

**ECONOMIC COMMISSION FOR EUROPE**

**INLAND TRANSPORT COMMITTEE**

**Working Party on Road Traffic Safety**

Sixtieth session

Geneva, 27–30 September 2010

Item 6 (a) of the provisional agenda

**Multi-disciplinary crash investigation  
Information from Denmark, Norway, Turkey and the United States of America**

**Denmark**

**1. Danish Road Traffic Accident Investigation Board**

The objective of the Danish Road Traffic Accident Investigation Board (AIB) is to compile knowledge of road traffic accidents. Any new knowledge acquired is to be applied for the benefit of improved road safety. The AIB is comprised by an interdisciplinary group of members engaged in in-depth analyses of frequent and serious types of road traffic accidents. The AIB investigates the circumstances of individual accidents in order to form a precise picture of the underlying factors.

The AIB carries out analyses based on available material from the police, vehicle inspectors, road authorities, hospitals/emergency rooms and the Department of Forensic Medicine.

The AIB complements this material with its own investigation of the vehicles involved and of the scene of the accident, and interviews with the parties involved in the accident as well as any witnesses, the police and the rescue team.

The AIB is commissioned to contribute new or supplementary knowledge in road safety, which at the initiative of other institutions leads to preventive action against road traffic accidents. The object is not to determine the question of guilt or innocence in a legal sense.

**2. Working procedures of the Danish Road Traffic Accident Investigation Board (AIB)**

AIB performs thorough analyses of accidents within themes to gain a thorough knowledge and understanding of these types of accidents. The analysis methods are qualitative and focus on the interaction between road users, roads/surroundings and the vehicles before, during and after the accident.

## **2.1 Choice of accident themes**

When AIB chooses a new accident theme, a subject is prioritised which has, in many ways, been marked out a problem area. By choosing a theme, a starting point is taken from one or several of the following criteria:

- The development of the accident statistics requires closer unearthing and analysis
- More knowledge is required within a particular area
- Other research in progress needs further investigating
- Particular types of accidents receive special awareness in the public arena
- The Minister for Transport requests AIB to analyse a particular problem

## **2.2 Data collection**

The collection of information on the particular accidents is performed in part in cooperation with the Police and partly as AIB's own investigations. When an accident occurs - material from the Police.

In connection with starting a new theme, AIB enters an agreement with a range of police districts for help with the investigation. The agreement involves the Police informing AIB when an accident within the theme occurs. The Police will also summon a car inspector to the accident location. The Police's car inspector performs an ordinary investigation, equal to the investigation normally performed for fatal accidents and performs a car inspection which supplements AIB's investigation. The Police also detain the implicated vehicles, until AIB's car inspector has investigated it. AIB has access to the Police material.

### **AIB's own investigations**

As soon as possible after the accident, AIB's psychologist will contact the people implicated and the witnesses to arrange interviews. In cases where the implicated cannot be interviewed (in the case of death or very serious injuries), the relatives are contacted instead. Participation in the study is voluntary. The interviews with the implicated are generally performed at their residence or in the hospital, while interviews with witnesses are done by phone. Within a week of the accident, AIB will inspect the accident location and the implicated vehicles. The accident location is inspected by AIB's inspection group (a road engineer, a policeman and a car inspector). The inspection consists of a detailed record of the road conditions, determination of the overview conditions, assessment of the traffic conditions etc. The party's location before, during and after the collision is assessed, and the stretch of the road is driven as closely as possible to the party's presumed course. This drive is video recorded. Often the inspection takes place so soon after the accident, that the marks from the accident can be recorded to supplement the Police's material. The vehicles are inspected by a policeman and a car inspector. The inspection includes an investigation of the vehicle's condition, a record of the damage (which is important for determining the speed and direction at the moment the collision occurs) and a comparison of the vehicles to document the actual collision. Based on the damage in the cabin the effect of the safety equipment and personal injuries are assessed. The above mentioned is a description of the main points in a standard investigation. There are, in practice,

always discrepancies. Sometimes it is not possible to perform all of the elements and sometimes there is a need for supplementary investigations. Sometimes supplementary investigations are made for all accidents within the same theme. In addition to material from the Police's and their own investigations, AIB gathers information from a range of authorities etc.: Information on the roads is obtained from the road authorities, e.g. maps, diagrams, traffic numbers etc. Information on the vehicles is obtained from the register of motor vehicles. Information on the implicated is obtained from the criminal register, driving licence register etc. AIB's doctor gathers further information on the injuries and their treatment from the hospitals.

