data Recorder As A Forensic Tool

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### Abstract

This paper aims to increase the awareness of event data recorders (EDR), specifically with respect to motor transportation, and how the data stored on these devices can be used as evidence to establish liability and eliminate fraudulent insurance claims. The paper details the history of EDR, its operation and how it can be used as a forensic tool. It aims to provide an understanding of how EDR can be used to mitigate the risk of insurance fraud while taking into account the pitfalls associated with it and current legislation. It is thought that with a better understanding of EDR the public would be more safety conscious, knowing that in the event of an accident information stored on an EDR could be used to incriminate them. It therefore rationalised that with improvement in motor safety will come less insurance claims, specifically fraudulent claims.

### Introduction:

With the death of the Celtic tiger Ireland has very much been forced into recession, resulting in most people having to adjust to their changed circumstances. A growing trend in insurance fraud suggests that some are finding alternate ways to 'supplement' their lifestyles. Axa, (2010) discusses how there was almost 700 new cases of suspected insurance fraud reported to the Insurance Confidential hotline in 2009 – a figure up from approximately 300 in 2008. As the recession continues it is thought so too will the risk of insurance fraud. Insurance Confidential (2013) discusses insurance fraud costs insurance companies in Ireland an estimated €100 million annually which ends up being paid by honest policyholders.

With insurance fraud on the rise a method of mitigating the risk is sought. It is thought that the use of automotive embedded systems, specifically EDR, could play a vital role in this mission. EDR have the capability of recording data which can be used to validate physical evidence and witness statements following an accident thus evaluating liability. In Ireland little is publically know about these devices and as a result to date there is not legislation detailing their use in the court of law.

It would be hoped that with increased awareness of EDR will come improved road safety, decreased insurance fraud and thus decreased insurance premium costs. With respect to legislation a focus needs to be put on the importance of formulation of legislation for the use of EDR in the Irish court of law, as at present legislation is currently in practice in other countries and is acting as a successful tool in decreasing fraudulent claims.

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## History of EDR

Rechner 2005 describes how EDR, also known as black boxes, have been used in various modes of transport like aircrafts, trains and cars for many years. These units' continuously record data collected by a number of sensors inside the transportation and saves it for analysis after a possible accident. Chidester et al 1999 highlights that by 1974 General Motors (GM) in the USA equipped selected production vehicles with airbag systems, these systems recorded airbag status and crash severity for impacts which resulted in a near/full airbag deployment. The authors detail how these systems incorporated electromechanical g-level sensors which measured g-force, a diagnostic circuit which continually monitored the readiness on the airbag control circuits and an instrument panel Readiness and Warning lamp which illuminated if and when a malfunction occurred. As discussed by Rechner 2005 it is seen that since 1974 there has been an evolution of technology resulting in more advanced sensor data and storage capabilities thus enhancing the possibilities of forensic crash analysis.

## Construction Operation

Halderman (2012) reports how many vehicles incorporate the EDR in the airbag control unit. EDR is used to record data on airbag status and crash severity for impacts resulting in both deployment and near deployment of the supplementary restraint system (SRS). Halderman (2012) describes how the EDR is embedded into the airbag control unit and receives data from various sources at varying sample rates.



Figure 1: Airbag Control Unit/EDR ([www.twicsy.com](http://www.twicsy.com))

Data received is constantly being stored in a memory buffer but it is not recorded into the electronically erasable programmable read only memory (EEPROM) unless an airbag deployment/near deployment has been commanded. As reported by the U.S. department of transport (2010) in the event that vehicle experiences rapid acceleration, either negative or positive, beyond what the car would be normally be capable of achieving, collisions sensors (acclerometers) register the level of acceleration and transmit this to the airbag control module (ACM). When transmission to the ACM has occurred it is at this point that a recording is triggered on the EPROM and 5 seconds of data is stored as an event.

Examples of crash data parameters capable of being recorder by the EDR include:

- Vehicle speed
- Steering wheel angle
- Crash severity (delta-v)
- Brake switch status
- Seat belt circuit status
- Tyre pressure
- Accelerator pedal position
- Transmission gear position
- Yaw rate

### **Communication Types & Protocols**

Crolla (2009) discusses how with advancements in technology it is now possible for digital communication between all on board sub-systems, this communication network is known as control area network (CAN). This CAN-Bus system is a form of local area network, which allows sharing of data and is used in most modern vehicles. Crolla (2009) illustrates how CAN is based on the so-called broadcast communication mechanism in which communication is achieved via the sending of gateway transmitting messages over the network. Each message sent in the system has a specific protocol that includes a message identifier. The identifier defines the content of the message in addition to its priority and is unique within the network. Each sub-system on board is coded to the individual vehicle and has the chassis number of the specific vehicle encrypted within it thus leaving it tamper proof. With the development of CAN-Bus the amount of retrievable data has increased, this has a domino effect leading to the EDR being able to record more data. Retrievable data may include fault codes from ABS, traction control and power-train system.

