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Memorandum

U.S. Department of Transportation
National Highway Traffic Safety Administration

DEPT. OF TRANSPORTATION

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NHTSA-99-5218-3

Subject: Submittal of Meeting Minutes of the **MVSRAC/Event** Data Recorder **(EDR)** Working Croup to Docket No. NHTSA-99-5218

Date: OCT 1 2 1999

From: Raymond P. Owings, Ph.D.
Associate Administrator for
Research and Development

Reply to Attn. of **NRD-01**

To: The Docket

THRU: Frank Seales, Jr.
Chief Counsel

Attached are the meeting minutes of the Motor Vehicle Safety Research Advisory Committee, Crashworthiness Subcommittee, Event Data Recorder **(EDR)** Working Croup meeting held on June 9, 1999.

Meeting history:

Meeting #	DATE
1	October 2, 1998
2	February 17, 1999
3	June 9. 1999

This working group is related to the following dockets:

NHTSA-98-3887: Crashworthiness **Subcommitte**
NHTSA-98-3928: MVSRAC Full Committee

Research and Development requests that the minutes of this meeting be placed in the public docket.

Attachments

#

Motor Vehicle Safety Research Advisory Committee

Crashworthiness Subcommittee
Event Data Recorder Working Group
Meeting #3

Final Minutes
Wednesday, June 9, 1999
9:00 AM - 4:00 PM
NHTSA Headquarters
Washington, DC

The Event Data Recorder (EDR) Working Group consists of a panel of government and industry officials appointed by the Motor Vehicle Safety Research Advisory Committee's (MVSRAC) Crashworthiness Subcommittee. The third meeting of the EDR Working Group members and invited guests was held at the National Highway Traffic Safety Administration's (NHTSA) headquarters in Washington, DC. The purpose of the meeting was to: 1) continue to work on the working group's objectives, 2) review working group member's inputs for data elements, 3) continue discussion of privacy and legal issues related to EDRs, and 4) continue to expand the working group's knowledge through several presentations. The meeting was co-chaired by John Hinch and Dave Bauch. The agenda for the meeting is included as **Attachment 1**.

1.0 Welcome, Introduction, Meeting Objectives, and Approval of Previous Meeting Minutes

The meeting was called to order by John Hinch, who welcomed everyone to the meeting. Dave Bauch was recognized as the meeting co-chair. Dr. Joseph Kanianthra, Chairman of the Crashworthiness Subcommittee of the MVSRAC, welcomed the members and guests of the working group and gave some details on the operation of a working group within the MVSRAC. Dr. Kanianthra told the group that he was very excited with the progress of the group, and that the EDR group was one of the most active working groups within MVSRAC.

The minutes from the February 17, 1999, meeting were approved by the working group. General Motors submitted a new position paper on data ownership. This replaced attachment 7 in the draft minutes. Additionally there were several minor typographical corrections reflected in the final minutes. The approved minutes and attachments for the February meeting were placed in the DMS in early July, 1999. You can review this information using the DMS, as follows:

➔Internet address: http://dms.dot.gov/
➔click on "Search" about ½ way down the page
➔click on "Docket Search Form"
➔fill in the docket ID with "5218"
➔select "NHTSA" for the agency
➔select "1999" for the CY
➔press search.

2.0 Objectives

John Hinch led a discussion on the objectives of the WG. First he reviewed all the objectives and solicited input from the WG for changes or new objectives. The following is the current list of objectives for the WG

1. *What is the status of EDR technology?*
2. *What data should be selected for recording?*
3. *How should the data be collected & stored?*
4. *How should the data be retrieved?*
5. *Who should be responsible for keeping the permanent record?*
6. *Who owns the data?*
7. *Who are the customers for EDR data?*
8. *Demonstration of EDR technology.*

After the review, there were several detailed discussions, as follows:

Item 1 - EDR Status
✐ John Mackey will contact VDO about Europe operations.
✐ EDR status should include a census of all manufacturers. John Hinch agreed to talk to the two major Associations to see if they could assist the MVSRAC in this effort.
✐ May want to include the suppliers in this census.

Item 2 - Data
No discussion

Item 3 - Storage
✐ Manufacturers do not use a common format for storing data
✐ There is a possibility that in the long term, manufacturers could develop a common format, but regulatory activity may be required.
✐ May want to look at the EPA and/or CARB requirements to see if there are any guidelines for standardization of data storage format.
✐ There was a request to see if we could get a presentation from EPA on OBD2 technology. John Hinch will check into this request.
✐ There was a question to the group for consideration on what should trigger an EDR. Currently, OEM systems use trigger logic associated with the air bag deployment system.

Item 4 - Retrieval
✐ There was a request that we try to get Vetronix to come to a meeting in the future to discuss data retrieval.
✐ There was a comment associated with the need for retrieval in the future when EDR data could be transmitted from the vehicle to a central file.
✐ Additional comment was made that this is already being done in some commercial non-OEM installations.

Item 5 - Permanent Record
No discussion

Item 8 - Demonstrations
✐ John Mackey submitted a description of an aftermarket system in response to Item 8. A copy is included in **Attachment 2.**

It was decided to have breakout sessions at the next meeting to concentrate on Items 2, 6, & 7 This ended the discussion of the objectives.

3.0 Discussion of EDR Data Elements

John Hinch led a discussion on selection of data elements for inclusion in an EDR system

Joe Marsh made a presentation on a selection procedure he had developed which would help the WG analyze the various inputs on the data. Kathy Gravino agreed to help with this effort. A copy of Joe's proposal is found in **Attachment 3**, along with additional inputs from Tom Kowalick on setting priorities.

Dave Bauch made a presentation on Ford systems. He discussed the police fleet EDR study and the current OEM system Ford is installing on some of their models.

Several new Data Forms were submitted for consideration. They are found in **Attachment 4**

LUNCH BREAK

4.0 Presentations

Art Carter, NHTSA, made a presentation on the Agency's activities associated with Automatic Collision Notification. A copy of Art's presentation is found in **Attachment 5.**

Joe Marsh made a presentation on recent activities he had learned about through an ISO meeting. A copy of the presentation is found in **Attachment 6.**

Vern Roberts discussed the recent NTSB symposium on Recorders. A copy of the pre-event proceedings was handed out to each member of the WG.

John Hinch and Joe Marsh passed out a set of Press clips related to EDRs. A set is found in **Attachment 7.**

5.0 Discussion of Privacy Issues:
Sharon Vaughn, NHTSA, led a discussion on data privacy and related legal issues. The discussion started with a review of NHTSA's position on data ownership and a presentation on data ownership by VW. The VW paper is found in **Attachment 8.**

There were some discussions related to insurance company access to EDR data. John Mackey and Sharon Vaughn agreed to put together a paper on this subject.

There was a comment that ITS had a position on privacy issues. I have contacted ITS and asked for its policy in this area. I will share this with the WG at the October meeting.

There was a request for a copy of NHTSA Crash Investigation release form. I discussed this with the Special Crash Investigation (SCI) staff and found that they obtain verbal permission to inspect the vehicle and take measurements. They obtain written permission to obtain medical records. A copy of the medical release is found in **Attachment 9.**

6.0 Working Group Activities

6.1 Member list and Attendee list: It was learned that two members have left the working group - Ray Peck from the California State Government and Ken Opiela from the Transportation Research Board, National Research Council. A copy of the current WG member list and June meeting attendee list is found in **Attachment 10.**

6.2 Meeting Co-Chair for next meeting: Sharon Vaughn

6.3 Next Meeting: October 6, 1999, Washington, DC

6.4 The following topics were presented for discussion at the next meeting:

- a. Three Breakout sessions:
  1. What data should be selected for recording?
  2. Who owns the data?
  3. Who are the customers for EDR data?
- b. Discussion of Insurance company legal issues
- c. Potential Presentations for Next Meeting
  1. Ford Racing
  2. VDO
  3. Sophia Rayner EDR system
  4. Vetronix

6.5 Work assignments/action items

6.5.1 Data Elements

Joe Marsh, Ford and Kathy Gravino, DaimlerChrysler agreed to develop a new data form based on discussions at the June Meeting. They will provide the form in electronic format to NHTSA who will circulate it to the working group members. The Members agreed to fill out the new form prior to the October meeting.

6.5.2 Ownership/Privacy

Sharon Vaughn, NHTSA and John Mackey, Loss agreed to put together a white paper on the role that insurance companies play in the legal issues associated to data ownership. They will present this paper at the October meeting.

6.5.3 The WG agreed to hold three breakout sessions at the October meeting. These will work on Objectives 2, 6, & 7. Each member will need to select which area they are interested in participating. Each member and guest should decide which area they want to work on prior to the meeting so we do not loose meeting time trying to divide in these groups.

6.6 New Business

6.6.1 John Hinch indicated he would be participating in a TRB A2A04 summer workshop. One of the activities for the workshop will be EDRs. John asked for input from the WG for presenting to the A2A04 members, which tend to be state, local and federal highway transportation officials.

6.6.2 Doug Gurin indicated that his office would be holding some workshops on research. Although the strategic planning workshops to establish research priorities for technology applications on behalf of traffic safety programs has not yet been scheduled, interested parties should contact Doug at 202 366 5594 for information.

6.6.3 John Hinch passed out a *Federal Register* notice which detailed recent NHTSA action denying a petition requesting the agency to require EDR technology on new motor vehicles. A copy is found in **Attachment 9.**

Attachments

1 Agenda

2 Loss Management Services, Inc. write up for Objective #8

3 Data Structure inputs:
- Revised data element structure proposed by Ford
- Classification methodology proposed by Tom Kowalick, John Carney, Jeya Padmanaban, and Greg Shaw

4 Data Forms
- John Carney,
- DaimlerChrysler
- FHWA
- Loss Management Services, Inc.
- Transport Canada, Collision Avoidance
- Transport Canada, Collision Investigation
- Transport Canada, Ergonomics

5 ACN Presentation

6 Japan Drive Recorder Committee presentation

7 Press clips and news stories on EDR

8 VW "White Paper" on privacy

9 Misc.
- NHTSA crash investigation medical release form
- Federal Register Notice

10 Attendance list and Updated Working Group Member list

AGENDA

Event Data Recorder Meeting #3

9:oo am - 4:00 p.m. Wednesday, June 9, 1999

Room 6200-04 NASSIF Building; 400 7th Street S. W.; Washington DC 20590

Working Group Objective
Facilitate the collection & utilization of collision avoidance and crashworthiness data from on-board EDRs.

