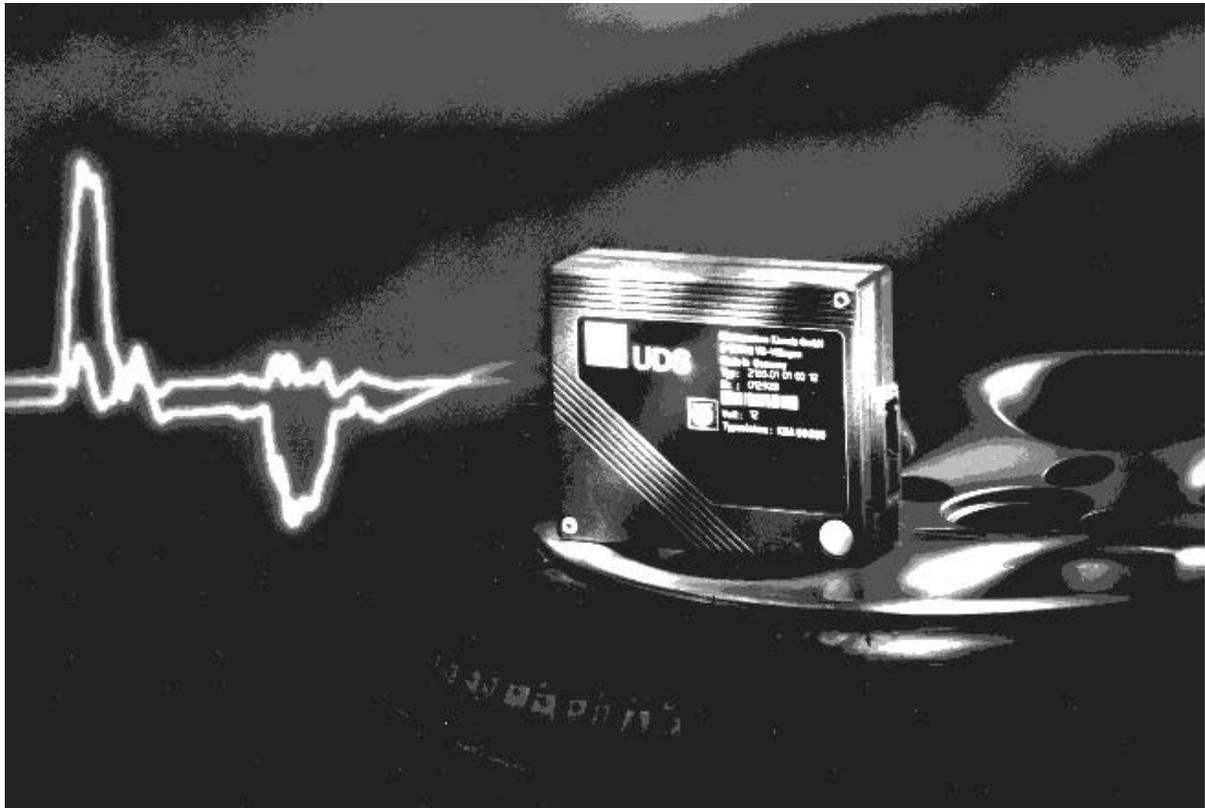


# UDS Accident Data Recorder

A Contribution to Road Safety



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## Table of Contents

<b>SUMMARY</b>	<b>3</b>
<b>ROAD SAFETY IN THE EU</b>	<b>4</b>
<b>PREVENTIVE EFFECTS OF ACCIDENT DATA RECORDERS</b>	<b>5</b>
Berlin Police Department	5
Viennese Police Department	5
SAMOVAR	5
WBO Pilot Test	6
WKD Security GmbH	6
Kötter Security	6
Hatscher Taxi Company	6
<b>ACCIDENT CLARIFICATION WITH ACCIDENT DATA RECORDER / RESEARCH FINDINGS</b>	<b>7</b>
bast Study "UDS as a Source of Information for Accident Research in the Pre-Crash Phase"	8
EU Study: SAMOVAR	8
<b>DEMANDS ON ROAD SAFETY POLICY</b>	<b>9</b>
EU Commission	9
Deutscher Verkehrssicherheitsrat (German Council for Road Safety)	9
Interessengemeinschaft für Verkehrsunfallopfer Dignitas (Traffic Accident Victims Association)	9
Deutsche Verkehrswacht (German Road Traffic Safety Organization)	9
<b>APPENDIX : TECHNICAL REPRESENTATION</b>	<b>11</b>

## Summary

*In spite of slightly decreasing numbers of accidents, there is still a total of 1.3 million<sup>1</sup> traffic accidents with personal injuries in the EU with 45,000 people killed and more than 1.6 million people injured. The social damage caused by traffic accidents in Western Europe amounts to approx. 145 billion ECU per year.*

*In Germany, about 90 % of the recorded accidents are a result of human failure of the parties involved; only 10 % are caused by technical defects or the condition of the roads. These numbers indicate that action is essentially required in the area of driving behavior.*

*For this purpose, the accident data recorder is available - a system called for by experts to improve road safety and legal certainty that contributes in two respects:*

- The analysis of accidents is provided with a new qualitative basis. Entry and recording of speed and movements of the vehicle as well as actuation of brakes, direction indicator, light, and horn during a short period of time immediately before, during, and after an accident make it possible to objectively determine the causes of an accident. This does not only lead to improvements for the clarification of accidents. The measured data can also be used for further considerations as to e.g. vehicle construction.*
- The use of accident data recorders in fleets shows that a considerable preventive effect can be achieved, i.e. a reduction of the number of accidents and costs. Accidents are reduced between 20 and 30 % as can be illustrated by some examples.*

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<sup>1</sup> 1995, latest available figures

## Road Safety in the EU

In a number of resolutions, the Commission, the Parliament and the Council of the European Union have pointed out the necessity of an active road safety policy.