Navet, (2009) discusses how telematics within vehicles can further expand information retrieval by the EDR. Navet, (2009) describes how telematics within vehicles includes systems which support information exchanges between vehicles or between vehicle and road infrastructure i.e. traffic lights.

### **EDR as a Forensic Tool**

While it is of great benefit that the data is recorded by the EDR it is of equal importance that it is possible for the data to be accessed and extracted from the EDR. Information available from their website (The crash data group, 2005) informs us that the Bosch crash data retrieval (CDR) tool is a commercially available device which has the capability to download data from an EDR.

The CDR tool is commonly used by police, insurance investigators and independent investigators to assess and image crash data which may be stored in the EDR. The CDR tool itself consist on a laptop computer, CDR interface and appropriate connection leads. The CDR tool can be connected via two ways, firstly directly to the vehicles diagnostic link connector (DLC)/European on-board diagnostics connector (EOBD), this is only possible if the vehicles electrics are operable, and the second method is by connecting directly to the airbag control module/EDR using the appropriate lead.

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It is important to note that after a pre-set number of key cycles the recorded data on the EDR can be wiped, leaving the evidence lost forever. The possibility of this occurrence calls for necessity of treating the vehicle as a crime scene, the vehicle should be totally sealed off, covered appropriately from elements or tampering and the keys locked away in a secure place, with access available only to the investigating forensic team.

In order to translate the information stored in the EDR a specialised trained accident investigator, let them be law enforcement, insurance investigator or an independent, is required to ensure accurate interpretation. In addition, the investigator should be appropriately trained to extract and evaluate the necessary data as the EDR is capable of recording multiple events and other information which could be misleading. Data capable of being extracted is illustrated below, Figure: 6, however this is only a simple representation of basic information recordable.

The data recorded on the EDR can be displayed in a freeze frame diagram. It is also possible in certain manufactured vehicles to capture 5 seconds or more freeze frames and data from the EDR and power-train control units. Information available from their website (Accident reconstructions, forensic and vehicle design, 2012) discusses how EDR can play a significant part in accident reconstruction/investigation. EDR information combined with mathematical analysis of vehicle motion, on-site surveys, crush analysis and analysis of photographic evidence can lead to a more accurate account of the events preceding, during and after an accident.

Advances in technology has led to the development of a system which will facilitate the input of data to create a computerised simulation of the events involved in the occurrence of an accident.

### **Insurance Fraud Definition**

Information available from the legal practitioner 2007 ([www.practitioner.com](http://www.practitioner.com)) describes how it is impossible to provide a comprehensive definition of fraud and how there are many dictionary definitions of the word 'fraud', despite being similar none are exactly the same.

Such expressions used to describe 'fraud' include:

- Unfair advantage by unlawful or unfair means;
- Knowingly making a false representation;
- Intentional deception resulting in injury to another person;
- An intentional perversion of truth;

According to Stephen (1883) there are two essential elements for fraud:

- Deceit or intention to deceive;
- Either actual injury or possible injury or an intent to expose some person either to actual injury or to a risk of possible injury by means of deceit.

Legislation (United Kingdom, Theft Act 1968) describes fraud more simply as any intentional or deliberate act to deprive another of property or money by guile, deception or other unfair means.

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From an automotive prospective insurance fraud is common place, some techniques as described by the BBC (2008) include:

- The 'classic rear-end shunt' where the driver in front suddenly slams on the brakes, possibly with brake lights disabled.
- The 'decoy rear-end shunt' when following one car, another one pulls in front of it, causing it to brake sharply, then the first car drives of.
- The 'helpful flash of the head lights shunt' by where the driver is signaled into a line of queuing traffic by the scammer who promptly crashes, then denies signaling.
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### **How EDR can be used to mitigate the Risk of Insurance Fraud**

EDR can sometimes help easily identify staged collisions and false stories by a claimant. The following is an example of a case, provided by IEEE Spectrum (2013), where the data stored on the EDR of the crash vehicle, was used to determine liability in a US case in May 2006:

