TRAFFIC ACCIDENT INVESTIGATION IN GERMANY

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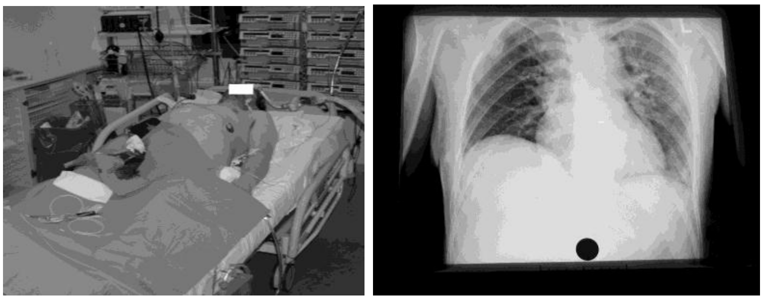
1. INTRODUCTION

"Zero-Three-Three including Zero-Three-One, motorway 7, southbound, section Mellendorf 105." What sounds quite incomprehensible to almost anybody contains all important information for the traffic accident investigation team of the Medical University of Hanover in Germany. A traffic accident ("Zero-Three-Three") has taken place on the motorway 7 near to Hanover city centre. One person has been injured ("Zero-Three-One") and this is the indication for the engineers and medical students to leave their office and go immediately to the accident scene.

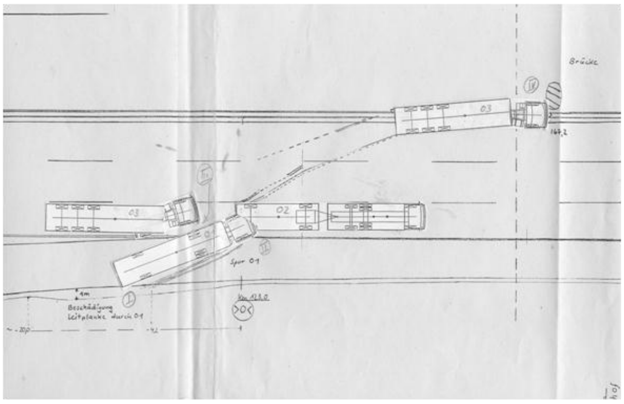
Picture 1. *Truck-Accident on the motorway No. 7: Three trucks have been involved. The driver of one truck was trapped and died at the hospital.*

About three minutes later two vehicles, fully packed with technical and medical equipment and flashing blue lights is driving to the accident scenery. During the trip a radio message informs the team that the injured occupant has been transported to the next hospital. The medical experts will follow up the person at the hospital whereas the engineers go to the accident scene and collect all important information on any involved road user, vehicles, environment, skidding marks, etc. More than 3000 variables are collected per accident case. Later on a true scale multi layer sketch of the scenery is produced. Energy-Momentum as well as a computer based reconstruction (using PC-Crash and other software) of each collision event is done. All this work is done by order of the Federal Highway Research Institute of Germany (BASt) and is supported by local police departments and the police and rescue teams at the accident location.



Picture 2. *Injured truck driver after admission to hospital*

More than 1000 accidents in the Hanover area are recorded per year in the prescribed way. The data collection process at the accident scenery takes about 45 minutes on average, whereas the team needs 25 to 30 minutes to get to the accident. Today there exist two such teams in Germany which work in parallel. One of them is located at the Medical University in Hanover and has been conducting accident research since the early 70s. The other one is located at the Technical University in Dresden and has been established in 1999. The first team is financed by the Federal Highway Research Institute of Germany (BASt) whereas the Dresden team is financed by the Research Association of Automotive Technology (FAT). Both teams together add up to build the GIDAS project (German In-Depth Accident Study), the most successful accident investigation project in Germany and one of the biggest accident research projects worldwide.



Picture 3. *First Accident Sketch*

The accident investigation “on the spot” has been started in 1973. The project was meant to be a supplementary source of information besides the documentation based on police reports. Whereas official accident reporting systems collect information on many accidents (> 300.000 per year in Germany), the information per case is usually quite limited (about 50 parameters per accident case).