### **Analysis and accident report**

When the accident material has been collected, the course of the accident is analysed. The first step is the preparation of a detailed report in which the circumstances of the accident are described and analysed. The road inspector, psychologist, policeman and car inspector all contribute to the report. This is all written up, whereupon the Accident Investigation Board handles the report in two ways. This is repeated for all relevant accidents, so in the end there is one report for each accident. These accident reports are confidential and therefore only for internal use.

### **Theme report**

When there is an accident report of each processed accident, an analysis is performed across the individual accident reports. Finally, based on this analysis, a concerted theme report is prepared, containing the following:

- A review of the accident and injury factors and underlying factors
- A description of the special issues concerning the accidents
- AIB's recommendations for initiatives to the prevention of this type of accident AIB's general recommendations for accident prevention is based on an analysis of the measures which, according to the analysis, could have prevented or limited the individual accidents.

The theme report is AIB's interpretation of the results within the specific theme. All data used in the theme report has been depersonalised.

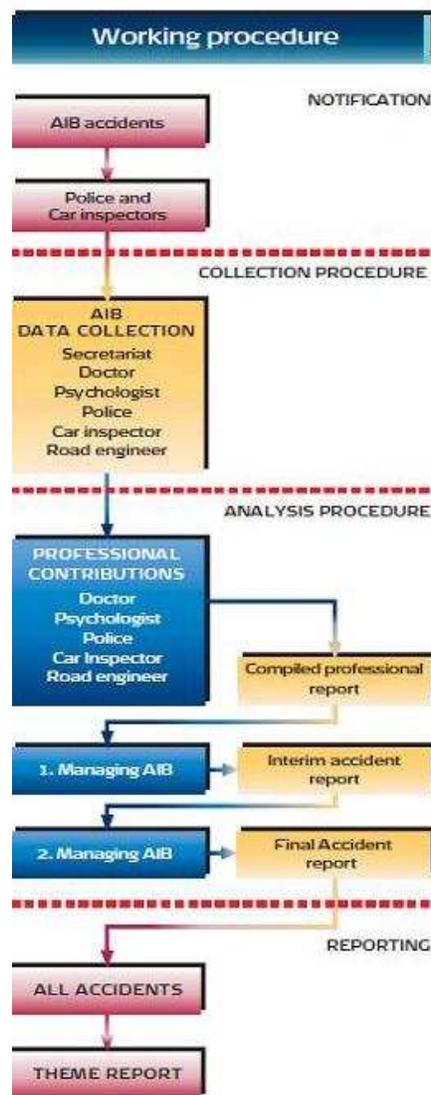


Table 1: AIB's working procedures

### 3. Analysis methods of the Danish Road traffic Accident Investigation Board (AIB)

AIB's analysis of the specific accidents has the aim of highlighting which conditions led to the accident occurring. There is no weight added to responsibility or legal offences, but naturally there is often a connection between clear offences and a significant percentage of the accident's cause. The analysis is performed following a fixed methodology which is mainly unchanged since AIB's first theme analysis. By using a fixed methodology, the accidents are more uniformly and thoroughly analysed, so that the analysis and conclusions do not stop with the most obvious explanations. The main element of the analysis is illustrated in the figure "AIB's analysis methods" and explained in more detail in the following.