Accidents are not only due to vehicle technology, the condition of the roads, appropriate formulation of the provisions controlling road traffic, etc. but above all to the behavior of individuals in road traffic<sup>2</sup>. In Germany, about 90 % of the recorded accidents are caused by human failure of the involved parties, only about 10 % by technical defects or the condition of the roads. In addition to the further development of safety provisions, etc., suitable measures for a positive effect on the behavior of the road users have to be taken.

In 1995, a total of 1.3 million traffic accidents with personal injuries took place in the EU, in which 45,000 people were killed and more than 1.6 million people injured. In Western Europe, the social damage caused by traffic accidents amounts to 145 billion ECU per year<sup>3</sup>. This is an unacceptable burden for society and economy<sup>4</sup>. These numbers indicate that action is urgently required in the technical area as well as in the area of behavior.

For some years, the accident data recorder represents a suitable system that has been called for by experts and the Deutsche Verkehrsgerichtstag (German Traffic Court Conference) under the aspect of road safety and legal certainty<sup>5</sup>.

According to the experiences on hand it is to be expected that the use of this device have a positive effect on the behavior of the driver. Without doubt, the noticeable contribution to road safety connected with the introduction of the tachograph can also be obtained by means of the accident data recorder.

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<sup>2</sup>Statistics of the bast (Bundesanstalt für Straßenwesen, German Federal Highway Office)

<sup>3</sup>Communiqué of the Commission for the Promotion of Road Safety in the EU, Program for 1997-2001, Page 1

<sup>4</sup>Communiqué of the Commission for the Promotion of Road Safety in the EU, Program for 1997-2001, Page 1

<sup>5</sup>Study: "Verkehrssicherheit und Kurzwegschreiber" (Buchreihe der Arbeits- und Forschungsgemeinschaft für Straßenverkehr und Verkehrssicherheit ("Road safety and Short-Distance Recorders" - book series of the Study and Research Group for Street Traffic and Road Safety) - Institute of the University of Cologne- Vol. XXVII, Cologne 1975

## **Preventive Effects of Accident Data Recorders**

When considering the preventive effects of an accident data recorder it will be differentiated in the following between managerial aspects of a fleet and macroeconomical aspects.

### ***Managerial Aspects***

The use of accident data recorders in fleets has shown that the number of accidents and the frequency of damage could in some cases be considerably reduced.

#### **Berlin Police Department**

The equipment of all 62-radio patrol cars of a Berlin police precinct in 1996 resulted in a total reduction of accidents through one's own fault of 20 %, and even of 36 % on duty. The costs of damage could be reduced by about 25 %, which corresponds to an amount of over 62,000 DM<sup>6</sup>.

These positive results occasioned the Berlin police to equip all radio patrol cars of its squadron with UDS, more than 400 vehicles in all 7 police precincts.

#### **Viennese Police Department**

The Viennese police department has also equipped a total of 175 vehicles with UDS. In addition to the above-mentioned preventive effects, improved discovery of damage that is not visible at first site was stated. This allows the immediate repair of such damage so that no further damage or safety defects are caused in the vehicles.

Approx. 75 % of the evaluated data could be explained by such causes and not by traffic accidents in which another party was involved<sup>7</sup>.

Due to the positive experiences of the Viennese police department, all newly purchased radio patrol cars of the Austrian police were equipped with accident data recorders.

#### **Samovar**

In the SAMOVAR (Safety Assessment Monitoring On Vehicle with Automatic Recording) research program executed in the scope of the European Union Drive Project V 2007, Great Britain, the Netherlands and Belgium took part with 9 fleets and a total of 341 vehicles that were equipped with different types of vehicle data recording technologies.

Together with a control group used in comparable experiments, 850 vehicles participated. The data were recorded for a period of 12 months. The overall synthesis of the results shows that the use of UDS reduced the accident rate by 28.1 % and the costs by 40 %.<sup>8</sup>

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<sup>6</sup> Prof. Dr.-Ing. (PhD in Engineering) Hartmut Rau et al. "UDS-Einsatz bei Polizei Berlin - Abschlußbericht der Pilotphase II" (The Use of the UDS by the Berlin Police Department - Final Report of Pilot Phase II), April 1997, Page 50ff

<sup>7</sup> UDS Information Brochure of the BMI, Vienna, Page 10

<sup>8</sup> University of London QMW, Dr. Fincham "Samovar: Drive Project V2007", 1995, Page 93

### **WBO Pilot Test**

123 busses equipped with UDS took part in this pilot test sponsored by the Ministry of Transport of the German Federal State of Baden-Württemberg with UDS in busses of WBO, the Verband der Württembergisch-Badischen Omnibusunternehmen (Association of Württemberg-Baden Bus Companies). Depending on the company, accidents were reduced by 15 to 20 %<sup>9</sup> with the busses equipped with UDS compared to a similar period of time.

### **WKD Security GmbH**

All cars (approx. 100) of this company that are used by different personnel for guarding of company premises and buildings etc. are equipped with accident data recorders. By virtue of the more conscious and situation-adjusted driving technique of the employees, the number of accidents decreased by 30 %, trivial damage was even reduced by 60 %. In addition, loss adjustment was also simplified thanks to the convincing documentation of damage.

Furthermore, due to the existence of objective data, the company climate could be considerably improved since disagreements with the drivers and thus resulting mistrust were eliminated<sup>10</sup>.

### **Kötter Security**

200 of the 850 vehicles of the Kötter security services are equipped with UDS. Each of the vehicles covers between 8.000 and 15.000 kilometers every month and is driven in shifts by different employees almost 24 hours a day. The accident damage was reduced and the expenditure for repair decreased.