Meeting Objective
Third meeting objectives: 1) Working Group Objective; 2) Review WG members' input for data elements; 3) Review of WG's privacy issue white papers; 4) Other systems & data

9:00 Welcome and Introductions (John Hinch)

Hello from Joe Kanianthra

9: 15 Review and Approval of February 17, 1999, Meeting Minutes (John Hinch)
- -GM Change

9:30 Working Group Objectives (John Hinch)
- Review of last meeting outcomes
- Sign-up for work on Objectives

10: 15 Break

10:30 Discussion of EDR Data Elements (John Hinch)
- -Review of Individual WG member Inputs
- -Refinement of "Top Ten" list
- -Summation of Results

11:30 Use of Data for Advanced Design (Dave Bauch)

12:00 Lunch

1:00 Automatic Collision Notification (ACN) Presentation (Art Carter)

1:45 Discussion on Privacy Issues (Sharon Vaughn)
- -Presentation of additional White Papers (10 min each max)
- -Summation of Major Ideas (WG)

2:40 Break

2:50 Small Manufacturer Concerns (ideas for next meeting)

3:00 Discussion of MVSRAC Meeting & EDR WG Presentation (John Hinch)

3: 15 Review of NTSB Symposium on Recorders (Vem Roberts)
- News articles

3:30 Committee Work
- -New Business
  - -NCHRP Summer Meeting Activities related to EDR (John Hinch)
- -Next Meeting
  - -Objectives
  - -Presentations
  - -Date
  - -Co-Chair for next meeting
  - -Breakout sessions

Working Group Material

For Review
- Books on EDRs

For Handout
- NTSB Draft Proceeding of Symposium

June 9, 1999

NHTSA EDR Working Group, Washington, D.C.

<u>Loss Management Services, Inc.</u>
John J. Mackey & Tony Reynolds (VDO North America)

WORK ASSIGNMENTS FOR OBJECTIVES 1, 2, 3, 4, 7 & *8
(a collective response)

* # 8 Mobile Accident Camera (MAC)box "proof of concept" demonstration

Digital Eye- Witness Systems

Loss Management Services, Inc., 36 Surf Road, Lindenhurst, NY 11757

HIGHWAY MOBILE ACCIDENT CAMERA

According to the National Center for Health Statistics, "National Health Survey", in 1996 there were 35 million motor vehicle accidents with an associated total economic loss of $120.8b. Approximately 60% of the $120.8b was spent on claims payment and an additional 12% in legal fees. What is not known is how much of this amount was spent settling or defending fraudulent and frivolous claims. However, Loss Management Services, Inc. (LMS) does have a way to control these costs. LMS has developed systems to control claims pay out and litigation costs while deterring fraudulent and frivolous claims, along with providing for a real crash data bank for regulatory agencies.

LMS has developed the MAC (Mobile Accident Camera) Box system which will record the events leading up to an accident, capture accident data and record the aftermath. The MACbox will provide a "driver's eye view" of the entire incident from beginning to end. The only difference is that the MACbox will disclose without bias, the event as it occurred. The system is an application of existing commercial technology answering the most common and most vexing mystery: Whose fault was it? And, what happened? By working closely with our client companies, the insurance industry and our technology partners we will also establish a rich repository of information that will be used to help mediate claims, assign responsibility, advance vehicle safety and reduce the total economic loss that results from motor vehicle accidents.

The MACbox acts as a 'Digital Eye-Witness' to the occurrence of a crash and removes any doubt as to which driver is at fault. This information will allow the insurers to immediately evaluate their exposure and decide whether settlement of the claim is in order. The impact of clearly establishing fault via video recording of the accident will drive the insurance companies to participate in this program. As there recently exists a type of **basic** Event Data Recorder (EDR) box within the GM higher valued end vehicles, the MACbox system affords much more data useful in determining and accurately assessing liability along with frivolous and fraudulent type insurance claims.
what is needed within the EDR environment.

The MAC Box system will be capable of providing benefit to the entire 200 million plus vehicles on the U.S. roads today. Unfortunately, like seat belts and anti-lock brakes, this system will take time to gain acceptance. Part of the problem is that the world does not change quickly and the insurance industry needs to accumulate actuarial data before they can offer financial incentives to change. Based on our research, the initial market will be the "Self- Insured Retention" (SIR) type risks and high end valued private passenger vehicles. Among state and local governments, private fleets and the high valued end vehicles, it represents a market of close to 100 million vehicles. With two years of data and some direct involvement with selected insurance industry partners, we believe that we can establish the statistical and business basis for these insurance companies to offer incentives to their clients that purchase our product, not to mention the immediate benefits with the commercial fleet exposures.

We have been in contact with the National Highway Traffic Safety Administration and they have formed a committee with representatives from the major automotive manufacturers, the insurance industry, universities and medicine to develop a standard for a less aggressive product that will only capture motion information and contact the emergency services. The NHTSA has expressed a strong desire to have us present our solution to this august body. Most recently, we had the opportunity to do so at NHTSA's EDR Working Group. LMS is now apart of that group and is currently involved with identifying issues to make clear what will be appropriate in the commercialization of EDR.

Future versions of our product will have added functionality and reduced unit costs expanding coverage to the total motor vehicle market. We envision a MACbox fitting in the rear view mirror of every automobile and providing the ability to not only see and record accidents, but to contact police and pass important medical information to emergency medical technicians that are responding to the call. Additionally, the real world accident data gathered will be of great value to both the Federal Government, local law enforcement and car manufacturers in improving vehicle safety systems, along with an accurate assessment of highway infrastructure conditions. The foundation has been laid for making this vision a reality. A prototype is complete. LMS has entered into marketing, manufacturing, and technology partnerships with industry leaders to ensure that there will a 'best of breed' in developing the system for commercialization.

The Market

LMS will direct market the MACbox to insurance companies, long and short haul trucking companies, charter bus companies, car and truck rental companies, corporate fleet and limousine companies, along with municipal transit authorities and taxi and limousine exposures. According to the 1996 FARS/GES published Report, the number of vehicles in operation at that time was:

124.6 million Passenger cars
65.4 million light trucks (includes vans and utility vehicles)
7.4 million large trucks

The vehicle base is growing at a rate of 2% plus annually.

The initial target market will be both high-end valued vehicles and commercial fleet-type vehicles. The estimate of this market alone is nearly 100 million vehicles. With the second phase of the product, we will have a cost-effective solution for the private passenger vehicles. This will expand the market to the total population of vehicles in operation.

insurance Companies

LMS will develop strategic alliances with the top insurance carriers in the United States. The purpose of the alliances will be to develop a database of information regarding claim cost reduction and its relation to premium discounts. To date, discussions have begun with Allstate, Geico, State Farm, Liberty Mutual.

Market Segmentation Focus:

Private Passenger Transportation - Vehicles (PPT)

The MACbox provides a unique method of reducing accident claim expenses incurred by insurers. A 1996 report by the Insurance Information Institute stated that the entire vehicular insurance market incurred $120.8 billion in losses during 1996. According to their data bank 6,115,000 private passenger motor vehicle (PPV) accidents were reported nationwide in 1996. This equates to $77.7 billion dollars in losses for the PPV's alone. These costs represent the total claim expense and settlement costs absorbed by PPV insurance companies. These costs could be drastically reduced if the extent of litigation

Charter Bus Companies

Charter bus companies such as Laidlaw/Greyhound represent a significant potential market for LMS. These companies provide much of their own liability protection with SIR, and have tremendous potential exposure for personal injury claims. These operators are looking for proactive technology solutions to limit their roadway exposure. LMS plans to modify the MACbox to record accident information within the bus to help determine personal injury exposure.

Long and Short Haul Trucking

Long and short haul trucking companies often provide a portion of their liability protection through Self-Insured Retention (SIR). Within the SIR marketplace, the insured typically assumes liability up to a predetermined limit. In the case of long haul truckers this may be the first $500,000 per occurrence. It is in their best interest to limit their exposure to long and costly claims management and potential litigation. With the MACbox, those companies would have an expert witness with each of their vehicles. In the event of an accident, the information provided could be used to help limit the overall expense involved with the claim, along with providing for future safer routes.

Private Passenger Transportation (PPT) Rental and Truck Rental Companies

These companies represent a tremendous opportunity for LMS. The likelihood of having a driver involved in an accident return to testify during litigation is very low considering that most drivers are from out of state. This presents a very difficult situation for the legal departments of the rental companies. They are often presented with indefensible claims and settle more claims than they would have to if they were to incorporate a MAC box in each vehicle.

Corporate fleet and Limousine Companies, Municipal Transportation Authorities and Taxi and Limousine Commissions

These potential customers represent a tremendous potential for LMS since they all involve operators for hire. The representative management involved with these risk exposures has a vested interest in maintaining the safety of the vehicles and their passengers. The ability to have an expert 'Digital Eye-Witness' available at the scene of every accident is an invaluable tool to these management teams. Both management and legal council will benefit from the information provided. They will be provided with information necessary to determine whether to litigate or settle as well as determine whether to terminate the employment of operators. LMS is presently in discussions with the New York City taxi & Limousine Commission.

Self Insured Retention (SIR)

Within the SIR market we have identified the following vehicular populations:
Long/Short Haul Trucking 800,000
Light Trucks 1,200,000
Buses (private charter/school) 500,000
Municipal (State & Local) 7,500,000
PPT (rental cars/fleet vehicles) 1,500,000
Taxies 3,500,000
Total 16,000,000

Personal Automobile consists of the majority of the transportation environment (124,600,000 vehicles – USA).

The MACbox system will be the much needed risk and insurance claim management tool for the transportation environment for the 21st Century.

Future Vision

Data Bank:

LMS will create and manage a database of image and crash data for use in determining roadway safety by Government agencies, Insurance Carriers and the Private Sector.

Civil Court Database:

LMS will provide for data transmission to the courts for automatic denial or a lack of causation of the Plaintiff regarding the liability portion of the action. That is, to determine, without jury selection, the validity of Plaintiff's case.

Trucker's Log:

The next generation of the MACbox will incorporate a "trucker's log" necessary in long haul trucking. The system will use accelerometer data to determine the movement and stationary positions of the truck. Trucker's logs are currently mandated by the Department of Transportation (DOT) and are used to determine a driver's activity.