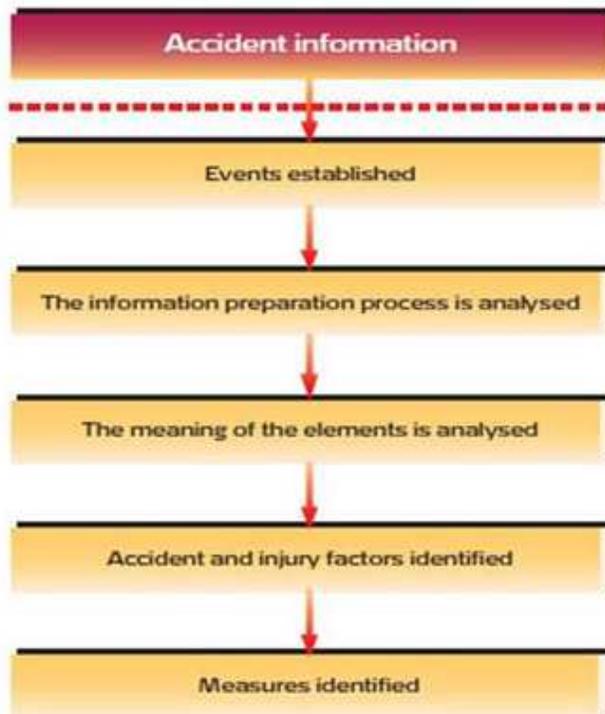


Figure 2: AIB's analysis methods

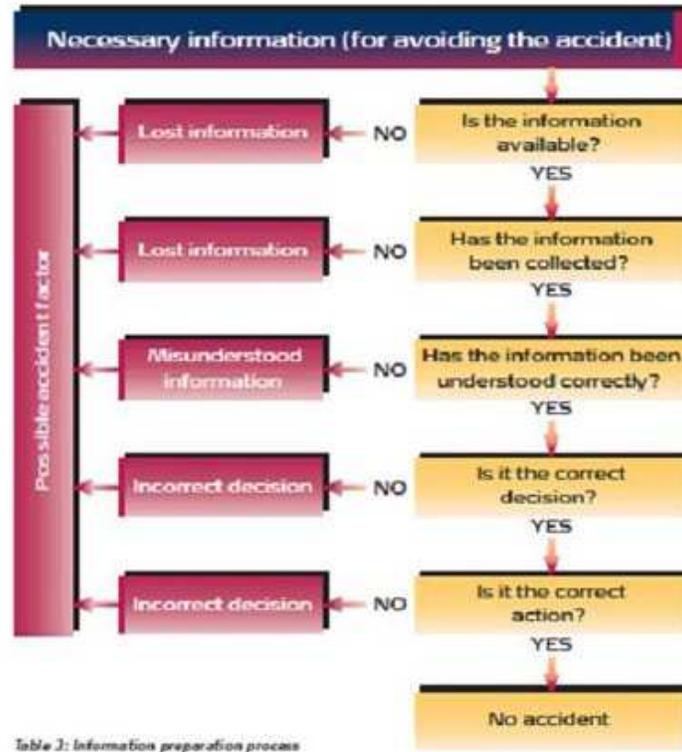
### 3.1 Establishment of the events

The first element in the analysis of the accident is to establish the events. The events are described, including significant conditions from the period before the accident, the conditions in the seconds up to the accident, such as avoidance manoeuvres, the collision and a description of the vehicles and the final positions of the parties. AIB determines the most likely events from the collected data, including explanations from witnesses and those involved. An important tool in this process is the "PC Crash" programme in which various possible scenarios can be simulated. Emphasis is placed on conformity between the actual damages and injuries to vehicles and persons and the simulated injuries. Similarly the simulated movement patterns and the vehicles' simulated final positions should conform to the actual conditions which are determined from the tracks left behind etc. When the events have been identified, the conditions which led to the accident are identified.

### 3.2 Information processing procedure

When the probable events have been determined, an analysis is performed in the road user's "information processing" in the seconds immediately prior to the collision. The analysis is based on the model illustrated in the figure "Information preparation process". This analysis methodology was originally developed in Sweden (TRK's Accident Investigation Board. Reporting of a research assignment. Stockholm 1978), and the additional work by AIB. The first step in the analysis of the information processing is to determine what the "important information", i.e. the information needed so that the accident could have been avoided. And determined when the information should

have been gleaned. The information will typically be the signal the road user should have reacted to (if they had been seen and understood correctly). Often this will consist of a real danger signal, but not all parties in an accident have a danger signal. The next step is to determine if the road user had access to the necessary information with enough time to avoid the accident. If the information was available, it must be investigated whether the road user noticed the information. The last part of the model is an assessment of the road user's decision and action; was it reasonable based on the information the road user had gleaned and processed. The above review is made for all road users involved in the accident when the analysis of the information processing is complete, a general analysis is made of the individual element's significance for the accident's cause and progress.