*"The Santa Clara County District Attorney's Office in San Jose, Calif., prosecuted the driver of a vehicle that in May 2006 struck and killed a 15-year-old pedestrian in a crosswalk. Conventional accident reconstruction techniques estimated that the driver was traveling at roughly 90 kilometers per hour in a 72 km/h zone. Subsequently, the prosecutor's office allowed the driver to plead guilty to hit and run—a lesser offense than vehicular manslaughter, which is what it had initially aimed to prove. Police investigators were initially unaware, however, that the driver's vehicle, a GMC Yukon, was equipped with an EDR capable of recording pre-crash data. (This underscores the extent to which EDRs' capabilities have been an open secret.) A year after the accident, authorities found out that the data they needed was available and recovered it. Prosecutors discovered that the driver had actually been traveling at 122 km/h. The box also revealed that the driver applied the brakes at some point between 2.1 and 1.3 seconds before he struck the pedestrian, lowering the SUV's speed to about 97 km/h at impact. With that evidence in hand, Charles G. Gillingham, the attorney who prosecuted the case, withdrew the plea agreement and proceeded to trial on the vehicular manslaughter charge and other, lesser charges. The driver was convicted."*

In the above example it is clearly evident that EDR can play a vital role in ensuring the appropriate charge is brought to case. While data stored on an EDR can be used in high profile case, like in the above example, it should be noted it can also be used on a day to day basis in less extreme circumstances, where insurance investigators are simply trying to determine the events surrounding a claim.

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An example as provided by Ruth, R., (2010) highlights this fact.

*"I was minding my own business going 30mph when this car pulled out in front of me. I slammed on my brake but couldn't avoid..."*

The data extracted from the EDR of the involved vehicle is illustrated in Figure: 9 shows how in actual fact that the driver was accelerating up until 1.6 seconds pre impact and no meaningful braking occurred.