Elevator MACbox:

Piloting commercial buildings with the MACbox within an elevator to capture sudden acceleration. The sudden drop or acceleration will cause the system to capture images within the elevator cab to determine the potential injury to any occupants. The Elevator MACbox can be used to indicate required maintenance.

Partners:

LMS has two partners that are currently committed to working on the development of the beta version of the first MACbox system. The parties and their component of the solution is as follows:

Phoenix Group Inc.	Specialized PC with Ruggidized enclosure and System Integration
VDO Kienzle North America	Shock and Motion Sensors and Trigger
ST Microsystems (Vision, Inc.)	Camera and Image Data Integration
S.A.I.C.	Telecommunication Operation
Forensic Accident Investigations	National Accident Reconstructionist Experts
LMS, Inc.	Marketing/Sales of MACbox & Image/Telemetry Repository Bank

Major Contacts

Targets for the Pilot Program

During our conversations with numerous organizations, some have expressed interest in being part of the initial 600 unit pilot program. They are:
Allstate Insurance
Avis Rental
UPS
New York City, NY MTA & Long Island, NY MTA
John Deere Insurance Services

Interested Entities

A key to the success of the MAC Box system will be the acceptance by the insurance industry. Our measure of their acceptance will be their premium discounts for the

installation of our product. While we are a couple years away from that level of acceptance, a number of insurance companies, transportation companies and agencies have expressed strong interest in working with us on this project. They are:
Allstate Insurance
John Deere Insurance Services
State Farm Insurance
Liberty Mutual Insurance Company
Office of Safety Performance Standards – NHTSA Research
NY MTA Buses – 4,900
NYC Taxi & Limousine Commission - 12,000 units
UPS - Fleet size - 164,000 units
AVIS Rental – 500,000
Enterprise Rental - 400,000
Greyhound/Laidlaw – 43,000
Northeast Trucking – 4,300

Current Service Offerings

LMS will offer a number of services that make use of the information developed by the MACbox or support the system. After we have developed the business with these foundation services we will expand the service offerings to include video recreations, expert witness testimony and arbitration services. As we move forward with the MACbox, the company is confident that we will find additional products and services that we can offer from the information that we collect.

Installation Services

LMS will offer our clients installation services with the new systems. Our organization will develop an installation process document that can be used by a local vendor to install the MACbox system into the vehicle and test the unit after installation. We intent to contract with electronic equipment installers that are local to our clients to make the process as convenient as possible for them. The initial installations will be performed under our supervision. The knowledge gained from these efforts will be incorporated into our process documentation. As part of the installation process, we will develop a remote certification procedure that will allow us to test the system prior to placing it into service.

Membership Fees

All users of the MACbox system will be charged an annual user fee. This fee will cover the maintenance of vehicle records containing, VIN number, owner, address and other user defined fields such as primary driver on our roster, quarterly remote testing of the MACbox to ensure that it is functioning properly and support from our help desk on the unit. The membership fees will be assessed per vehicle.

Accident Reports

LMS will provide accident reports for our clients. The information taken from the MAC box system will remain the property of LMS and users of that information will be required to purchase the information from us in the form of an "Accident Report". These reports will be available in both a hard copy format and an electronic format that will be accessible over a secure link to the Internet. The reports will be generated by LMS and moved from our internal repository to a customer repository that is managed using a sophisticated image and data management system. A security system will be used that ensures compliance with local, state and federal law related to defendant and plaintiff access to information. Billing for the reports accessed via the Internet will be automatic and clients will receive a monthly statement for usage. While the electronic access vehicle will be the most efficient way for our clients to receive accident information, certain clients may require hard copy. For those clients, a printed version of the report, including video images will be available. The accident report will contain all information from our data repository including vehicle information, time and date detail on the accident, the entire image file containing approximately 300 images and the motion data. The images will be taken at 10 frames per second for 15 seconds before and after the accident and the motion data will be saved for the same period of time. The motion information will track changes in velocity on two axes for the vehicle.

Future Services:

Video Accident Recreations:

Using a combination of the video images, motion information and computer based animation tools, LMS will be able to produce a video recreation of the accident from multiple angles. These recreations will incorporate the live video images where appropriate and augment the live video with animation to recreate the entire incident.

Expert Witness Services:
LMS will develop a network of "Expert Witnesses" from the ranks of educational institutions and industry that will be available for testimony in accident related cases. This network will span the country using individuals with the appropriate professional credentials to assist in explaining the physical characteristics of the accident and their professional opinion on the dynamics of the incident. LMS will contract with our clients for these services and retain the network of expert witnesses on our staff, as consultants that are compensated on an as needed basis.

Accident Arbitration Services:

LMS will offer arbitration services that will allow the parties involved in an accident a means outside of the court system to resolve accident related claims. Drawing on the information collected at the time the accident occurred, we will employ professional arbitrators to mediate cases using information taken from our repository.

The Products

'Product' Overview

With our partners, LMS is developing the Mobile Accident Camera (MAC) Box. LMS will provide these systems, which *Capture and Secure* 'driver's eye view' images and telemetry data prior to, during and immediately after an actual accident; *Manage* this data, including chain of custody; and *Distribute* the data, through the use of emerging digital and communications technologies.

By taking a component approach toward the development of the MACbox, LMS leverages the individual expertise of industry leaders to build a 'best of breed' solution. Partnered with Instrumented Sensor Technologies Inc. and Phoenix Group Inc. LMS will develop and manufacture the lowest cost, most reliable system for recording storing and transmitting accident data.

Within the MACbox resides a digital video camera as well as circuitry and software to:

- 'Sense' when an accident has occurred
- Capture video and telemetry data prior to, during and immediately after an accident
- Store and lock accident image and telemetry data after an accident
- Upload accident image and telemetry data to wireless networks
- Download accident image and telemetry data to a portable computer

The MACbox is made up of five functional components:
1) ST Microelectronics' Digital Video Camera utilizing a real-time software video compression engine - licensed through Phoenix Group, Inc. (www.ivpgi.com)
2) VDO Kienzle's biaxial accelerometer and 'trigger' system - developed by Instrumented Sensor Technology, Inc. (www.isthq.com)
3) Transceiver (vendors under evaluation)
4) CPU including system and flash memory as well as related interface circuitry for the other system components. The x86 CPU operating system is Windows CE. - System developed by Phoenix Group, Inc.
5) Power Supply and Battery Backup - developed by Phoenix Group, Inc.

Phoenix Group will provide the integration of all of the components with the digital video camera subsystem, CPU and power supply. PGI will be responsible for final assembly and testing.

Functional Overview

The MACbox continuously records: a) Video data in a software 'video loop' from the driver's point of view and b) Acceleration in two axis at a sampling rate of 2000 times per second. When an accident occurs, the VDO subsystem 'senses' that accident signature parameters have been matched or exceeded. This event 'triggers' the CPU to permanently store a video sequence which encompasses a definable period of time before and after the accident. The MACbox then transmits the video and accelerometer data that was acquired during and after the accident through the Motorola cellular transceiver. The MACbox then encrypts and 'locks' this data to prevent tampering.The result is a group of images and associated data transmitted by the MACbox, immediately after the accident has occurred, to a secure server.

The system allows a crash investigator, or other authorized party to see the crash develop before and after the impact from the driver's perspective. Accelerometer and video data are time-stamped to allow a complete re-creation of the crash. This data set will facilitate an accurate reconstruction of the crash.

The use of a personal computer based system will allow us to enhance the systems to include multiple cameras, driver monitoring and the other related features.

System Programmability

The system software embedded within the MACbox is programmable and can be tailored to the particular vehicle or application. System parameters including system thresholds and the number of images taken prior to, and immediately after, an accident can be altered to meet the requirements of a particular application.

***For** instance, if the default setting allows for the capture of images for **30** seconds prior to an accident and for an additional **30** seconds after the accident **but** then it is determined that it is advantageous to have more images before **the** accident than after, the system can **be** re-programmed to store **48** seconds worth of images prior to the accident and only **12 seconds** after.*

Engineering Requirements & Strategic Alliances

Phoenix Group, Inc.
(Contact: Richard Pandolfi, CEO @ 516-951-2700)

PGI, formed in 1994, is comprised of a cadre of highly skilled engineering and management personnel who have worked together for more than twenty years. Lead by Dick Pandolfi, this team built Miltope Corp. from a 1975 start-up into a 100 million dollar a year company. Under the auspices of Mr. Pandolfi, PGI is dedicated to the design and development of rugged, truly portable miniature computer systems.

The comprehensive PGI product line has been designed for demanding industrial and military field applications, where performance under harsh environmental conditions is essential. PGI products are ideally suited for vehicle, aircraft, shipboard and outdoor field applications.

PGI will design and manufacture a custom variation of one of their standard products to meet LMS's specifically defined criteria. PGI has years of experience integrating systems for end user application for their traditional customer base including OEMs (Original Equipment Manufacturers), VARs (Value Added Resellers) and Systems Integrators.

PGI's customers include Fortune 500 Companies, the U.S. Department of Defense as well as Foreign Ministries of Defense. PGI's Design capability coupled with its in-house automation offers LMS a source of quick prototyping and unique customizing skills. PGI's in-house integrated facility includes AutoCad supported by CAM, allowing quick and efficient conversion from design to final product. A modern, automated NC sheet metal and machining capability is combined with in-house mold making and injection molding capability. This will allow us to use the most cost effective and superior space age high strength carbon filled materials, pliable rubber and plastics in all LMS designs.

VDO Kienzle North America LLC
(Contact: Tony Reynolds, Product Manager @ 540-723-8015)

VDO North America is an industry leading high-technology instrumentation company focused on developing innovative products for vehicular transportation field measurement and data recording. The company specializes in development of physically compact, high performance digital data acquisition and recording systems for high-speed mechanical measurements.

VDO North America's mission is to provide high quality, high reliability data recording products and software at reasonable cost, and supported with high-level customer and applications support and service. The company's products are used widely in such applications as crash recording, transportation measurement and recording, automotive shock and vibration testing, vibration measurement, accident re-construction, and many others crash related measurements.

VDO North America offers a unique source of expertise and industry experience. They will design and manufacture a custom variation of one of their standard products to meet LMS's specifically defined criteria.