### 3.3 The Elements' meaning

AIB sees accidents as a failure in the interaction between road users, vehicles and the road/surroundings. That is why a general assessment is made of these elements' significance for the accidents. It is in this part of the analysis that there is a possibility to highlight the condition of the road design which could have prevented or alleviate inconsiderate road user behaviour. An assessment is also made of the significance of the speed. Under road user, it is assessed whether their behaviour or personality has deviated from ordinary road users in a manner which could have promoted accidents. This may include a motorcyclist with an extensive history in the criminal register for both and traffic and criminal charges. If, in relation to the accident, his driving is totally indefensible, e.g. at very high speed, this information, together with other information from the analysis, could indicate a person thrill seeking with a generally high propensity for accidents. Under the road's significance it is assessed whether the road's design or surroundings has contributed to

the accident's cause or progress. Under the vehicle's significance it is assessed whether any faults or deficiencies of the vehicles could have contributed to the cause or progress. The significance of the vehicles having better safety standards within selected areas, e.g. integral braking systems with ABS for motorcycles is also assessed. The significance of speed is assessed in relation to the speed limit or in some cases in relation to a defensible speed which is suitable for the conditions. This may be the case on small winding country roads with poor visibility, where it has been concluded that speed should be adjusted to the surroundings. If the speed was above the speed limit or not suitable for the conditions, it can be concluded that the accident could have been avoided if the limit/ the reasonable speed had been observed. If the accident would have happened anyway it will be assessed if whether exceeding the speed limit was significant to the personal injury. If the speed's significance is assessed, it is always based on the actual events. A calibration is made where the road user's speed is changed to the speed limit at the location where he reacted to the second party/danger signal. Everything else remains un-changed. In practice, in most cases this is based on the valid speed limit.

### 3.4 Accident and injury factors

When the events have been determined and the information processing and the element's significance is analysed, it can be determined which factors led to the accident and which were significant to the extent of the injuries. AIB uses a limited number of possible factors and these are related to the analysis of information processing and the significance of the elements.

**Accident factor:**

An accident factor is an adverse factor without which the accident would not have occurred.

**Injury factor:**

An injury factor is a circumstance which worsens the extent of personal injuries but has not caused the accident.

**Underlying factors**

An underlying factor is a clarification or an explanation of the determined accident and injury factors. It should be noted that the factors are generally circumstances which should not be present in traffic.

### 3.5 Measures/prevention

When accident factors are identified, it must be investigated which measures would in all likelihood have prevented the accident. Attention will be focused on the interaction between the road user, vehicle and road/surroundings. Road or vehicle measures will therefore be identified as solutions for road user related factors.

## 4. AIB Theme Reports

The AIB theme reports can be downloaded from the internet: [www.hvu.dk](http://www.hvu.dk). All reports contain a summary in English.

- The report on Motorcycle Accidents is available in English: Motorcycle Accidents, 2009. English version (pdf).
- Road traffic accidents between cyclists and motor vehicles at road junctions, 2008 (pdf).

- Road traffic accidents involving lorries turning right and cyclists travelling straight on, 2006 (pdf).
- Road traffic accidents with vans, 2005 (pdf).
- Road traffic accidents on motorways 2003 (pdf).
- Single vehicle accidents with drivers under the age of twenty-five, 2002 (pdf).

## Norway

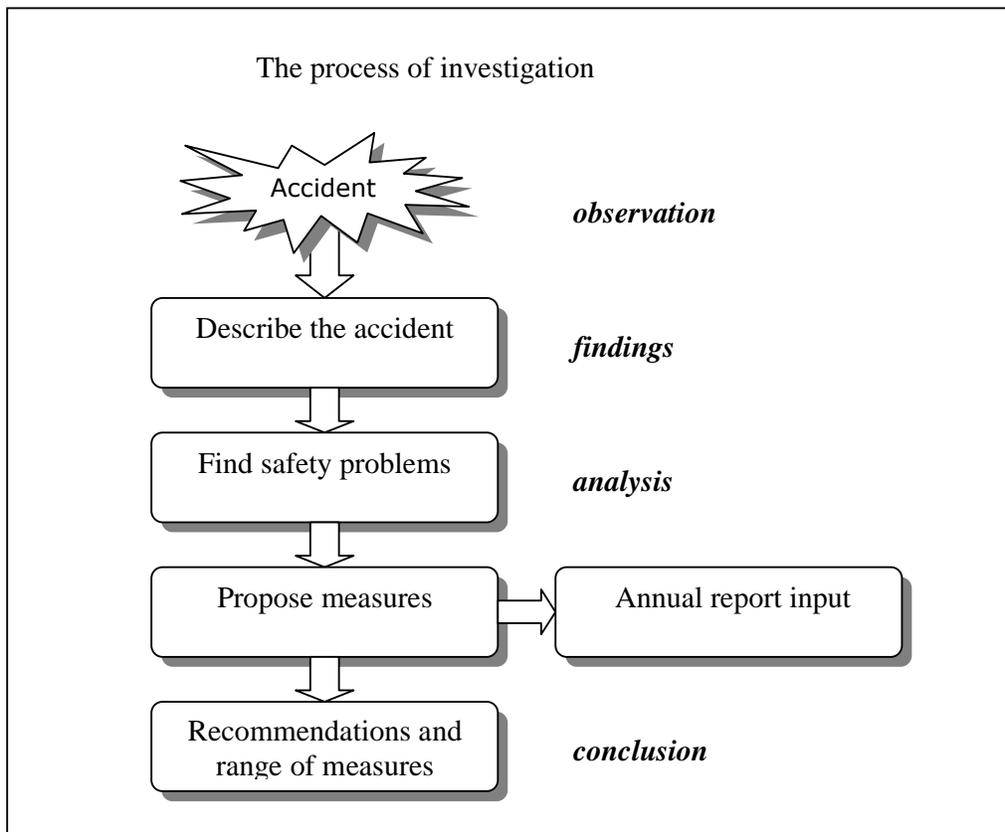
### Crash investigation of Norwegian Public Roads Administration (NPRA)