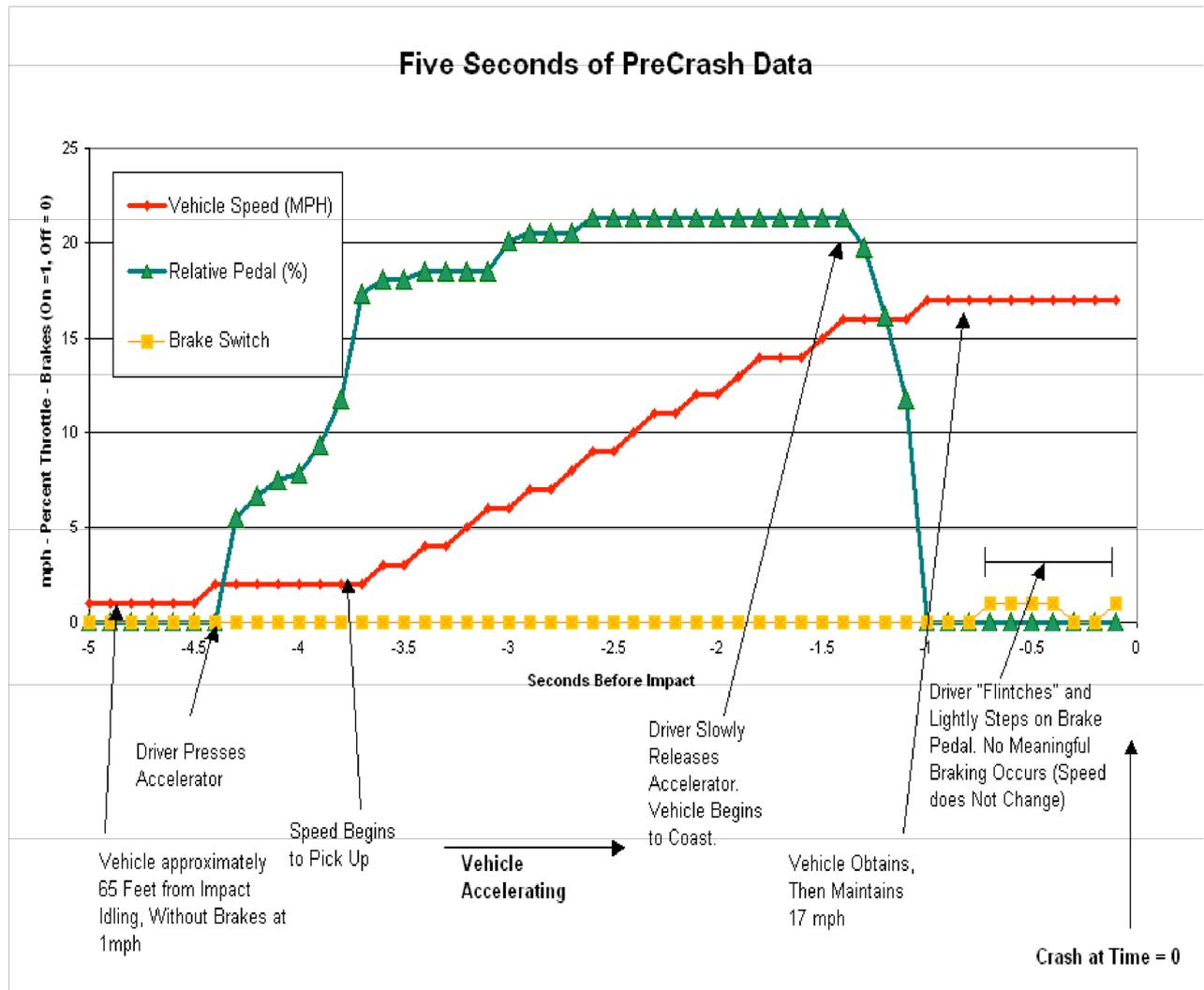


Figure 2: Data extracted from EDR (Ruth, R., 2010)

A final example, as provided by the crash data group (2013), shows how data stored on the EDR of a vehicle can be used to mitigate the risk of insurance fraud.

"A vehicle owner presented a claim to recover damages his car sustained when it was damaged while parked and unattended".

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The Data retrieved with the CDR tool contradicts the owner's account of the loss. The EDR data indicates the vehicle was in motion when it was struck from behind and was accelerated forward. The data also suggests there were multiple occupants in the vehicle at the time of the loss and multiple ignition cycles occurred.

This is potentially a problematic claim as with data extraction from the EDR there is now the possibility of occupants who could in theory file claims for injury. The data extracted from the EDR verifies that the loss did not occur as reported in addition to providing evidence there was another party in the vehicle. In this case the stored data on the EDR has proven valuable in the detection of fraud.

### **Pit-Falls Concerned with EDR**

While there are many advantages in having EDR it should be noted that there are also many pit-falls. Kowalick, T M, (2001) describes how EDR technologies may make it possible to place private vehicles under continuous surveillance thus reducing informational and personal privacy, posing the question is this ethical? The author reports how with links to GPS constellation of satellites it may be possible to track the location of private vehicles at all times. With information therefore being so accessible it is of a concern that the stored data on the EDR could be misused by government, law enforcement and insurance companies in order to alter liability or by original equipment manufacturers in warranty disputes. The author brings to the fore an important fact, specifically no technology is infallible.

Kowalick, T M, (2001) highlights how there are serious concerns regarding unauthorized third-party access to EDR and who exactly owns the information. It is noted that a disadvantage of the technology is the fact that thus far the consumer has been given no choice regarding the presence of EDR technologies in private vehicles and that there are concerns that no choice will ever be offered.

Lastly the most worrying pit-fall that is seen is the "big brother syndrome", the feelings of "being watched" which could cause a reluctance to use private vehicles utilizing EDR technologies.

### **Legislation**

Currently in Europe the use of EDR has not been defined in law. As reported by Jung, J, (2012) the German parliament, the Bundestag, plan to make such technology mandatory in cars after a study commissioned by the European Commission found the use of EDR can improve road safety. Across Europe the interest in EDR has increased resulting in 2012 the European Parliament asking the European Commission to come up with a detailed plan for the introduction of black boxes across the continent before the end of the year, however this did not come to pass. The boxes attracted much criticism due to the risk they pose to privacy and were often labelled as unnecessary and expensive. Thus to date these devices are not required to be installed by law across Europe.

The current situation in Europe differs greatly from that in the USA as State Statute (2013) reports how the [National Highway Traffic Safety Administration \(NHTSA\)](#) in December 2012 proposed a new rule that would require automobile manufacturers to install EDRs in all light passenger vehicles beginning September 1, 2014. Most car manufacturers currently install these devices in new vehicles.

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**Conclusion:**

After reading many books, research papers and news articles detailing EDR I feel that it can be concluded that the use of EDR can be beneficial to the public, An Garda Siociona, insurance sector and court systems. EDR is a source of information which is a powerful objective witness, a resource which will only improve further, broadening its capabilities with public demand. With respect to recommendations that I would put forward to be implemented, I feel that the Irish government should review current legislation with the aim to include EDR as an expert witness when investigating motor accidents.

EDR is a forensic tool which is very much under used in this country. When employed correctly it has endless capabilities, it could be used to provide statistics in driver behaviour potentially leading to more appropriate insurance loading i.e. young drivers, high risk, low risk. Lastly EDR could also be used to evaluate the expected extent of injuries sustained in an accident thus aiding the settling of cases in a more realistic and appropriate manner.

The potential uses of EDR is abundant yet the question is posed 'why is it not used more commonly in Ireland?'