ST hficroelectronics (Vision, Inc.)
(Contact: Paul Gallagher @ 408-556-1553)

ST Microelectronics (Vision) is a company developing video systems for both retail and commercial markets. They have developed what we consider the most appropriate real-time video compression and resolution systems and related applications for Loss Management Services products.

Science Applications International Corporation (SAIC)
(Contact: Julius Nagy, Business Development Mgr. Automotive Technologies @ 248-263-3408)

SAIC is a leading telecommunications company that have agreed to supply their technological support for LMS, and assist in the up link of wireless image data transmission along with other existing telemetry data critical in the repository effort and service of LMS.

Forensic Accident Investigations, Inc.
(Contact: Robert C. McElroy, Ph.D. @ 561-995-6781)
FAI is a nationally renowned group of investigation experts that provide for accurate reconstruction of automobile and other ground transportation type crashes. FAI will provide LMS for expert reconstruction when warranted.

By leveraging the individual strengths of each partner, LMS will be able to offer its customers best-of-breed solutions at a competitive price. And the fact that each of these partners is a technology leader in their respective areas makes their support of the start-up company that much more significant.

Engineering

All existing system components were originally developed for the mobile computing/data recording market. For this reason, the completion of a prototype and ensuing production is less of a development process than a re-engineering and integration of components used in the Proof of Concept. The component suppliers are leading development, engineering and manufacturing firms in their particular markets. The greatest challenge is the re-engineering - for cost reduction and ease of integration - of LMS partner components and the development of the proper triggering thresholds.

Proof of Concept (began July 15, 1998; ended April 23, 1999)
Sept. 15, 1998 - Vision installs XX on PGI Nightingale
PGI interfaces VDO box

Oct. 1, 1998 - PGI interfaces Vision software and VDO UDS box
Dec. 7, 1998 - VDO tunes integrated system
April 24, 1999 - Product Demo Completed

Prototype Stage (began December 30, 1998; end April 30, 1999)

1) Requirement Analysis (began September 30, 1998; end October 30, 1998)
   - b) Determine System Specifications
     - i) Enclosure: ruggedized/environment/construction/X and Y-axis orientation/mounting
     - ii) Camera (shock dampening, windshield mount, operational light level, resolution)
     - iii) Cabling (connection specifications)
     - iv) Upgradeability
     - v) Extensibility
     - vi) Real-time Operating System Requirements
       - Startup requirements
       - Shutdown requirements
       - Diagnostics - remote monitoring, fault detection/prediction
     - vii) XY Sensitivity
       - trigger threshold waveform development
     - viii) Video Memory:
       - Resolution and 'frame-rate'
       - X Seconds before
       - Y Seconds after
     - ix) Power supply requirements
       - Main Power
       - Battery Backup
2) Prototype development and testing (begin development March 15, 1999 - April 30, 1999)
   - a) Re-engineering of system components
   - b) Re-engineered system component integration

Beta Test Stage May 15, 1999 – August 30, 1999

600 Units placed in various vehicle types for data collection and testing. Buses, Trucks and Private Passenger Vehicles.
   - a) Re-engineering of system components
   - b) Re-engineered system component integration

First Revenue Ship November 1, 1999

By working closely with the transportation industry, insurance companies and our technology partners, we will establish a rich repository of information that will be used to help mediate insurance claims, insurance fraud, assign responsibility, advance vehicle safety and reduce the total economic loss that results from motor vehicle crashes. The System will finally answer the most vexing mystery: What happened? And, whose fault was it?

THE CONTRIBUTION OF ONBOARD RECORDING SYSTEMS TO ROAD SAFETY AND ACCIDENT ANALYSIS

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INTRODUCTION

This paper presents onboard computer systems (black boxes), that

1. contribute to road safety by helping to reduce the number of accidents
3. provide data for accident analysis based on field experiences in USA and Europe with case studies.

There are several versions of onboard computers that record the performance of drivers and vehicles. Field experiences and case studies show that a 'feed back' of these records lead to a favourable modification of drivers' behaviour. Further these objective and accurate recordings allow detailed reconstruction and analysis of accidents.

FREQUENCY. COST AND CAUSE OF ACCIDENTS

In the EU a total of 1.3 million road accidents with personal injury and 45.000 people killed were registered in 1995. The damage caused by these accidents has been estimated to reach as much as 45 billion ECU (about the same in US$).

It is worth noting that - in Germany for instance - 90% of the registered accidents are caused by human error. only !0% by technical defects. These figures show that urgent action is required mainly in the field of driving behaviour.

EXPERIENCES GAINED WITH ONBOARD COMPUTERS FOR ACCIDENT RECONSTRUCTION AND ACCIDENT ANALYSIS

Extensive experiences have been gained concerning the accident-preventing effect of onboard computers and their contribution to improved accident analysis. Let us mention the extraordinarily high contribution of the tachogaph to improve road safety in the commercial vehicle sector in the European Union. which led many other counties to also stipulate tachographs for the commercial transport of goods and passengers.

This paper describes the effect of two further onboard computers or black boxes. The first system is an onboard computer used in the first place to improve fleet management by recording such data as driving time, road speed. distance travelled, engine load etc. The second system is an Accident Data Recorder that has been developed to meet the specific requirements of accident analysis.

CASE STUDY FOR ACCIDENT PREVENTION BY A FLEET MANAGEMENT ONBOARD COMPUTER

Laidlaw Inc.. the largest contractor operator of school bus fleets in the United States fitted 50% of its Bridgeport fleet with onboard computers supplied by **VDO** North America. Based on **a 6** months test two bus groups (with and without onboard computer) were analysed with the following results:

Reduction of Accidents

Busses without VDO onboard computers accounted for 72% of accidents.

Bridgeport fleet would have suffered 62 accidents without the VDO onboard computers. The actual account was 43. Thus 19 accidents were prevented by the educative effect of the onboard computer.

Accident Data and Analysis Produce Legal Evidence

Data extracted from vehicles involved in accidents allow detailed reconstruction and analysis. Conflicting reports from eye-witnesses. drivers, and passengers can be reconciled. The hard facts facilitate investigations considerably. Providing indisposed data on accidents **can largely reduce the amount** of management and administrative time required for review etc.

Fleet Management Control Restored

The management is supplied with objective, accurate. minute-by-minute recordings of all drivers in monitored busses. Drivers with registered short- **comings** can be counselled. These corrective interviews are the tool in the 'feedback loop' to the required modifications of drivers' behaviour and to restore fleet management control.

Reduction of Liability and Maintenance Costs

By avoiding 19 accidents in the case study it could be estimated that 76.000 USS in body work expense was saved.

Case study: Laidlaw Inc.. Bridgeport. CT facility

1. Reduction of accidents
2. Accident data and analysis produce legal evidence
3. Fleet management control restored
4. Reduction of liability and maintenance costs

Figure 1: Accident prevention by a fleet management onboard computer

These results show that the investment is paid back twice. Firstly by reducing accidents with the involved human and social implications and costs and secondly, by the improvement **of** the fleet management.

THE ACCIDENT DATA RECORDER

The Accident Data Recorder was specifically developed for accident analysis but has also proven its accident preventive character in more than four years of field experience.

Technical Features of the Accident Data Recorder

Before discussing these two aspects, accident prevention and accident analysis, it will be useful tc briefly explain the functions of the black box called Accident Data Recorder. This device will remind you of a flight recorder for use in passenger cars. trucks and busses.

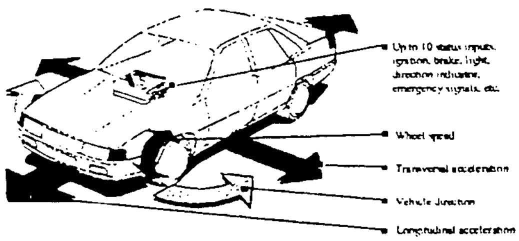


Figure **2: UDS system functions, sensors and status inputs**

The Accident Data Recorder is mainly composed of sensors measuring the transversal and longitudinal acceleration of the vehicle as well as its change of direction and road speed. The Accident Data Recorder discerns when and how long ignition. lamps. indicators and brakes have been activated. In case of an accident, this data is recorded with high precision 30 seconds before and 15 seconds after the accident. The Accident Data Recorder automatically detects the accident.

Up to three accidents can be stored in the Accident Data Recorder. Critical traffic situations can also be manually stored.

The Accident Data Recorder can easily be installed into any vehicle. There is no need for additional sensors

Accident Analysis **and Accident Prevention**

After this technical digression, it can be explained how the Accident Data Recorder contributes to optimising accident analyses and why it has an accident-preventing effect.

For **the accident analysis** expert, the Accident Data Recorder is an instrument, which provides objective accident data not available before. The analysis in view of accident reconstruction is made by a dedicated software package (see figure 3).

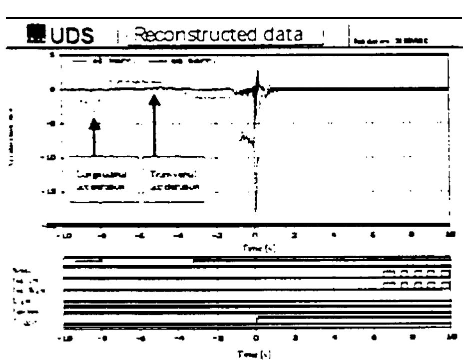


Figure **3: Accident Reconstruction**

If an accident occurs, the Accident Data Recorder stores up to 500 times per second the relevant information such as longitudinal and transversal acceleration. With this accurate information it is possible to analyse at the computer even the slightest details of the critical fraction of a second (see Annex for an accident analysis case).

A study conducted by bast (Bundesanstalt fin Strassenwesen = German Federal Road Agency) confirms the contribution of the Accident Data Recorder to improve accident analysis:

The bast study of June 1997 is based on information gathered from 42 real accidents in which vehicles fitted with the Accident Data Recorder were involved This shows that the Accident Data Recorder increases the degree of certainty to as much as 100% compared to traditional sources of information both in the pre-crash phase and in all other phases of the accident in respect of individual characteristics which, normally, cannot be fully ascertained without the Accident Data Recorder. These include driver reaction. road speed characteristics over a period of the last 30 seconds preceding the crash or the sequence in case of mass rear-end collisions. Information on vehicle deceleration and vehicle speed where no marks can be found on the road as well as the accurate chronological correlation of the actuation of vehicle controls can be safely established.