#### Background

The purpose of conducting in-depth analyses of fatal road accidents in Norway is to learn more about what causes accidents, to be better prepared to implement preventive measures.

The Norwegian Public Roads Administration (NPRA) is responsible for the field of road safety and is the owner of the Norwegian road accident database.

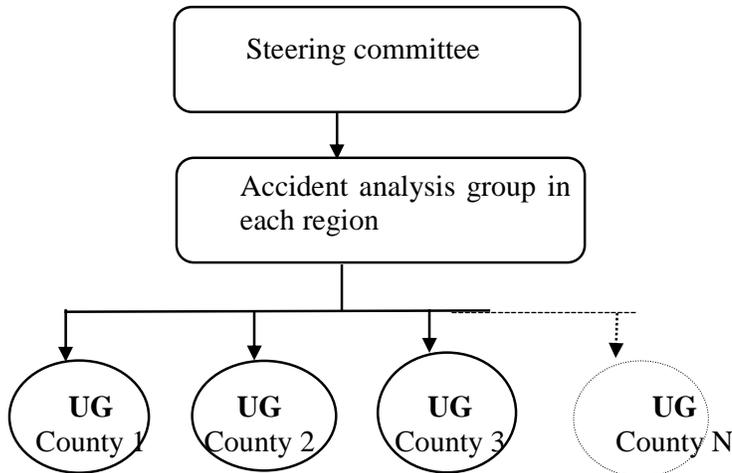
The NPRA is obliged to and has the authority to investigate limitations of the road, the vehicle and the road-user. There is a need for more information about causal factors in road accidents.



## Organizati

In-depth analysis is organised on three levels

1. Steering committee
2. Accident analysis group
3. Accident group



UG = Data collection group in each county

### 1. Steering committee

The five regions are allowed to choose whether to have a steering committee. However, the work must be deeply rooted in the organisation. Therefore, the regular management meetings at regional level may function as a natural steering committee. The tasks of the steering committee are to

- Initiate the establishment of the accident analysis group (regional level) and the accident groups (district level)
- Ensure that the participants in these groups are trained
- Collect the reports from the accident analysis groups

### 2. Accident group

In general, an accident group is established in each district. In some cases several districts set up a joint accident group. The advantage is that less people are involved and those who are involved analyse more accidents and gain more experience. On the other hand, this requires more effort from each participant and therefore constitutes a larger proportion of each employee's position. Additionally, the geographical distance to some accidents will be longer.

The members of the accident group need expertise/know-how and insight in the following areas:

- Roads
- Vehicles
- Road-users

The accident group collects information necessary for the analysis and begins to process the raw data. It is recommended that one person in the group visits the accident site immediately in order to record accurate information about easily changing conditions (e.g., weather, road). This includes taking pictures of the vehicles involved in the accident. After this visit to the accident site first-hand information is entered in a provisional form that goes to the heads of relevant departments and sections providing central information of the accidents.

If needed, the group can revisit the accident site as soon as possible together with the police.

Together with all the documentation from the accident group, the Region takes over the processing of the raw data, normally within 4 weeks after the accident occurred.

The project manager of the accident group coordinates and prepares (in dialogue with the district leader) a list of relevant persons for accident site visits. The list is updated every 3 months. The project manager should also train new persons in the group and advise the group members in the processing of complex accidents.