II. HISTORY

Historically, road accident research is closely related to the investigation of military aircraft accidents. Based on experience with aircraft cases a first “Automotive Crash Injury Research Group (ACIR)” was established at the Cornell University (USA) in 1953. This group was leaded by Hugh de Haven, a pioneer in the field of aircraft safety. De Haven demonstrated the safety belt with pyrotechnical retractor in 1942 and developed (together with Hasbrook) ideas for some energy absorbing instrument panel. Triggered by the fast growing number of automobiles and road traffic accidents, aircraft safety developments have been carried to the field of automotive safety. In was straight forward that similar restraint systems would be useful for car occupants as they have shown to be useful for aircraft passengers and pilots. In parallel to the work of the ACIR group, William Haddon started the first “in time” and “on the spot” accident data collections in the USA. Subsequently, Haddon became the first director of the afterborne National Highway Traffic Safety Administration (NHTSA).

In Europe, accident investigations on the spot have been started in 1957. In Sweden, car accidents have been reconstructed by drop-impact tests from cranes. This tests resulted in the first dynamic test procedure for safety belts in 1958.

In Germany manufacturers have been started accident investigations since 1967 (Opel 1967, Daimler-Benz 1969, Ford 1970, VW 1971). Whereas manufacturers have been mainly interested in the performance of their cars, academic research started to follow up biomechanical issues (University of Birmingham: Mackay, Ashton; Chalmers University: Aldman; University of Odense: Nordentoft; a.o.).

In 1973 - being confronted with the steadily increasing number of road user fatalities - some high-mobility NATO countries started pilot projects on traffic accident research, motivated by the order of NATO’s committee for environmental issues. The most important research result of this common project was a highly detailed catalogue of requirements for modern type accident investigations. The “NATO Collision Analysis Report Form” has been formulated by physicians, engineers and policemen from all participating countries (e.al. Great Britain, France, the Netherlands and Germany) and has been the basis for all follow-up accident investigation projects.

III. USE OF IN-DEPTH ACCIDENT DATA

At the beginning of all “In-Depth accident investigation” the individual case analysis was predominantly of interest in order to raise questions on secondary vehicle safety. Efficiency of safety belts, steering wheel displacements, door locking and hinges in rollover accidents or the stability of passenger compartments under various crash conditions have been thoroughly investigated.

Picture 4. *Side Impact 1974 versus similar side impact today*

This resulted in a dramatic improvement in car safety. Impacts which had fatal consequences will be survived with minor injuries today (see picture 4).

Picture 5. *Detection of potentially dangerous constructions*

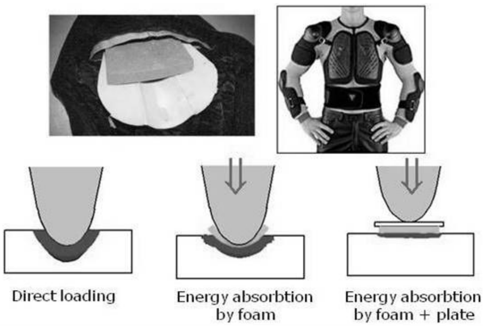
Accident data was also useful to find potential hazard constructions (see picture 5).

Also sound accident data has always been an essential ingredient for any sustainable road safety policy. The data from BASt has been used to develop and improve a multitude of current and new legislation and directives; concerning vehicle type approval, pedestrian safety or e.g. to determine the test conditions for motorcycle and bicycle helmets (ECE 22 and CEN EN 1078, respectively). Many more examples can be found like research on seatbelt efficiency, child restraint systems, efficiency of advanced safety systems, passenger car compatibility, improving truck rear and frontal under-run protection, safety of small commercial vehicles, etc.

As already mentioned GIDAS data use is not restricted to issues of automotive engineering, but can also be used to improve road design. One example is the analysis of run-off-the-road accidents followed by an impact with a tree. This is very important accident type in Germany, as 34% of all fatal car occupants belong to this category. A detailed analysis of single cases can reveal interesting facts to an extend that ditches in the lateral area of the street can act as sort of a protection zone to avoid tree impacts in skidding scenarios (Otte 1995).

Already in 1987 Otte demonstrated the use of GIDAS data in order to improve protective clothes for motorcyclists. Frequently occurring severe injuries could be associated to contacts with certain body parts. Paying in particular attention to injuries with long term consequences the lower leg of motorcyclists has shown to be problematic.

Based on this research new protective clothes for motorcyclists have been developed. Panel supported foam protectors (sandwich construction) have been able to absorb up to 40% more energy. Consequently, the introduction of the new devices resulted in a significant drop of complicated fractures.