With **regard to accident prevention** experience gained with the Accident Data Recorder during the last four years became evident that it considerably influences the driving behaviour and thus contributes to accident prevention.

In a number of vehicle fleets the accident rate and damages incurred could be reduced by up to 30%. How can this achievement be explained? It is the knowledge about the fact that the driving behaviour can be checked objectively at any time which makes the driver to behave more attentively in critical accident-bound situations.

More careful driving will also cause less wear of material. The Accident Data Recorder can thus directly improve the running costs of a fleet company.

Out of the numerous series of preventive experience a few examples are shown below:

Police of Berlin

Fitting all 62 patrol cars of a Berlin police head office in 1996 reduced the number of accidents due to the driver's own fault by 20% and by 36% in emergency-trips. The cost involved could be reduced by approx. 25%

These positive results induced the Berlin police authority to equip all their patrol cars - these are more than 400 vehicles - with the Accident Data Recorder.

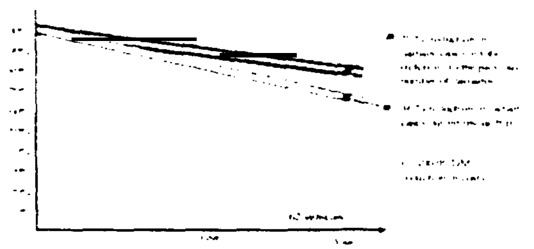


Figure 4: **Example - Police of Berlin**

WKD Pinkerton Security GmbH

In this company for property protection all passenger cars (approx. 100) that are used with a changing crew are fitted with Accident Data Recorders. This led the drivers to drive more carefully, adapting their driving behaviour to the individual traffic situation. with the result that the number of accidents decreased by 30%. minor damages even by 60% This in turn led to considerable savings of insurance premiums.

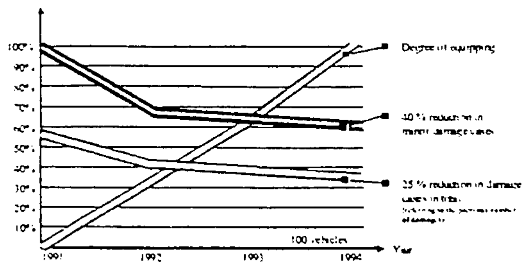


Figure 5: Example **- WKD Pinkerton Security, Bisingen. Germany**

WBO (Association of Baden-Württemberg Bus Operators)

In the pilot run promoted by the Baden-Württemberg Ministry of Transport with the Accident Data Recorder installed in busses run by WBO 123 Accident Data Recorders were involved. With the busses fitted with an Accident Data Recorder the number of accidents decreased between 15 and 20% compared with the reference period, depending of the company concerned.

Samovar

In Great-Britain, the Netherlands and Belgium nine vehicle fleets with a total of 341 vehicles fitted with data recording equipment participated in the research program SAMOVAR (Safety Assessment Monitoring on Vehicles with Automatic Recording) conducted by the European Union in the framework of the Drive Project V 2007.

Together with a control panel involved in similar tests a total of 850 vehicles participated in the program. The data were collected over a period of 12 months. The result shows that the accident rate decreased by 28.1% by the use of the vehicle data recorder.

The Samovar Report finally concluded that the intelligent use of a vehicle data recorder is able to make a considerable. distinctive, and independent benefit to road traffic safety.

CONCLUSION AND REQUESTS TO THE TRAFFIC POLICY

Onboard computers and specially the Accident Data Recorder have been designed as a contribution to road safety and legal security. The experiences at hand show that the systems can come up with the expectations placed in them. In view of the accident rates on our roads and the resulting human and economic damage we should make traffic policy aware of the opportunities of improving traffic safety conditions by means of vehicle data recording devices. It is also a question. which we have to find an answer for. whether we can accept a considerable lack ofjustice for traffic victims if modem technology offers relief.

ANNEX

Example of a Real Accident Analysis
Intersection Accident

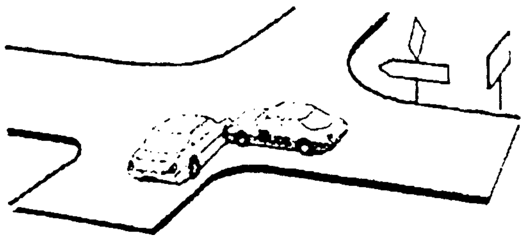


Figure 1: The accident situation

The picture shows a rather clear situation because of the priority-regulation on this junction. But the driver coming from the left accused the driver with the Accident Data Recorder of

- having entered the crossing at a too high speed
- having set the direction indicator to the right and thus causing him to enter the junction
- having shown no reaction to avoid the accident.

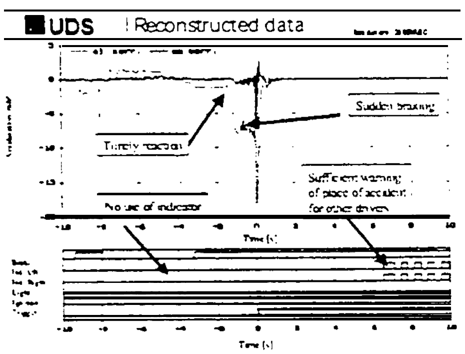


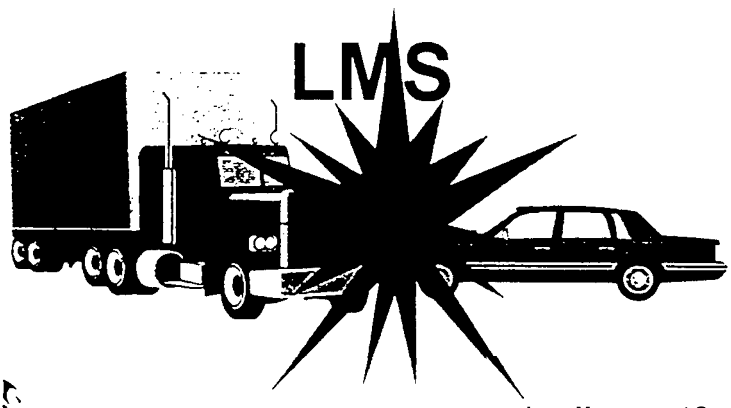
Figure 2: Reconstructed data

Figure 2 shows the raw data and proves at a glance that the driver coming from the tight is not responsible for the accident. He reacted in time (braking) and didn't use the indicator.

As information for the accident analyst: At the point of the accident, the relevant data is stored with 500 Hertz, which means 500 times acceleration data and other information per second. This is very helpful in cases of more complicated accident situations.

The Future is Now...

LOSS MANAGEMENT SERVICES, INC.



Loss Management Services, Inc.
36 Surf Road, Lindenhurst, New York 11757

Introduction

- For more than three years, LMS has been involved in field investigation, adjusting and managing transportation insurance claims.
- LMS is dedicated to developing cost effective ways to service the insurance claims industry's investigation and litigation procedures through 21st century technology.
- By combining high-tech sensors and digital imaging, LMS could solve the most vexing questions today involving automobile accidents....

What Happened?

Who is at fault?

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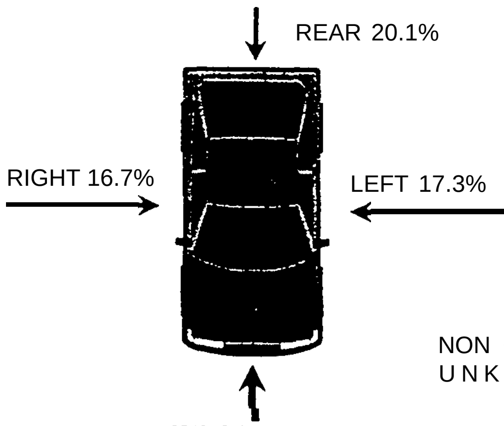
Accident Statistics

Collision point of contact percentages



Loss Management Services, Inc.

36 Surf Road, Lindenhurst, New York 11757

Solution

The Mobile Accident Camera, "MACbox™" will:.

- **Secure a "driver's eye view" of *valuable* digital imagery.**
- **Provide a repository of information, including in-cabin acceleration data, for customers, insurance carriers, government agencies, and auto manufactures.**
- **Provide telemetry data.**
- **Better control and manage claim expenses and pay outs.**

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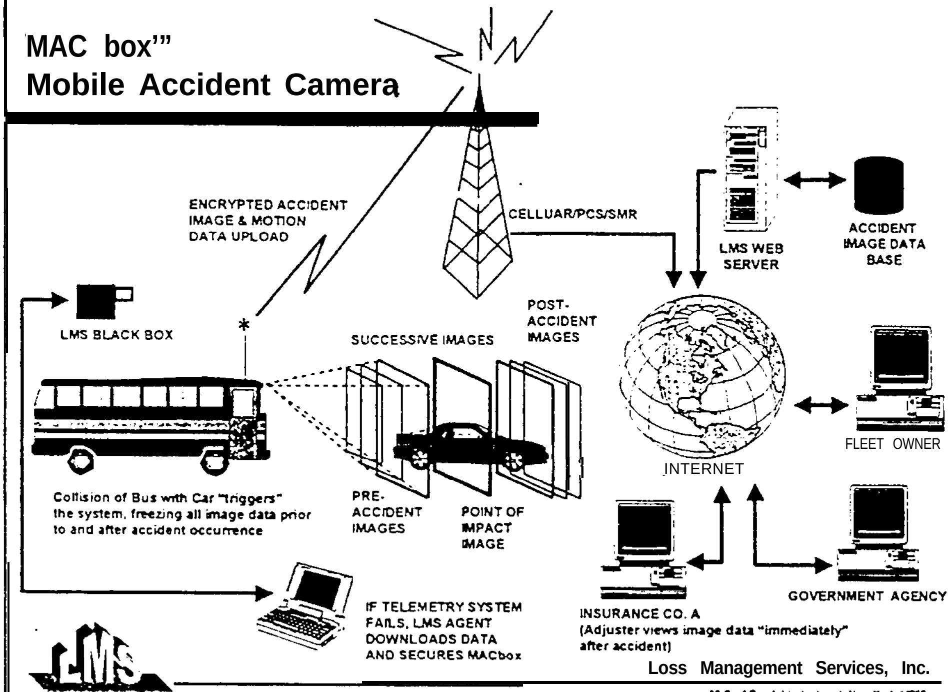
'MAC box'"
Mobile Accident Camera