### **3. Accident analysis group**

One accident analysis group is established per region. This group advises the local accident group and completes the analysis using the received documents and data from the accident group. This group finalises accident reports and writes annual reports. Minimum three persons should be in the group, covering the following areas of competence:

- Roads
- Vehicles
- Road-users

The accident analysis group is subordinate to the steering committee, whose members may be employees of a district office and therefore also members of the accident groups. It is recommended that one of the members should be from the analysis group to ensure information exchange between the accident groups and the accident analysis group. An alternative is that each member of the accident analysis group follows up a certain number of accident groups.

In addition to the members described above there is also a medical doctor in each group. This member should be appointed by the relevant regional health unit. The tasks of the medical doctor are to

- Consider which conditions have led to the fatal outcome
- Consider whether medical or other road-user conditions might have contributed to the accident
- Consider what treatment of injured persons after the accident might have led to the worsening of their condition.

On average each accident analysis group analyses about 50 fatal accidents per year. This means that the work involved is an important part of the appointed members' tasks.

#### **4. The organisation at a national level**

The Directorate of Public Roads is responsible for initiating and following up the accident analysis work as well as analysing and publishing the results. Together with the heads of the five accident analysis groups, the appointed members from the Directorate form a group that ensures progress in the accident analysis work and exchange of competence between the regions. This group also presents the results to relevant areas/departments within the Directorate and the regions and considers needs for training involved persons. This group is also the link to the Accident Investigation Board Norway (air traffic, railway, maritime and road traffic). Privacy - confidentiality Ethical guidelines/directions. An in-depth analysis of fatal road accidents is a natural part of the work of the NPRA aimed at providing information about conditions that contribute to fatal road accidents. The results are currently used by the NPRA to improve transport safety. Therefore, this activity can hardly be considered as research; it is, instead, a natural and regular part of the work of the NPRA. Road, traffic, or operational conditions that might have contributed to the accidents may be revealed. Conditions of the vehicles or road-users and their behaviour might also be revealed, as well as conditions at the organisational level. This means that the involved persons and the accident groups have information and assumptions that may be sensitive for implicated persons. Everyone that carries out services or works for an administrative organ is obliged to the duty of confidentiality according to the chapter 13-13f of the Public Administration Act. Sometimes the analysis of an accident requires participants that are not from an administrative organ. If so, they must sign a standard written agreement that requires them to follow the same rules of confidentiality.

#### **Cooperating with the Police and the Administrations of Justice**

The police have access to the accident report which includes access to confidential information. If there is a trial to determine who is to blame, and the accident has been analysed by a accident analysis group, the police may use information from those involved in the accident report. The Ministry of Transport and Communication must normally approve the use of confidential information presented in a trial as testimony. The presentation/use of the report by the accident analysis group must be considered based on the police's own regulations after they have received the report.

Therefore, it is important that the NPRA is aware of our obligation to inform the police when needed. Further, members of the NPRA are obliged to tell the truth when called upon by the courts. Accordingly, persons that appear as expert witnesses in a trial must be clear and open about this obligation when communicating with involved persons. Actual findings and statements shall be presented and documented for those who have the right to this information.

## **Turkey**

### **Crash investigation – general principles in Turkey**

In accordance with the Turkish Traffic Legislation, traffic accident is defined as below:

“A traffic collision on the road resulting in death, injury or casualty where one or more than one moving vehicle get involved.”

In traffic accidents, depending on the judicial investigation, statistical information and insurance law, crash investigation is carried in order to provide detection of violation and violator with evidences and to detect casual link between behaviour and result. Then the accident report is issued. Furthermore, the acquired information is processed on POLNET accident database, and is used to eliminate the causes affecting the occurrence of the crashes. Traffic police is generally responsible for the crashes, whereas gendarmeries in their assigned fields. According to their zone of responsibilities, traffic police or gendarmerie units interfere with all crashes resulting in injury or death. Judicial procedures are executed by police stations or gendarmerie order units. Accident report, issued after the completion of crash investigation, is submitted to judicial authorities (The procedure for the accidents resulting in injury or death).

#### **A. The Accidents Resulting in Material Damage**

With the project put into effect in April 1, 2008; if the parts mutually agree on issuing the accident report, the procedures can be carried out by the accident involving drivers personally without intervening of the traffic police, in the accidents resulting in material damage.