**References:**

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- [1] Chidester, A., Hinch, J., Mercer, T. & Schultz, S. (1999), 'Recording Automotive Crash Event Data' *International Symposium on Transportation Recorders*. Arlington, Virginia, May 3-5 1999. USA.
- [2] Williamson, M. (2010) David Warren: Inventor and developer of 'black box' flight data recorder. *The independent*, July 3<sup>rd</sup> 2010.
- [3] Rechner, H. (2005) *A distributed Cooperation Event Data Reorder for Networked Vehicles*. Published Thesis. Wilhelm Karls University of Tubingen.
- [4] Crash for cash - a scam for the unquestioning? - Consumer. 2013. *Crash for cash - a scam for the unquestioning? - Consumer*. [ONLINE] Available at: <http://www.bbc.co.uk/blogs/theoneshow/consumer/2008/09/15/crashing-in-on-crime.html>. [Accessed 17 November 2013].
- [5] Twiscsy, (2011), *Airbag Control Unit/EDR* [ONLINE]. Available at: <http://twiscsy.com/i/T4ggtb> [Accessed 02 November 13].
- [6] Stephen, J. (1883) *A History of the criminal law of England*. London: Macmillan & Co.
- [7] Definition of Fraud. 2013. *Definition of Fraud*. [ONLINE] Available at: [http://legal.practitioner.com/regulation/standards\\_9\\_2.htm](http://legal.practitioner.com/regulation/standards_9_2.htm). [Accessed 17 November 2013].
- [8] Crash Event Data Recorders Final Report. 2013. *Crash Event Data Recorders Final Report*. [ONLINE] Available at: [http://ntl.bts.gov/lib/jpodocs/repts\\_te/14146.htm](http://ntl.bts.gov/lib/jpodocs/repts_te/14146.htm). [Accessed 17 November 2013].
- [9] VolksPage.Net - Seu Portal Volkswagen. 2013. *VolksPage.Net - Seu Portal Volkswagen*. [ONLINE] Available at: <http://www.volkspage.net/>. [Accessed 17 November 2013].
- [10] Vehicle Crash Data Retrieval - Crash Data Group. 2013. *Vehicle Crash Data Retrieval - Crash Data Group*. [ONLINE] Available at: <http://www.cdr-system.com/>. [Accessed 17 November 2013].
- [11] ]TLC Technology. 2013. *TLC Technology*. [ONLINE] Available at: <http://thomaslangley.com/TLCTechnology.htm>. [Accessed 17 November 2013]
- [12] ]Accident / Crash Simulation | Crashteam. 2013. *Accident / Crash Simulation | Crashteam*. [ONLINE] Available at: <http://crashteam.com/Services/Crash-Reconstruction/Crash-Simulation.html>. [Accessed 17 November 2013].
- [13] ]The Automotive Black Box Data Dilemma - IEEE Spectrum. 2013. *The Automotive Black Box Data Dilemma - IEEE Spectrum*. [ONLINE] Available at: <http://spectrum.ieee.org/computing/embedded-systems/the-automotive-black-box-data-dilemma>. [Accessed 17 November 2013].
- [14] Vehicle Crash Data Retrieval - Crash Data Group. 2013. *Vehicle Crash Data Retrieval - Crash Data Group*. [ONLINE] Available at: <http://www.cdr-system.com/industries/insurance.html>. [Accessed 17 November 2013].
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- [15] Kowalick, T M, 2001. Real world perceptions of emerging (EDR) technologies. *Click, Inc Transportation Safety Technologies*, 2001-06-0204, 146.
- [16] Insurance Confidential. 2013. *Insurance Confidential*. [ONLINE] Available at: <http://www.insuranceconfidential.ie/>. [Accessed 17 November 2013].
- [17] Fraud in a time of Recession » AXA Insurance Blog. 2013. *Fraud in a time of Recession* » AXA Insurance Blog. [ONLINE] Available at: <http://blog.axa.ie/2010/07/fraud-recession/>. [Accessed 17 November 2013].
- [18] Privacy of Data from Event Data Recorders: State Statutes . 2013. *Privacy of Data from Event Data Recorders: State Statutes* . [ONLINE] Available at: <http://www.ncsl.org/research/telecommunications-and-information-technology/privacy-of-data-from-event-data-recorders.aspx>. [Accessed 17 November 2013].
- [19] Jung , J, 2012. Germany's cars to get teched-up as parliament proposes black boxes for vehicles. *The German View* , August 30, 2012
- [20] Long, J. (2010), *The use of hydrogen as a fossil fuel extender for internal combustion engines*.
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