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Benefits

- Accurate Assessment of Liability
- Reduce the Cost of Litigation
- Reduce the Need for Expert Witnesses
- Reduce Costs Associated with Claims Investigations
- Assist with Accurate Claim Reserving
- Deter "ROAD RAGE"
- "G-Force" Comparison to the Extent of the Injury
- Acceleration data used improve cabin safety

Loss Management Services, Inc.
36 Surf Road, Lindenhurst, New York 11757

Applications

- Municipal Transportation Environment (Buses - Emergency Vehicles)
- Long Haul / Short Haul Trucking
- Taxi / Livery Services
- Commercial Passenger Transportation Fleets

LMS
Loss Management Services, Inc.
38 Surf Road, Lindenhurst, New York 11757

DRAFT

EDR Data Variable Selection - Proposed New & Expanded Codes

- CUSTOMERS - new
- Outline the community of data users/ customers (expand descriptions):
  - * **PreCrash**: Crash avoidance, Defects, Driver actions (speeding)
    Users: Police (enforcement), Litigation, Cause research
  - * **Injury:** Crashworthiness, Injury risk, Crash severity, Occupant protection
    Users: Crash statistics, Biomechanics research., Litigation
    Restraint system performance and effectiveness evaluation
  - * **Sensor:** Crash pulse shape
    Users: Air bag crash sensing system algorithm design
  - * **PostCrash**: Crash notification; Users: EMS
- Put (four) CUSTOMER columns in front of each suggested **data** element.

PRIORITY - expand
- Add two (2) extreme/ limit categories:
  KEY (critical, must have) and
  0 (Not needed)
- Have each user community place their PRIORITY 'number' in their respective CUSTOMER columns for each data element:

  4- KEY, **3**- HIGH, **2**- MED, **1**- LOW, **0**- ZERO (none)

- PRACTICABLE - new column (as recommended **2/17/99)**
- Is in-vehicle data available? How practical? Major technical or cost issues?
- Possible categories:
  H - High (data already in EDR module, or is available on data bus)
  M - Med (sensors in vehicle but not available on common data bus.)
  L - Low (data / sensors not in current vehicles; low feasibility)
  0 - No feasible way currently known to implement

WHEN POSSIBLE - expand
- Add two (2) **extreme/** limit categories:
  X (already **eXists** in some new vehicles today) and
  0 (technology not expected in foreseeable future)
- Entries should be restricted to manufacturers and technology suppliers. (NO entry is needed from others, as first 5 columns reflect their interests.)

DATA ELEMENTS - expand
- Add more detail/ refinement, e.g.,:
  Number of Occupants ⇒ FR, FC, FL, or Back Seat Occupied?
  [others??]
- Permit new data elements to be added to list ONLY IF of 'Key' or 'High' priority to at least one user/customer group.

- PURPOSE
Compile all comments provided in one enlarged box.

DRAFT

First NHTSA Version

EDR DATA ELEMENT SELECTION FORM			
PRIORITY	**DATA ELEMENT**	**WHEN POSSIBLE**	**PURPOSE**
	Air bag inflation time		
	Air bag on/off switch position		
	Battery Voltage		
	Brake status - ABS		

Proposed Revision

DRAFT

CUSTOMER Priority (4,3,2,1,0)				EDR DATA ELEMENT SELECTION FORM			
Pre Crash	**Injury**	**Sensor**	**Post Crash**	**DATA ELEMENT**	**PRACTICAL** H, M, L	**WHEN POSS.** X,3,2,1,0	**PURPOSE**
0				Air bag inflation time			
				Air bag on/off switch position			
				Battery Voltage			
				Brake status - ABS			

PRIORITY : 4-Key, 3, 2, 1, 0-Not needed [Underlined codes are new proposals]
PRACTICABILITY: H-Hish, M-Medium, L-Low, 0-Not feasible
WHEN POSSIBLE: X-Exists, 3, 2, 1, 0-Technonolosy not expected in foreseeable future

EDR WORKING GROUP MEMO

TO: John Hinch

FROM: Tom Kowalick

DATE: June 9, 1999

RE: Proposal to classify EDR's as Type I & Type II

The following classification of event data recorder's suggestion was circulated to John Camey, Jeya Padmanaban, and Greg Shaw. The rationale for the suggestion was to model the method utilized by the railroad event data recorder working group to defining and classifying numerous data elements. Classification of EDR's is a simple solution to a complex problem.

Feedback from Jeya Padmanaban cited strong emphasis on providing weight and size of occupants, crash behavior of occupants in regards to in-position vs. out-of-position and sensing triggering indicators for rollovers.

Feedback from Greg Shaw cited that it made sense to start with a more modest device first and that it was hard to agree on a limited set of parameters. Greg would like to see peak acceleration in x, y, z and the time they occur after initiation of impact added to the type 1 unit.

Verbal feedback from John Camey indicated understanding of the need to define parameters (data elements) and possible classification of EDR types. John indicated that he would review and respond

CLASSIFICATION OF EVENT DATA RECORDERS (EDR'S)

Event Data Recorder (EDR).

An on-board **device capable** of monitoring, **recording,** and displaying pro-crash, crash, and post-crash data ● iomont **parameters** from a **vehicle,** ● vent **& driver.**

Use of EDR parameter data elements

The overall objective of utilizing EDR data is to **increase the safety** of our highway transportation **system. Recorded** data **provides** a more **accurate** ● ssoumont of ● vents loading up to an **accident** (pro-crash), **real time** (crash) and ● naiymis (postcrash).

Classification of Event Data Recorders (EDR's)

- **TYPE I**
- **TYPE II**

Establishins minimum parameter data elements

- **TYPE I = 6**
- **TYPE II = 6 +**

TYPE I parameter data elements

⇒ TIME
⇒ LOCATION
⇒ DIRECTION
⇒ VELOCITY
⇒ OCCUPANTS
⇒ SEAT BELT USAGE

TYPE ii parameter data ● iomonts

⇒ Ail TYPE I + OTHERS

□ Active suspension measurements □ advanced systems □ air bag inflation time □ air bag status □ air bag on/off switch position □ automatic collision notification □ battery voltage □ belt status each passenger □ brake status-service □ brake status-ABS □ collision avoidance, braking, steering, etc. □ crash pulse-longitudinal □ crash pulse-lateral □ CSS presence indicator □ Delta-V-longitudinal □ Delta-V-lateral □ electronic compass heading □ engine throttle status □ engine RPM □ environment-ice □ environment-wet □ environment-temp □ environment-lumination □ fuel level □ lamp status □ location-GPS □ number of occupants □ principal direction of force □ PRNDL position □ roll angle □ seat position □ stability control □ steering wheel angle □ steering wheel tilt position □ steering wheel rate □ time/date □ traction control □ traction coefficient □ transmission selection □ turn signal operation □ vehicle mileage □ vehicle speed □ VIN □ wheel speeds □ windshield wiper status □ yaw rate □ cruise control □ phone status □ brake pressure □ auto distance control □ suppression system status □ electric steering functional □ service engine soon lamp on □ throttle-by-wire □ ignition cycle counter □ tire pressure warning lamp on □ environment-temp inside □ 2 Vs 4 wheel drive

DATA FORM			
PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
Low	Active suspension measurements		
Low	Advanced systems		
High	Air bag inflation time (time from start of crash to start of air bag inflation)		
?	Air bag status		
High	Air Bag on/off switch position		
med	Automatic collision notification		
med	Battery Voltage		
High	Belt status - each passenger		
med	Brake status - service		
med	Brake status - ABS		
med	Collision avoidance, braking, steering, etc		
High	Crash pulse - longitudinal		
High	Crash pulse - lateral		
med	CSS presence indicator		
High	Delta-V - longitudinal		
High	Delta-V - lateral		
med	Electronic compass heading		
med.	Engine throttle status		
med	Engine RPM		
med	Environment - ice		

DATA FORM			
PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
med	Environment - wet		
med	Environment - temp		
med	Environment - lumination		
med	Environment - other		
low	Fuel level		
low	Lamp status		
med	Location - GPS data		
med	Number of occupants		
med	Principal Direction of Force		
med	PRNDL position		
med	Roll angle		

EDR Data Elements-REVISED

Sorted on Top Ten from Feb. 99

	PRIORITY	DC North America Plan	Top Ten from 2/17/99	DATA ELEMENT	Event Timing	WHEN POSSIBLE	PURPOSE
Line Item	High, Medium Low, TBD		Sort on	Description	P = Pre-crash Status-5 seconds before crash, C = During Crash-100ms	Near Term-6 months, Short Term-4* (GM) years, Long term -more than 4 years	1) Accident Reconstruction (incl. Litigation) & Improvement of Occupant Safety in Restraint & Vehicle Systems 2) Roadway Design Improvement Potential, 3) Improve Emergency Response
1		DC	1	Crash pulse - longitudinal	C	Long term	1
2		DC	1	Crash pulse - lateral	C	Long term	1
3		DC	1	*Lateral Acceleration just prior to crash*	P	Long term	1
4		DC	1	Delta-V - lateral	C	Long term	1
5		DC	1	Delta-V - longitudinal	C	Long term	1
6			1	Principal Direction of Force	C		1
7			2	Location - GPS data	P		2, 3
8		DC	3	Belt status - each passenger	P	Short term-Driver & Front Pass.	1,3
9			4	Number of occupants	P		1,3
10		DC	5	Brake status - ABS	P	Short term	1
11		DC	5	**Brake Applied**	P	Short term	1
12		DC	5	Engine RPM	P	Short term	1
13		DC	5	Engine throttle status	P	Short term	1
14		DC	5	PRNDL position*	P	Short term	1
15		DC	5	*Throttle-by-wire*	P	Short term	1
16		DC	5	Transmission selection*	P	Short term	1
17		DC	5	Vehicle speed	P	Short term	1,2
18			5	Brake status - service	P		1
19			5	*Electric Steering Functional*	P		1
20		DC	6	Time/date	P	Short term	1,2,3
21			7	Roll angle	C	Long term	1,2
22			8	Yaw rate	P	Long term	1
23			9	Active suspension measurements	P	Long term	1
24			9	Stability control	P	Long term	1
25			9	Traction coefficient (estimated from ABS computer)	P	Long term	1,2
26			9	Traction Control	P	Long term	1
27		DC	10	Air bag status (including lamp)	C	Near term	1
28		DC	10	Air Bag on/off switch position	P	Short term	1