However, if

- a) the accident results in death or injury;
- b) one of the vehicles does not have compulsory insurance;
- c) one of the parts does not have driving licence or it is not appropriate for the type of the vehicle,
- d) one of the drivers is suspected to have alcohol or drug;
- e) one of the vehicles belongs to state institutions or organisations, or diplomatic missions,
- f) state property or goods of third party is given harm;
- g) one of the vehicles is registered in foreign country;

the parts shall not agree, the procedures like evaluation of crash are executed by the traffic police. In the accidents resulting in material damage, if the parts do not mutually agree; the crash is intervened by traffic police, and Accident Report is issued.

#### **B Procedures for the Accidents Resulting in Injury or Death**

1. The closest traffic unit is dispatched to the scene of crash as denouncement is received.
2. The first unit arriving to the scene takes safety precautions.
3. First aid team and other supporting units are called to the scene.
4. The injured are dispatched to the hospitals.

5. A thorough investigation is carried in the scene; all kinds of evidences including road, vehicles and break marks are detected.
6. The photos of the scene and video record are taken.
7. The public prosecutor is informed for the accidents resulting in death and serious injury, and is expected to arrive in the scene.
8. If the drivers are in good condition, their BAC is detected by breathalyzer; or else blood sample is taken.
9. The information of driver and vehicles are collected.
10. The coordination of crash point is detected by GPS to create a digital crash map; first transferred to report and then to database.
11. The scene is cleaned up; security of traffic flow is provided (If crash is caused by a technical problem of road, necessary markings are done and stated in the accident report).
12. In the light of the information collected, Accident Report is issued and submitted for judicial process.
13. When record of statement and other documentary procedures are completed, the parts involving in accident are first called to prosecution and to court.
14. Accident Report is registered to POLNET accident database.

### **Compulsory Traffic Insurance**

It is obligatory for the vehicles to make compulsory traffic insurance by the keeper for preventing death or injury, or suffered damage to provide fulfilling the responsibilities. In the circumstances that the vehicle which causes loss after a crash would not be identified, or the vehicle would not keep the compulsory traffic insurance, or the insurer would go bankrupt, or the keeper would not be held responsible for the stolen vehicle; the expenditures are met by the Assurance Account within the fund of Insurance.

### **Compulsory Highway Passenger Transportation Personal Accident Insurance**

It is compulsory for the busses making highway passenger transportation nationally or internationally to have the “Compulsory Personal Accident Insurance” in accordance with the cabinet decision.

### **Assurance Account**

Assurance Account meets medical treatment expenses of those who suffer bodily injuries (such as injuries, disabilities and death) under any coverage provided under compulsory insurances, and pays disability indemnities to those who become disabled due to such accidents and also death benefits to dependents who have been deprived of the deceased’s support in case of death.

## **INSURANCE PROCEDURES**

### **Compensation in Accidents Resulting in Material Damage**

- The accident report issued by the parts has the same force as the Traffic Accident Report by traffic police.
- The referenced insurance company submits the report and photos, if available, to Traffic Insurance Information Centre (TRAMER) electronically, till the end of the following workday, at latest.
- TRAMER submits the report and photos, if available, to Traffic Insurance companies and Comprehensive Insurance companies electronically, till the end of the following workday, at latest.
- The insurance companies perform an evaluation of liability according to the Report in proportion to %0, %50 and %100 considering the crash chart within 3 workdays following the submission of the report and photos, if available, by TRAMER.
- If the report received by TRAMER results in different evaluations than the company's evaluations within 3 days following the submission, the Report and photos are presented to Report Evaluation Commission within the body of TRAMER.
- The Commission definitely determines the liability proportions as %0, %50 and %100, analysing the report and photos, if available. The result is submitted electronically to the related companies through TRAMER within 3 workdays.
- In case that there is no mutual agreement in accidents resulting in material damage, or the parts would not issue a statement because of any reason;
- Accident Report shall be issued by the traffic police or the gendarmerie.

### **Crash Investigation Trainings for Police Officers**

Within the scope of Road Traffic Act, the crash investigation trainings are scheduled by Traffic Training and Research Department in order to contribute the experience of the traffic personnel working in centre and provincial institutions of Turkish National Police who interfere and issue Traffic Accident Report. 70 hours of training is applied in 10 workdays. With these trainings; it is aimed to scientifically perform the crash investigation, to provide detection of violation and violator with evidences and to detect casual link between behaviour and result.