### **Hatscher Taxi Company**

The 15 vehicles of this company cover approx. 150.000 km per year each. Every week, each vehicle is used by frequently changing drivers in an average of 17 shifts. As a result, a reduction of trivial damage could be noted after one year only. The accident rate decreased by 66 %. All in all, the vehicles were treated with more care and the company image could be improved<sup>11</sup>.

The preceding results were achieved on the basis of a large number of vehicles and over longer periods of time. It is noteworthy in this context that in spite of different preconditions as to vehicle structure, covered distances and use of the vehicles, the achieved results resemble each other in most points.

### ***Macroeconomic aspects***

As illustrated in the above-mentioned preventive effect, the effects of an accident data recorder in the area of commercial or public fleets alone have a considerable influence on the costs that can be avoided by means of the accident data recorder.

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<sup>9</sup> Final report for the pilot test of the WBO, Page 25

<sup>10</sup> WKD, reference letter dated 8/5/1996

<sup>11</sup> Hatscher, reference letter dated 12/05/97

In Germany, the approx. 2 million accidents registered with the police (including those without personal injuries) alone cause a macroeconomic damage of approx. 40 billion DM<sup>12</sup>.

Taking as a basis the cost of an accident data recorder of approx. 130 ECU (250 DM)<sup>13</sup> per vehicle, this results in total costs for the equipment of all the 170 billion vehicles registered in the EU<sup>14</sup> amounting to approx. 22 billion. ECU.

Assuming a total reduction of the number of accidents of 15 %, the above-mentioned accident induced costs in the EU amounting to 145 billion ECU can also be reduced by approx. 22 billion ECU per year (!). In order to obtain amortization after three years, a reduction of accidents by only approx. 6.5 % is required: 9 billion ECU are thus economized each year, a total of 27 billion ECU while due to the initial capital expenditure and 10 % new vehicles per year approx. 26.5 billion ECU have to be raised.

Additional macroeconomical advantages result from the improved options for accident clarification described in the following section.

## **Accident Clarification with Accident Data Recorder / Research Findings**

There are few areas of judicial decisions that have to be so frequently taken on unclear evidence as traffic proceedings. Inaccurate, subjectively influenced testimony or even wrong medical accusations from victims, no accident traces (ABS), difficulties when determining the reaction of the driver before the accident (brakes, direction indicator) are daily occurrence.

Legal uncertainty as well as the possible loss of the material compensation for damage is the consequences.

The question of analysis of traffic accidents is therefore of prominent importance under criminal aspects (principle of legality) as well as under aspects of the civil law analysis of the facts an inquiry into them without doubts to hold the person responsible for the accident and the damage caused by it<sup>15</sup>.

Studies of insurance companies have shown that the use of UDS results in economic and actuarial advantages.

Also in the interest of legal certainty, the UDS can be an important aid for accident clarification. UDS recordings do not replace the classical accident reconstruction but complete it in essential parts<sup>16</sup>.

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<sup>12</sup> Statistics of bast (Bundesanstalt für Straßenwesen)

<sup>13</sup> Tatsachen und Zahlen aus der Kraftverkehrswirtschaft, 59. Folge 1995, Verband der Automobilindustrie e.V. (Facts and Numbers from the Motor Vehicle Sector, Part 59, 1995, Registered Association of the German Automobile Industry)

<sup>14</sup> Exchange rate of the ECU as of 28/07/1997: 1 ECU = 1.9796 DM

<sup>15</sup> DEKRA, Ahlgrimm, UDS als Hilfsmittel der Verkehrsunfallanalyse (The UDS as an Aid in Traffic Accident Analysis), Page 65

<sup>16</sup> DEKRA, Ahlgrimm: UDS als Hilfsmittel der Verkehrsunfallanalyse (The UDS as an Aid in Traffic Accident Analysis), Page 85

In addition to the legitimate interests of the owner of a vehicle, accident data recorders also serve to protect the victims of traffic accidents who can be drivers, co-drivers as well as cyclists and pedestrians. In general, UDS recordings supply essentially faster and more evident information to clarify the ratio of causation in traffic accidents. Protracted technical analyses and partly conflicting expert opinions in case of unclear factual position that complicate the settlement of the accident facts and often result in year-long actions in civil courts can thus be avoided<sup>17</sup>.

### **bast Study “UDS as a Source of Information for Accident Research in the Pre-Crash Phase”**

The Bundesanstalt für Straßenwesen (bast, German Federal Highway Institute) that has been charged with the study "UDS as a Source of Information for Accident Research in the Pre-Crash Phase" by the German Minister of Transportation, presented the final report in June 1997<sup>18</sup>. The report is based on the collection of data of 42 actual accidents in which vehicles equipped with UDS were involved.

With UDS, the ratio of collection is increased to 100 % compared to classical data sources in the pre-crash phase as well as in the other accident phases for individual characteristics that can generally not be completely collected without UDS. This includes reactions and responsiveness of the driver, speed development over a period of 30 seconds before the collision or the chronological order of series rear-end collisions. Data on the course of vehicle decelerations and vehicle speeds if there are no traces on the road and the exact chronological assignment of the actuation of operating elements can be reliably collected<sup>19</sup>.

### **EU Study: Samovar**

In the research program SAMOVAR<sup>20</sup> (Safety Assessment Monitoring On Vehicle with Automatic Recording) carried out by order of the European Union, data of the 341 involved vehicles were also evaluated as to the achievable quality of the accident analysis in comparison to the options of classical accident reconstruction.

The report establishes the result that in comparison to classical ways of accident analyses, accident data recorders can be used to provide detailed results with higher accuracy in less time<sup>21</sup>.