EDR Data Elements-REVISED

Sorted on Top Ten from Feb. 99

	PRIORITY	DC North America Plan	Top Ten from 2/17/99	DATA ELEMENT	Event Timing	WHEN POSSIBLE	PURPOSE
Line Item	High, Medium, Low, TBD		Sort on	Description	P = Pre-crash Status-5 seconds before crash, C = During Crash-100ms	Near Term-6 months, Short Term-4* (GM) years, Long term -more than 4 years	1) Accident Reconstruction (incl. Litigation) & Improvement of Occupant Safety in Restraint & Vehicle Systems 2) Roadway Design Improvement Potential, 3) Improve Emergency Response
29		DC	10	*Supression System Status (Occupant Sensing)*	P	Short term	1
30		DC	10	Air bag inflation time (time from start of crash to start of air bag inflation)	C	Short term	1
31			10	CSS (child seat?) presence indicator	P	Short term	1
32		DC		*Ignition cycle counter*		Near Term	1
33		DC		Vehicle mileage	P	Near Term	1
34		DC		VIN	P	Near Term	1
35		DC		Battery (System) Voltage	P	Short term	1
36		DC		*Cruise Control Active*		Short term	1
37		DC		*Door Ajar Switch on*		Short term	1
38		DC		*Door Lock State*		Short term	1
39		DC		*Service Engine Soon Lamp on*		Short term	1
40		DC		*Tire Pressure warning lamp on*		Short term	1
41		DC		Turn signal operation	P	Short term	1
42		DC		Windshield wiper status	P	Short term	1
43				*2 x 4 wheel drive*	P		1,2
44				Advanced systems	P/C		1,2,3
45				Automatic collision notification	Post Crash		1,3
46				Collision avoidance, braking, steering, etc	P		1
47				Electronic compass heading	P		1,2
48				Environment - ice	P		
49				Environment - lumination	P		1,2
50				Environment - other	P		1,2
51				Environment - temp	P		1,2
52				Environment - wet	P		1,2

EDR Data Elements-REVISED

Sorted on Top Ten from Feb. 99

	PRIORITY	DC North America Plan	Top Ten from 2/17/99	DATA ELEMENT	Event Timing	WHEN POSSIBLE	PURPOSE
Line Item	High, Medium Low, TBD		Sort on	Description	P = Pre-crash Status-5 seconds before crash, C = During Crash-100ms	Near Term-6 months, Short Term-4 (GM) years, Long term -more than 4 years	1) Accident Reconstruction (incl. Litigation) & Improvement of Occupant Safety in Restraint & Vehicle Systems 2) Roadway Design Improvement Potential, 3) Improve Emergency Response
53				*Environment-temp (inside)*			1,2
54				*Environment-temp (outside)*			1,2
55				Fuel level	P		1
56				Lamp status	P		1
57				Seat position	P		1
58				*Service Vehicle Soon Lamp on*			1
59				steering wheel angle	P		1
60				Steering wheel rate	P		1
61				Steering wheel tilt position	P		1
62				Wheel speeds	P		1

DATA FORM
FEDERAL HIGHWAY ADMINISTRATION Input

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE/COMMENTS
Low	Active suspension measurements	Long Term	
High	Advanced systems	Long Term	Priority dependent on what each advanced system is. If the advanced system is Advanced Collision Avoidance, should be high to determine if activated during crash.
Low	Air bag inflation time (time from start of crash to start of air bag inflation)	Long Term	
High	Air bag status	Short Term	Necessary to determine if this safety countermeasure deployed during crash. Should also be able to determine which air bag deployed (Driver, Passenger, Side).
High	Air Bag on/off switch position	Short Term	If no air bag deployment during crash, necessary to determine why.
High	Automatic collision notification	Long Term	Necessary to determine if this safety collision notification system was activated as a result of crash.
Medium	Battery Voltage	Mid Term	Necessary to determine when and if sensors and electronic logic are operational during a crash.
High	Belt status - each passenger	Short Term	Necessary to determine if this safety counter measure was used by each passenger. Therefore, must be related to a sensor to determine what seats contained occupants.

DATA FORM
FEDERAL HIGHWAY ADMINISTRATION Input

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE/COMMENTS
Medium	Brake status - service	Mid Term	Necessary to determine if the brakes were operational during a crash.
Medium	Brake status - ABS	Mid Term	Necessary to determine if ABS system was operational during a crash.
High	Collision avoidance, braking, steering, throttle opening, etc	Short Term	Necessary to determine driver behavior during a crash. This type of information is very important for future modeling of driver behavior and development of new or improved crash test procedures.
High	Crash pulse - longitudinal	Short Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
High	Crash pulse - lateral	Short Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
Low	CSS presence ndicator	Long Term	I assume that "CSS" stands for child seat sensor.
High	Delta-V - longitudinal	Short Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
High	Delta-V - lateral	Short Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
Low	Electronic compass heading	Long Term	

DATA FORM FEDERAL HIGHWAY ADMINISTRATION Input			
PRIORITY	**DATA ELEMENT**	**WHEN POSSIBLE**	**PURPOSE/COMMENTS**
High	Engine throttle status	Short Term	Necessary to determine driver behavior during a crash. This type of information is very important for future modeling of driver behavior and development of new or improved crash test procedures.
Low	Engine RPM	Long Term	
Medium	Environment - ice	Mid Term	I am not sure how environmental data can be determined from motor vehicle sensors. However, from a highway safety standpoint environment conditions during collision are very important.
Medium	Environment - wet	Mid Term	Same
Medium	Environment - temp	Mid Term	Same
Medium	Environment - lumination	Mid Term	Same
Medium	Environment - other	Mid Term	Same
Low	Fuel level	Long Term	
Low	Lamp status	Long Term	It is not clear if this refers to all lamps or to specific lamps such as the brake lamp or turn signal lamps.
High	Location - GPS data	Short Term (Immediately)	This is FHWA's number one priority data item. Location of individual motor vehicle crashes is very important information which can be used by FHWA and the States to determine specific roadway/roadside features or objects that may be causing or contributing to collisions.

DATA FORM
FEDERAL HIGHWAY ADMINISTRATION Input

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE/COMMENTS
High	Number and seating location of occupants	Short Term	Related to "Belt status - each passenger." These sensors are necessary to determine seat belt use or non-use by each motor vehicle occupant
Medium	Principal Direction of Force	Mid Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
Low	PRNDL position	Long Term	
Medium	Roll angle	Mid Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
Low	Seat position	Long Term	
Low	Stability control	Long Term	
High	Steering wheel angle	Short Term	Necessary to determine driver behavior during a crash. This type of information is very important for future modeling of driver behavior and development of new or improved crash test procedures.
Low	Steering wheel tilt position	Long Term	
Medium	Steering wheel rate	Mid Term	Necessary to determine driver behavior during a crash. This type of information is very important for future modeling of driver behavior and development of new or improved crash test procedures.

DATA FORM
FEDERAL HIGHWAY ADMINISTRATION Input

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE/COMMENTS
High	Time/date	Short Term	Time of day is necessary from a roadway safety design standpoint to determine relative magnitude of total daytime and night time motor vehicle crashes.
Low	Traction Control	Long Term	
Medium	Traction coefficient (estimated from ABS computer)	Mid Term	I am assuming that this gives the coefficient of friction between the tires and road surface. This type of information is important for modeling of individual motor vehicle crashes and for a determination of the relative skid resistance of the many different road surface materials.
Low	Transmission selection	Long Term	Does this differ from "PRNDL position"?
Medium	Turn signal operation	Mid Term	
Low	Vehicle milage	Long Term	
High	Vehicle speed	Short Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
High	VIN	Short Term	The specific model and type of motor vehicles involved in each crash is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
Low	Wheel speeds	Long Term	
Medium	Windshield wiper status	Mid Term	

DATA FORM

FEDERAL HIGHWAY ADMINISTRATION Input

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE/COMMENTS
Medium	Yaw rate	Mid Term	This type of information is very important for modeling of individual motor vehicle collisions and development of new or improved crash test procedures.
	R/O Sensing		We cannot even render a guess regarding what "R/O Sensing" refers too.
Medium	Suppression System Status	Mid Term	It is believed that this refers to automatic disabling of the air bag actuation electronics if a child is present in the seat. If no air bag was deployed during a crash and an occupant was sensed, this indication is necessary to determine why/ It is thought that NHTSA considers this data item an individual privacy data element.

LOSS MANAGEMENT SERVICES, INC.

DATA FORM

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
MED.	Active suspension measurements	NEAR TERM	VEHICLE STABILITY
HI	FIFO DIGITAL CAMERA Advanced systems	NEAR TERM	DRIVER'S EYE VIEW OF EVENT PRE/POST
—	Air bag inflation time (time from start of crash to start of air bag inflation)	—	INSURANCE/MEDICAL RESPONSE LIABILITY —
HI	Air bag status	SHORT TERM	PASSENGER SAFETY
MED.	Air Bag on/off switch position	NEAR TERM	MINORS/INFANT PASSENGER SAFETY
HI	Automatic collision notification	NEAR TERM	MEDICAL, INSURANCE LIABILITY
LOW	Battery Voltage	SHORT TERM	VEHICLE CHARGE MONITOR
HI	Belt status - each passenger	SHORT TERM	SAFETY, INSURANCE LIABILITY
HI	Brake status - service	SHORT TERM	VEHICLE SAFETY
HI	Brake status - ABS	SHORT TERM	VEHICLE SAFETY
HI	Collision avoidance, braking, steering, etc	SHORT TERM	PASSENGER SAFETY
HI	Crash pulse - longitudinal	NEAR TERM	VEHICLE "STIFFNESS" & INSURANCE/MEDICAL
HI	Crash pulse - lateral	NEAR TERM	VEHICLE "STIFFNESS" & INSURANCE/MEDICAL
—	CSS presence indicator	—	—
HI	Delta-V - longitudinal	NEAR TERM	VEHICLE STABILITY
HI	Delta-V - lateral	NEAR TERM	VEHICLE STABILITY
LOW	Electronic compass heading	NEAR TERM	DRIVER
—	Engine throttle status	—	—
MED.	Engine RPM	NEAR TERM	DETECT DRIVER'S APPROACHING SPEED/REG LIMIT
MED.	Environment - ice	NEAR TERM	ROAD SAFETY & INSURANCE LIABILITY