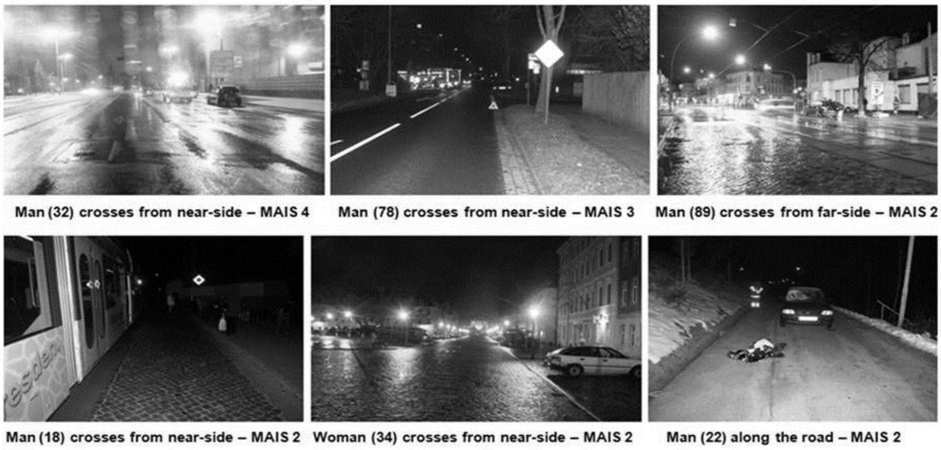
Picture 6. *Motorcyclist protection devices*

In Depth accident data was also used for the development of road restraint systems (DIN EN 1317), e.g. providing information on typical feeding angles and impact speeds.

Today the focus of car safety is changing towards strategies for accident prevention and avoidance. Innovative safety related driver assistance systems like autonomous emergency braking (AEB) or lane keep assistance (LKA) claim to have a high safety potential.

However, in order to progress and to fully exploit the capacity of such system, high quality accident data is necessary in order to see whether current sensor generations are reliable, sufficiently fast and satisfactorily robust.

For example, the In-Depth analysis of fatal pedestrian cases in Germany has shown that there is a high need for sensors with night vision capabilities when trying to avoid such accidents. Furthermore requirements for the opening angle of such sensors can be derived as such accidents are frequently happening with pedestrians crossing the street from the far-side lane. In addition many of those accidents happen under adverse lighting conditions with diffuse reflections and glaring as can be seen from the examples, provided in picture 7.



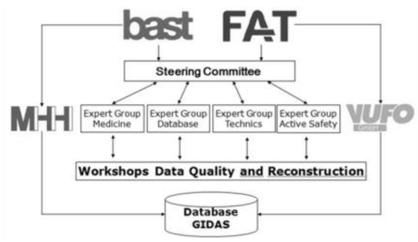
Picture 7. *Typical accident sceneries for serious and fatal pedestrian accidents*

4. COMBINING RESOURCES: GERMAN INDUSTRY JOINING THE INVESTIGATION

Since 1999 the German car industry – namely the Research Association for Automotive Technology (FAT) - has actively supported the accident investigation by providing financial resources for a second investigation team in the Dresden area.

Both investigation teams use a similar accident recording scheme, which provide the possibility to pool both data collections in a common database. The number of cases per year was doubled and is now 2000 cases with personal injury per year.

Besides improving the statistical power there are synergetic effects, by improving the common data collection scheme and by sharing a common quality control. Experts from car industry and government work together in special task groups addressing in particular the quality of the medical documentation, database issues, reconstruction and investigation techniques and active safety impacts.



Picture 8. *GIDAS business model*

Pooling the expertise has led to some significant improvements in the data quality. One example and one of the latest innovations is the laser based accident measurement (picture 9).

Picture 9. *Laser for accident measurement*

The GIDAS consortium is also open to provide expertise to recently installed accident investigations. In-Depth projects in the Czech Republic and in China (namely, CZIDAS and CIDAS project) have been implemented on the basis of the GIDAS methodology.

In fact there are activities running, trying to establish a bigger network of In-Depth accident investigations pooling a core dataset (iGLAD-activity), where the GIDAS business model serves as a reference.

A further advantage of running a common accident investigation with several stakeholders in the field of road safety is having a common forum for discussions and interchange. It is also a pro that results which are built on such a database will have a higher reliability and a better reputation.

This becomes evident when looking at the advanced Euro NCAP awarding process, where GIDAS have been selected to be the reference database and its use has been made compulsory.

5. INTERNATIONAL IN-DEPTH ACCIDENT DATA

In 2004 the first conference on In-Depth accident data has been established at the Hanover investigation side of the GIDAS project. Every two years, accident researchers from 5 continents meat in Germany to discuss recent topics on road and traffic safety.