Accident data recorders are thus a suitable means to provide fast and highly accurate, detailed answers to questions of accident analysis.

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<sup>17</sup> DEKRA, Ahlgrimm: UDS als Hilfsmittel der Verkehrsunfallanalyse (The UDS as an Aid in Traffic Accident Analysis), Pages 82/83

<sup>18</sup> bast final report "Der Unfalldatenspeicher als Informationsquelle für die Unfallforschung in der Pre-Crash-Phase" (The Accident Data Recorder as a Source of Information for Accident Research in the Pre-Crash Phase) (FP 2.9302), 1997

<sup>19</sup> bast final report "Der Unfalldatenspeicher als Informationsquelle..." (The Accident Data Recorder as a Source of Information ...) (FP 2.9302) P. 70, 77

<sup>20</sup> University of London QMW, Dr. Fincham "Samovar: Drive Project V2007", 1995

<sup>21</sup> University of London QMW, Dr. Fincham "Samovar: Drive Project V2007", 1995, Page 94

## **Demands on road safety policy**

Accident data recorders contribute to road safety under two essential aspects

- Clarification of accidents is provided with a new quality. Important statements on the course of the accident and the conclusions drawn on the avoidability of accidents can be made quickly and in a qualified manner. This results in a considerable advantage for accident evaluation also under aspects of civil and criminal law. Can it be sensible to refuse technical means, which provide more justice for road accident victims?
- A considerable preventive effect in fleets can be proven, in sufficiently large long-term studies between 20 and 30 %, whereas conclusions as to private users with overall equipment with UDS still have to be established.

Both aspects directly influence the costs caused to our national economies by accidents, injured and killed people, clarification of these events and subsequent claim settlement.

### **EU Commission**

Within the scope of the work program for the promotion of road safety in the EU 1997 - 2001, the EU commission stated under Point 3 "Clarification": "Accident data recorders record important data on the collision and thus considerably facilitate accident analysis. The use of UDS results in less accidents because the drivers drive more carefully."<sup>22</sup>

### **Deutscher Verkehrssicherheitsrat (German Council for Road Safety)**

The entire managing board of the German council for road safety DVR advocates a request of all vehicle drivers to equip their cars with UDS of their own accord in the interest of road safety and demands that the equipment of vehicles with UDS in the sense of the law on dangerous goods on the road (Gefahrgutverordnung - Straße (GGVS)) and for busses should be prescribed by law in the EU<sup>23</sup>.

### **Interessengemeinschaft für Verkehrsunfallopfer Dignitas (Traffic Accident Victims Association)**

In Germany, the Traffic Accident Victims Association Dignitas in line with the respective European federation of road victims demand that the equipment of cars with UDS should become compulsory. Their objectives are better protection of accident victims by means of just clarification of accidents<sup>24</sup>.

### **Deutsche Verkehrswacht (German Road Traffic Safety Organization)**

Also the Deutsche Verkehrswacht DVW sees its most important task in finding and executing suitable measures to positively influence the behavior of the road users and in this context speaks for the establishment of clear legal rules regulating the exclusive evaluation of UDS data for the clarification of accidents and exclude the use of these data for other purposes<sup>25</sup>.

Faced with the high accident rates and human harm and enormous costs connected with these accidents, not only the European Union but also every single member state is obliged to take all reasonable measures to make traffic on European roads safer. Since the most essential causes of accidents are the behavior of the road users, introduction of

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<sup>22</sup> Communiqué of the Commission for the Promotion of Road Safety in the EU, Program for 1997 - 2001, Page 44

<sup>23</sup> Protocol of December 1996, Page 21

<sup>24</sup> Founding of legal interest group by attorney Buschbell, 1995

<sup>25</sup> Positions of DVW in LVW bulletins in Bavaria, March 1997

UDS is one measure contributing noticeably to reduce accidents, improve clarification and reduce consequential costs. It is therefore the obvious thing not only to prescribe this device for particularly endangered transport types but also to promote the voluntary use with specific financial incentives.

## Appendix: Technical Presentation

### Situation

- Every year, 1.3 billion road traffic accidents with personal injuries take place in the EU
- 45.000 people are killed
- 1.6 million people are injured
- Resulting social damage in Western Europe amounts to approx. 145 billion ECU



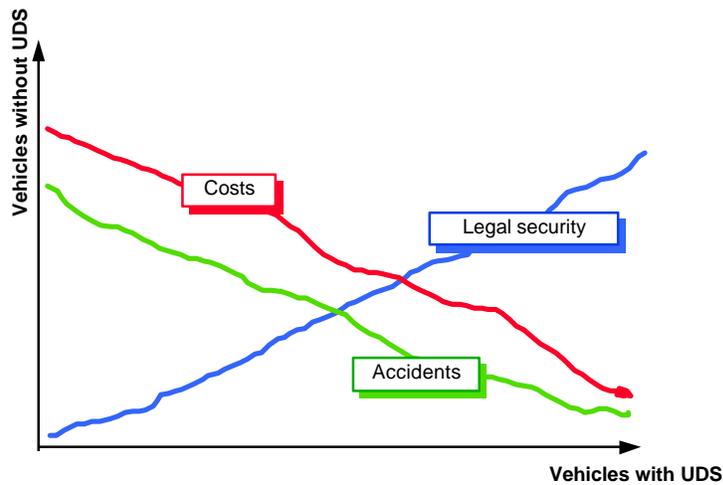
V D O KIENZLE

In spite of the slightly decreasing numbers of accidents, a total of 1.3 million road traffic accidents with personal injuries took place in 1995 in the EU in which 45,000 people were killed and more than 1.6 million people were injured. The social damage caused by road accidents in Western Europe amounts to approx. 145 billion ECU per year.