JM

DATA FORM

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
HI	Environment - wet	NEAR TERM	ROAD SAFETY & INSURANCE LIABILITY
LOW	Environment - temp	NEAR TERM	ROAD SAFETY & INSURANCE LIABILITY
MED.	Environment - lumination	NEAR TERM	ROAD SAFETY & INSURANCE LIABILITY
HI	VISUAL Environment - other	NEAR TERM	DRIVER RESPONSIBILITY & LIABILITY RD SAFETY
—	Fuel level	—	—
MED.	Lamp status	NEAR TERM	DRIVER SAFETY & INSURANCE LIABILITY
HI	Location - GPS data	NEAR TERM	MEDICAL ASSISTANCE & DRIVER SAFETY
HI	Number of occupants	NEAR TERM	MEDICAL ASSISTANCE & INSURANCE LIABILITY
HI	Principal Direction of Force	NEAR TERM	INSURANCE LIABILITY
—	PRNDL position	—	—
HI	Roll angle	NEAR TERM	VEHICLE STABILITY & ROAD SAFETY
MED.	Seat position	NEAR TERM	PASSENGER STATURE VS. AIR BAG IMPACT
MED.	Stability control	NEAR TERM	
—	Steering wheel angle	—	—
—	Steering wheel tilt position	—	—
—	Steering wheel rate	—	—
HI	Time/date	NEAR TERM	INSURANCE LIABILITY
—	Traction Control	—	—
—	Traction coefficient (estimated from ABS computer)	—	—
—	Transmission selection	—	—
MED.	Turn signal operation	NEAR TERM	INSURANCE LIABILITY
LOW	Vehicle milage	NEAR TERM	ROAD TRIP INDICATOR VS. DROWSYNESS
HI	Vehicle speed	NEAR TERM	PASSENGER SAFETY, ROADWAY SAFETY, INSURANCE LIABILITY

JH

DATA FORM

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
MED.	VIN	NEAR TERM	LAW ENFORCEMENT & INSURANCE POLICY
MED.	Wheel speeds	NEAR TERM	MECHANICAL DETECTION VERIFICATIO
HI	Windshield wiper status	NEAR TERM	DRIVER'S EYE VIEW & INSURANCE LIABILITY
HI	Yaw rate	NEAR TERM	VEHICLE STABILITY

JM

TC Collision Avoidance

DATA FORM

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
Low	Active suspension measurements	Long	
HIGH	Advanced systems	Short	Indicate safety features and type
HIGH	Air bag inflation time (time from start of crash to start of air bag inflation)	Short	
HIGH	Air bag status	Short	
HIGH	Air Bag on/off switch position	Short	
LOW	Automatic collision notification	Long	
Low	Battery Voltage	Long	
HIGH	Belt status - each passenger	Short	Police report is [illegible] for injured & not injured passengers.
HIGH	Brake status - service	Short	Was the driver braking? & for how long?
HIGH	Brake status - ABS	Short	same ↑ - did ABS engage?
HIGH	Collision avoidance, braking, steering, etc	Short	Better info on crash events
Low	Crash pulse - longitudinal	Long	
Low	Crash pulse - lateral	Long	
	CSS presence indicator?		
HIGH	Delta-V - longitudinal	SHORT	Better info on crash events
MED	Delta-V - lateral	Long	Spinning?
HIGH	Electronic compass heading	Short	Vehicle direction before crash - Crash reconstruction.
LOW	Engine throttle status	Long	

TC Collision Avoidance

DATA FORM			
PRIORITY	**DATAELEMENT**	**WHEN POSSIBLE**	**PURPOSE**
LOW	Engine RPM	LONG	
HIGH	Environment - ice	SHORT	Improved info on environment
HIGH	Environment - wet	SHORT	↓
HIGH	Environment - temp	SHORT	↓
HIGH	Environment - lumination	SHORT	↓
	Environment - other		
LOW	Fuel level	LONG	
High	Lamp status	SHORT	Headlight & Brake lamp status/ Visibility
Low	Location - GPS data	LONG	
Low	Number of occupants	LONG	Currently provided in Police report.
Med	Principal Direction of Force	LONG	Crash configuration
Low	PRNDL position	LONG	
	Roll angle ?		
MED	Seat position	LONG	
HIGH	Stability control	SHORT	Cause of crash
LOW	Steering wheel angle	LONG	
Low	Steering wheel tilt position	LONG	
HIGH	Steering wheel rate	SHORT	Evasive manoeuvres?
HIGH	Time/date	SHORT	Correlate crash recorder & [illegible] vehicle [illegible]
HIGH	Traction Control	SHORT	status ?
HIGH	Traction coefficient (estimated from ABS computer)	SHORT	Cause of crash
LOW	Transmission selection	LONG	

TC Collision Avoidance

DATA FORM

PRIORITY	DATAELEMENT	WHEN POSSIBLE	PURPOSE
MED	Turn signal operation	LONG	CRASH INVESTIGATION
LOW	Vehicle milage	LONG	
HIGH	Vehicle speed	SHORT	Cause of crash
HIGH	VIN	SHORT	LINK to VEHICLE DATA
LOW	Wheel speeds	LONG	Cause of crash
LOW	Windshield wiper status	LONG	
HIGH	Yaw rate	SHORT	Cause of crash / Events in CRASH

TC Collision Investigation

DATA FORM

PRIORITY	DATA ELEMENT	WHEN ~~POSSIBLE~~ Needed	PURPOSE
Low	Active suspension measurements	Long	Evaluation of causal factors
Med	Advanced systems	Short	Evaluation of ACRS deployments
High	Air bag inflation time (time from start of crash to start of air bag inflation)	Near	Evaluation of ACRS deployments
High	Air bag status	Near	Evaluation of ACRS (non-)deployments
High	Air Bag on/off switch position	Near	Evaluation of ACRS (non-)deployments
—	Automatic collision notification	—	No requirement
—	Battery Voltage	—	No requirement
High	Belt status - each passenger	Near	Belt use determination
Med	Brake status - service	Short	Evaluation of causal factors
Med	Brake status - ABS.	Short	Evaluation of causal factors
High	Collision avoidance, braking, steering, etc	Near	Evaluation of causal factors
High	Crash pulse - longitudinal	Short	Crash severity
High	Crash pulse - lateral	Short	Crash severity
Med	CSS presence indicator	Short	Evaluation of advanced ACRS
High	Delta-V - longitudinal	Near	Crash severity / PDOF
High	Delta-V - lateral	Near	Crash severity / PDOF
Med	Electronic compass heading	Short	Collision configuration
High*	Engine throttle status	Near	Evaluation of causal factors

* Engine RPM acceptable alternative

TC Collision Investigation

DATA FORM			
PRIORITY	**DATA ELEMENT**	**WHEN ~~POSSIBLE~~** Needed	**PURPOSE**
High	Engine **RPM**	Near	Or engine throttle position
Low	Environment - ice	Long	Reasonable information generally available from police reported data
Low	Environment - wet	Long	
Low	Environment - temp	Long	
Low	Environment - lurnination	Long	
—	Environment - other	—	
—	Fuel level	—	Not required
Low	Lamp status	Long	Evaluation of causal factors
Low	Location - GPS data	Long	POI
Low	Number of occupants	Long	Generally available (police)
—	Principal Direction of Force	—	Determine from Delta-V
Low	PRNDL position	Long	Speed via RPM
—	Roll angle	—	No requirement
Med	Seat position	Short	Evaluation of advanced ACRS
Low	Stability control	Long	Evaluation of causal factors
High	Steering wheel angle	Near	Evaluation of causal factors
—	Steering wheel tilt position	—	No requirement
Med	Steering wheel rate	Short	Evaluation of causal factors
—	Time/date	—	No requirement
Low	Traction Control	Long	Evaluation of causal factors
High	Traction co efficient (estimated **from ABS** computer)	Near	Crash severity (reconstruction)
High	Transmission selection	Near	With RPM

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TC Collision Investigation

DATA FORM			
PRIORITY	DATA ELEMENT	WHEN ~~POSSIBLE~~ Needed	PURPOSE
—	Turn signal operation	—	No requirement
—	Vehicle milage	—	No requirement
High	Vehicle speed	Near	Collision severity v(t)
—	VIN	—	No requirement
Med	Wheel speeds	Short	Collision severity/reconstruction
—	Windshield wiper status	—	No requirement
High	Yaw rate	Short	Collision configuration/ reconstruction

TC Ergonomics.
All "Hi" relevant to crash avoidance issues.

DATA FORM

PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
	Active suspension measurements		
	Advanced systems		
	Air bag inflation time (time from start of crash to start of air bag inflation)		
	Air bag status		
	Air Bag on/off switch position		
	Automatic collision notification		
	Battery Voltage		
	Belt status - each passenger		
	Brake status - service		
	Brake status - ABS		
Hi	Collision avoidance, braking, steering, etc		
	Crash pulse - longitudinal		
	Crash pulse - lateral		
	CSS presence indicator		
	Delta-V - longitudinal		
	Delta-V - lateral		
	Electronic compass heading		
Hi	Engine throttle status		

TC Ergonomics

DATA FORM			
PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
H1	Engine RPM		
H1	Environment - ice		
H1	Environment - wet		
H1	Environment - temp		
H1	Environment - lumination		
	Environment - other.		
	Fuel level		
H1	Lamp status		
	Location - GPS data		
H1	Number of occupants		
	Principal Direction of Force		
	PRNDL position		
	Roll angle		
	Seat position		
H1	Stability control		
H1	Steering wheel angle		
	Steering wheel tilt position		
H1	Steering wheel rate		
H1	Time/date		
	Traction Control		
	Traction coefficient (estimated from ABS computer)		
	Transmission selection		

TC Ergonomics

DATA FORM			
PRIORITY	DATA ELEMENT	WHEN POSSIBLE	PURPOSE
H1	Turn signal operation		
H1	Vehicle milage		
H1	Vehicle speed		
H1	VIN		
H1	Wheel speeds		
	Windshield wiper status		
	Yaw rate		
H1	cell phone use		
H1	navig system interaction		
H1	voice interaction	(Auto-pc)	
H1	ACC use		