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

Gerhard Lehmann
Mannesmann VDO AG
Germany
Alan Cheale
VDO North America LLC
United States
Paper Number 98-S2-O-34

ABSTRACT

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

1. contribute to road safety by helping to reduce the number of accidents
2. 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 10% 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 tachograph to improve road safety in the commercial vehicle sector in the European Union, which led many other countries 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 US$ 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
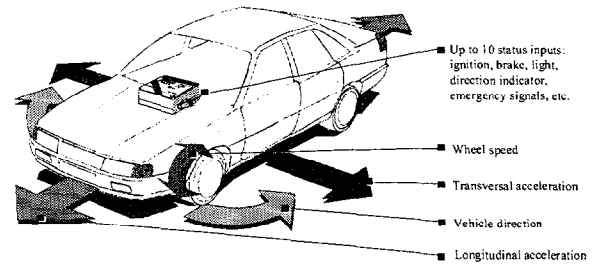
These results show that the investment is paid back twice. Firstly by reducing accidents with the involved human and social implications and costs and secondly, by the improvement of the fleet management.

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 to 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.

Up to 10 status inputs: ignition, brake, light, direction indicator, emergency signals, etc.

Wheel speed

Transversal acceleration

Vehicle direction

Longitudinal acceleration

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).
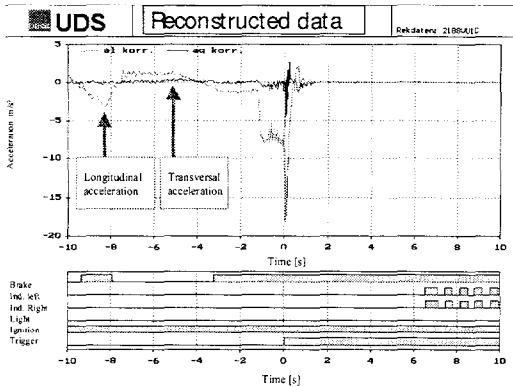
Figure 3: Accident Reconstruction

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 für 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 chrono-logical 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 squad 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 squad cars - these are more than 400 vehicles - with the Accident Data Recorder.
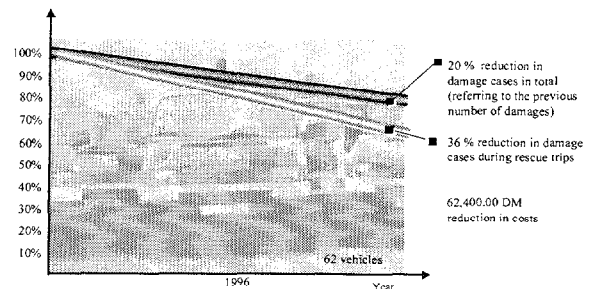
Figure 4: Example - Police of Berlin

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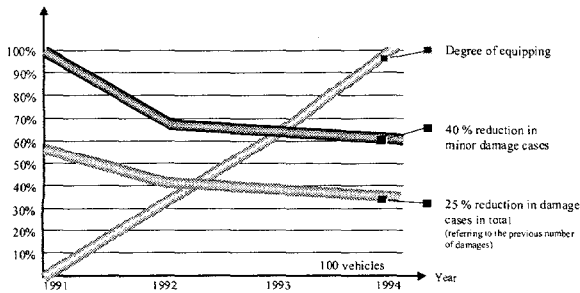
Figure 5: Example - WKD Pinkerton Security, Bisingen, Germany

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 of justice for traffic victims if modern technology offers relief.

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.

REQUESTS TO THE TRAFFIC POLICY

Onboard computers and specially the Accident Data Recorder have been designed as a contribution to road safety and legal certainty. The experiences at hand show that the systems can come up with the expectations placed

465

ANNEX

Example of a Real Accident Analysis
Intersection Accident
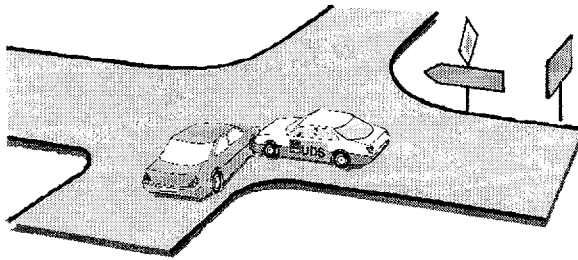
Figure 1: The accident situation

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.
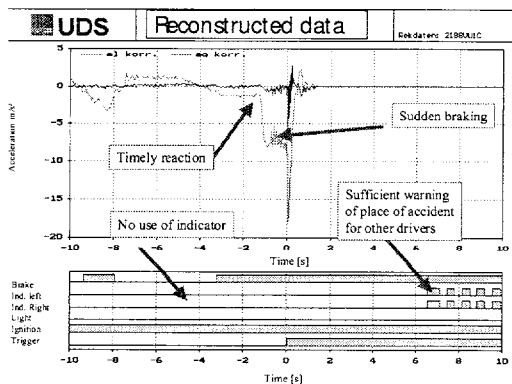
Figure 2: Reconstructed data

Figure 2 shows the raw data and proves at a glance that the driver coming from the right 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.