In Germany, about 90 % of the recorded accidents are a result of human failure of the parties involved, only approx. 10 % are caused by technical defects or the condition of the roads. These numbers indicate that action is essentially required in the area of driving behavior.

## Benefit

Prevention and reduction of accidents



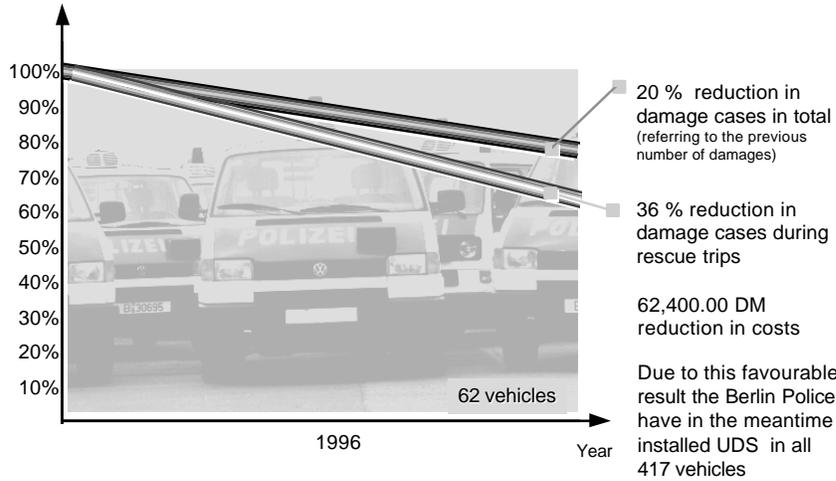

V D O KIENZLE

With the accident data recorder, clarification of accidents is provided with a new quality. This means more legal certainty for the driver, objective data for the expert and if necessary the judge.

The use of UDS in fleets shows that a considerable preventive effect, e.g. a decrease of the accident numbers and consequently a cost reduction is achieved.

### Benefit

Example: The Berlin Police Department

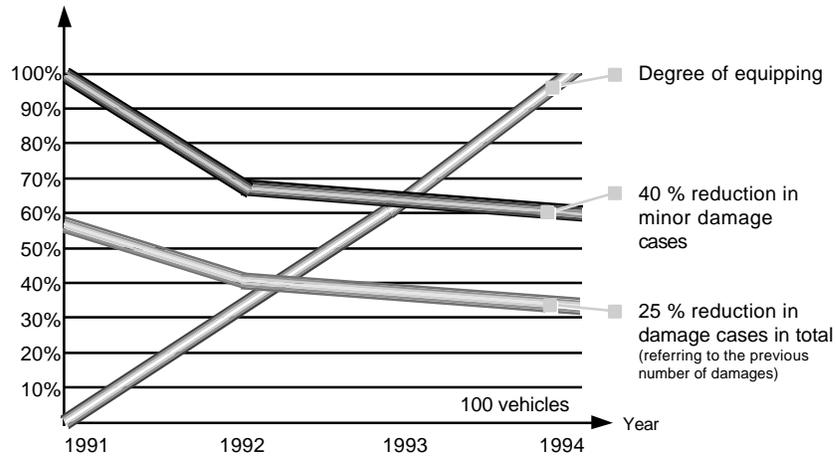


V D O KIENZLE

Due to the positive experiences in the year 1996, all radio patrol cars of the Berlin police department, a total number of 400 vehicles, have been equipped with UDS.

**Benefit**

Example: WKD Pinkerton Security, Bisingen, Germany

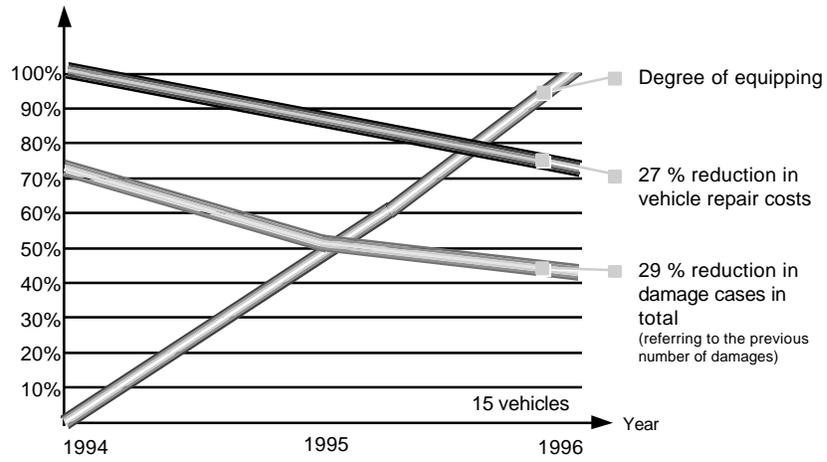


V D O KIENZLE

The vehicles are mainly used by night by different drivers for guarding persons and premises.

**Benefit**

Example: Hatscher Taxi Company, Oldenburg, Germany

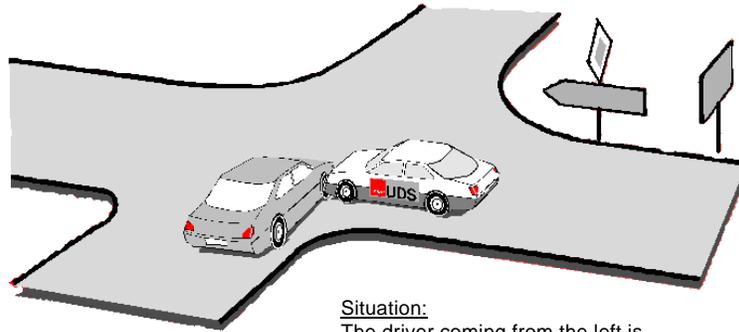


V D O KIENZLE

The cars are used in shift service and each cover approx. 150,000 km per year.