Whereas several conferences about biomechanics and vehicle safety exist, a common international forum on accident data was missing. It is the goal of the “Expert Symposium on Accident Research” to facilitate international exchange on methods and results from local investigations all around the globe. Keynote speakers from industry and policy have repeatedly emphasized the necessity and importance of reliable data for the regulatory process and to trigger innovations in car safety design.

Notwithstanding these efforts, seen from a global perspective, accident data collections face a common issue: international data sets are highly individual, making direct data comparisons between countries a challenging if not impossible task. This forfeits the potential of directly comparing both the individual accident focus point and the effect of measures introduced into the individual systems – a challenge both for globally active car manufacturers and global technical regulators at the same time.

The problem of unified data was already identified quite a while ago, and numerous bi-lateral initiatives, regional working groups and task forces are attempting to find solutions. The drawback is that no truly international and global approach has yet been taken to find a globally harmonized and ultimately standardized approach to accident data.

Today the GIDAS consortium, in compliance with ACEA and FIA, supports alternatively the implementation of a universally accepted common data subset built on top of already existing in-depth data. This attempt will not force one database scheme for all participating in-depth projects. Setting up a suitable business model, data providers and data users will be brought together. Participants shall be confronted with a win-win situation and no further external funding shall be necessary.

References

[1]. Aldman, B.: The early History of the Lap and Shoulder Three-point safety belt Written oral presentation, not published, 1973. www.autoliv.com/Appl_ALV/alvweb.nsf/ Files/Belthist/$file/Belthist.pdf.

[2]. Volpe: Collision Analysis Report Form. Office of the Secretary of Transportation Washington, D.C. December 1, 1971.

[3]. Wanderer, U.; Weber, H.: First Results of Excat Accident Data Aquisition on Scene, SAE Paper 74568, USA 1974.

[4]. Stürtz, G.; Suren, E.G.; Gotzen, L.; Richter, K.:Analysen von Bewegungsablauf, Verletzungsursache, -schwere und -folge bei Fußgängerunfällen mit Kindern durch Unfallforschung am Unfallort. Der Verkehrsunfall 2, 29-38, 1975.

[5]. Appel, H.; Stürtz, G.; Gotzenh, L.:Influence of Impact Speed and Vehicle Parameter on Injuries of Children and Adults in Pedestrian Accidents. Proc. IRCOBI, Birmingham UK 1975.

[6]. Brinkmann, B.; Brühning, E.; Hautzinger, H.; Langwieder, K.; Löffelholz, H.; Otte, D.; Zeidler, F.: Erhebungen am Unfallort. Projektgruppenberichte der Bundesanstalt für Straßenwesen, Bereich Unfallforschung, 1983.

[7]. Hautzinger, H.:Statistische Methode zur Auswertung der Erhebungen am Unfallort. Bericht zu FP8500/2, Bundesanstalt für Straßenwesen, 1990.

[8]. Otte, D.:Charakteristika von Unfällen auf Landstraßen. Bericht der Bundesanstalt für Straßenwesen M122, 1995.

[9]. Otte, D.:Kinematik des motorisierten Zweiradunfalles – Verletzungsmuster, Langzeitfolgen und Schutzmöglichkeiten. Zeitschrift Unfallchirurgische Versicherungsmedizin 80, Heft 1, 37-46, 1987.

[10]. Otte, D.; Middelhauve, V.: Quantification of Protective Effects of Special Syntetic Protectors in Clothing for Motorcyclists. Proc. IRCOBI , 1-18, Birmingham UK 1987.

[11]. Otte, D.:Possibilities of Load Reduction by Leg Protectors in the Protective Clothing of Motorcyclists – Technical, medical and biomechanical Approach. Proc. 46th AAAM Conf., 367-385, Tempe USA 2002.

[12]. Otte, D.:Mechanisms of cervical spine fractures and soft tissue injuries of Motocyclists for the assessment of the effectivenes of back protectors. IJ Crah 1998, Vol 3, No4, 325-334, Dezember 1998.

[13]. Otte, D.:Unfalldynamik – Flugbahn des Motorradfahrers und seine Verletzungssituation. Vortrag Medizin-Forum-Leipzig, nicht publiziert, 2003.

[14]. Otte, D.:3-D Laser Systems for Scaled Accident Setches and Documentation of Traces after Taffic Accidents as Basis of Biomechanical Analysis. Poster IRCOBI 2005.

[15]. Otte, D.; Krettek, Ch.; Brunner, H.; Zwipp, H.: Scientific Approach and Methodology of a New In-Depth-Investigation Study in Germany socalled GIDAS. Proc. ESV Conf. Nagoya Japan 2003♦