## Examples of Accident Analyses

## Intersection Accident

Situation:

The driver coming from the left is accusing the driver coming from the right that:

- He was driving too fast
- He was turning on the right indicator



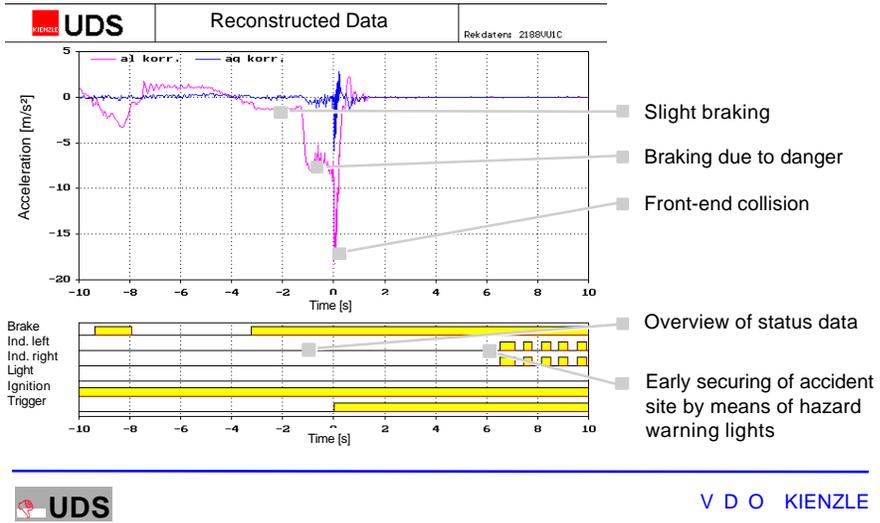
V D O K IENZLE

In this accident at a crossing, the following questions have to be clarified for the involved parties (drivers, owner of vehicles, lawyers, judges, insurance companies):

- *Initial speed:* How fast was the vehicle at the moment when the driver reacted?
- *Collision speed:* How fast was the vehicle when the collision took place?
- *Reaction (brake operation, yes/no):* Did the driver of the UDS vehicle recognize the situation and react to it by braking and/or making way?
- *Possible beginning of brake operation:* How early did the driver react? Proof of a reaction in time leads to discharge of responsibility.
- *Speed at the location of the place-name sign:* to clarify if the car went too fast into the built-up area.
- *Right direction indicator actuated yes/no:* State of the direction indicator to verify the statement of the accident adversary that the "UDS driver first actuated the right direction indicator and only changed his decision directly in front of the crossing".

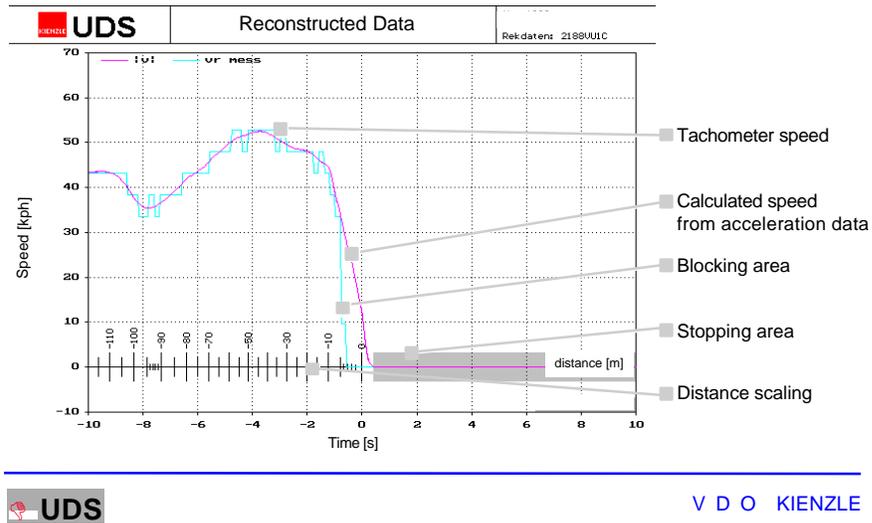
# Examples of Accident Analyses

## Intersection Accident - Acceleration values via UDScope



Acceleration and status information in detail.

## Examples of Accident Analyses

Intersection Accident - Combined Representation  
of Reconstructed Data via UD*Scope*

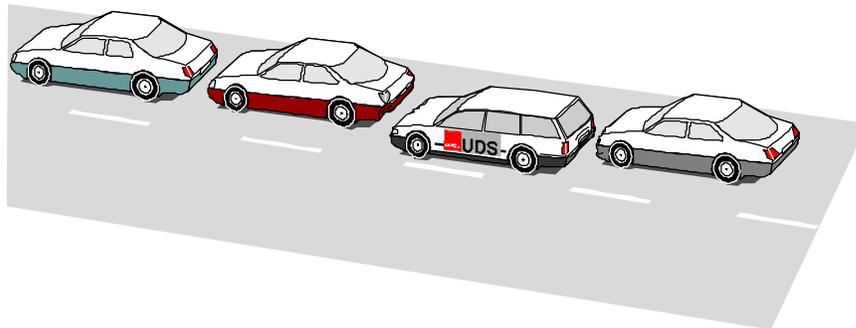
Calculated speed  $v[t]$  in detail with fade-in distance scaling and standstill ranges.

- Blue: wheel speed (speedometer speed)
- Red: calculated speed.
- Already before the collision, the speedometer speed is zero, this means: the drive wheels are blocked; the speedometer speed in this area cannot be used. The collision speed (12 km/h) was calculated from the remaining data.

The speedometer speed steps result from the individual distance pulses.

## Examples of Accident Analyses

### Serial Collision

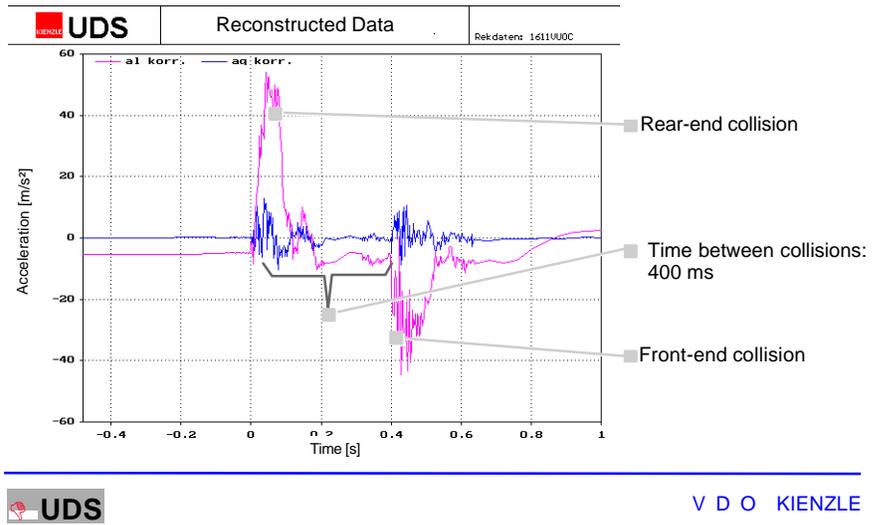


V D O K I E N Z L E

In this rear end collision, the following questions have to be clarified for the involved parties (drivers, owners of vehicles, lawyers, judges, insurance companies):

- *Who collided first?*
- *Collision speeds?*
- *Reaction (brake operation yes/no)*
- *Possible beginning of brake operation?*
- *Initial speed?*
- *Speed modification at collision?*
- *Stopping time or remaining stopping distance?*

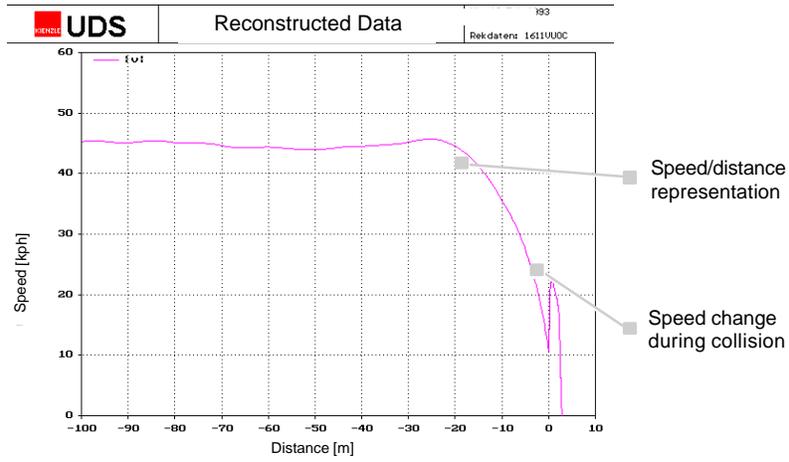
Examples of Accident Analyses  
 Serial Collision - Acceleration values via UDScope



Acceleration in the collision phase in detail.

# Examples of Accident Analyses

## Serial Collision - Reconstruction Results via UD Scope

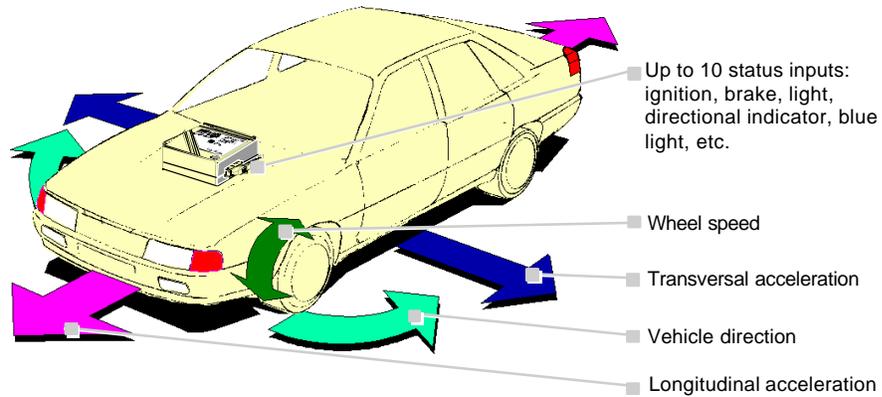


V D O KIENZLE

The reconstructed speed outlined over the distance covered.

## UDS System Functions

### Sensors and Status Inputs



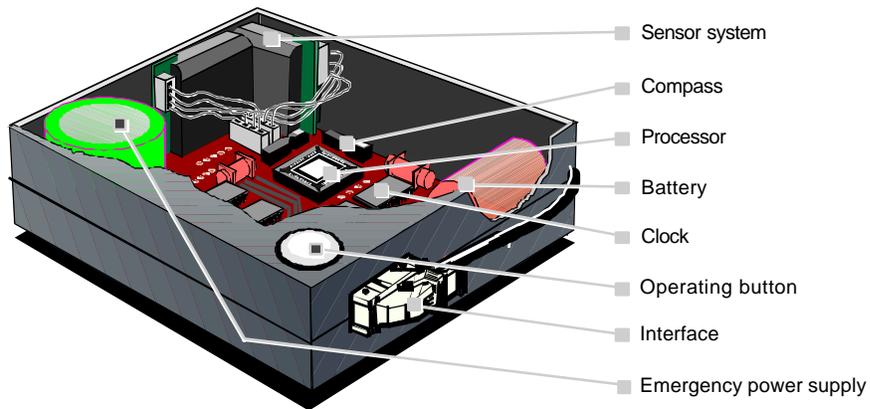
V D O KIENZLE

The UDS sensors record the lateral and crosswise accelerations as well as all changes of direction of the vehicle. In addition, the device registers the vehicle speed.

UDS detects by means of status inputs, when and for how long ignition, brakes, direction indicator and lighting have been actuated.

Furthermore, free status inputs can be assigned, for example, for siren or blue light for rescue vehicles.

## UDS System Functions Technology

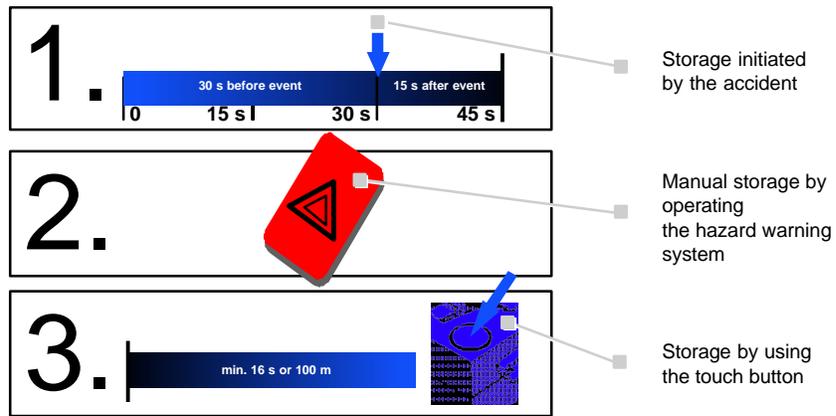


V D O KIENZLE

UDS is equipped with acceleration sensors, a compass, emergency power-generating plant, and clock as well as control key, processor and interface or data interface connecting the device with the electronics of the vehicle.

If the device cannot be mounted near the driver, it is equipped with an external control component.

UDS System Functions  
Data Recording Possibilities

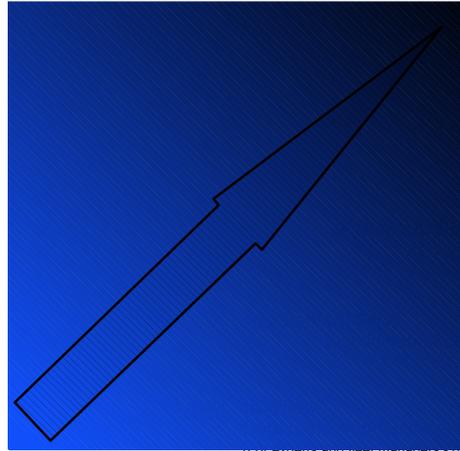


V D O KIENZLE

Triggering of storage:

- Either automatically by an accident (trigger criterion fulfilled)
- By pressing the control key on the device or the external control component
- Manually by actuating the hazard warning system

## Software Products



Step: **Reconstruction of trajectory**  
by VDO KIENZLE

Step: **Accident reconstruction**  
by accident experts  
(one week of schooling)

Step: **Service including test and data presentation**  
(installation and final inspection)

Step: **Data presentation**  
(for experts and fleet managers - qualified readout of UDS-data)

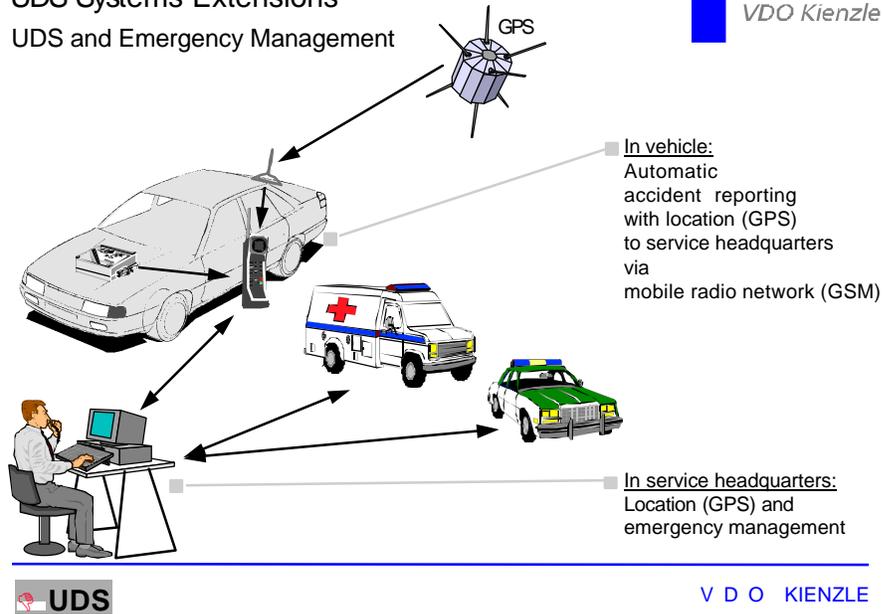


V D O KIENZLE

An entire family of software products is available for different applications.

## UDS Systems Extensions

### UDS and Emergency Management



In spite of the constantly improved life-saving service, precious time is still lost in rescue operations in road traffic due to late or inaccurately received emergency calls.

Here, UDS as an integrated part of emergency management can lead to noticeable improvements:

- In case of emergency, the UDS system automatically transmits alarm signals to the service center (Mannesmann AUTOCOM) via cellular phone network
- Precise location of the accident location by GPS (satellite navigation)
- The service center can establish speech communication with the rescue services
- Reduced reporting times for accidents and rescue