### **EXPERTISE**

Expertise activities in our country are basically performed in accordance with the provision of three codes: "Code on Criminal Procedure (5271), **Code of Civil Procedure (1086)** and **Code of Administrative Procedure (2577)**". It is decided directly by the judge, upon the request of public prosecutor, participator, the suspect or the accused, defender or legal representative to receive the opinion of the expertise in case of special and technical requirements needed. In phase of investigation, public prosecutor can also use the authority defined in the Article.

**In accordance with the Road Traffic Regulation of Road Traffic Act;**

If the traffic police or police assigned in traffic units is chosen by the authorities or assigned due to the Codes, they can expertise for crashes. Traffic personnel bearing the certificate “Crash Research and Expertise Training” can be assigned as the “Traffic Expertise” by the court. Furthermore, the personnel working in “traffic teams” of Gendarmerie General Command can also be assigned as expertise according to the Codes. Besides, the below mentioned institutions and qualified personnel within can be assigned as traffic expertise in the presence of the court;

- Forensic Medicine Specialised Board of Traffic
- Technical Universities
- General Directorate of Highways

Mechanical engineers are assigned as expertise regarding the detection of technical defects of vehicles, whereas civil engineers for defects of road.

## **United States of America**

### **Multi-disciplinary Crash Investigation- United States of America (USA) National Highway Traffic Safety Administration**

The National Highway Traffic Safety Administration (NHTSA) has two multi-disciplinary crash investigation efforts:

- (a) The Crash Injury Research and Engineering Network (CIREN) program which is collaborative research involving in-depth studies of crashes, injuries, and treatments at six Level 1 trauma centers; and
- (b) The Special Crash Investigations (SCI) program which serves as an early warning system and provides details on crashes involving motor vehicles with new technology.

Below we provide information on each of these.

#### **Crash Injury Research and Engineering Network (CIREN)**

The Crash Injury Research and Engineering Network (CIREN) is a program in the Human Injury Research Division at the National Highway Traffic Safety Administration. The CIREN is a true multidisciplinary crash investigation and research program based on prospective data capture, established engineering principles and experienced input from trauma physicians. The CIREN Centers are located at Level 1 trauma centers across the United States of America. CIREN combines real-time medical data capture with vehicle and scene investigations to develop injury causation scenarios based on a team review of the evidence available from the case. A CIREN team consists of a team coordinator, crash investigator, mechanical engineer experienced in crash dynamics/biomechanics and a trauma physician.

All enrolled occupants must sign an Institutional Review Board (IRB) approved informed consent from the enrolling facility to participate in the program. This consent allows CIREN researchers full access to the occupant's medical record, including radiology. However, any personally identifiable data points are sanitized prior to final case submission and storage. Initial crash information is gleaned from a Police Accident Report (PAR), which is a publicly available document. The crash investigator conducts a full scene and vehicle inspection, measuring crush characteristics and occupant contacts. CIREN occupants are protected by a Certificate of Confidentiality issued by the National Institutes of Health, which prevents disclosure of information.

Final assembly of each CIREN case is conducted in a multidisciplinary meeting involving all team members and other appropriate professionals. The review process combines the evidence from the crash and from the detailed medical data (radiology images) with the veteran insight of trauma physicians and experienced mechanical engineers to establish causation scenarios for all significant injuries sustained by the occupant. Any indicators of culpability are removed prior to the case being completed.

**How the information in CIREN has been used:**

The information in CIREN is used on several different research fronts. Some of the past applications include illustrating the high long-term costs and disability associated with ankle and hind foot injuries. Although these injuries are not life threatening they often leave the occupant with change of life issues including permanent mobility problems, possible career issues and months of staged surgeries and/or rehabilitation. The sensitivity of the CIREN data and the 12 month follow-up that is conducted has aided the program in this work. Another finding has been injury to the acetabulum (pelvic portion of the hip joint) in frontal impact crashes. These injuries were discovered by CIREN due to the multiple injury coding systems applied to each case, which is unique to CIREN. This discovery has led to additional research by NHTSA and the development of new injury criteria to indicate acetabulum injury in crash test dummies.

CIREN initiated research 2006-07 to investigate small over-lap frontal crashes. This work was initiated after a trend of injury patterns was seen in CIREN indicating possible reduced effectiveness of the steering wheel air bag due to out-board movement of the occupant. Additional work has been funded on this topic to determine if and what kind of new testing procedure might be required to protect occupants in these types of crashes.

Elderly occupant injury is another area where CIREN has done significant work. CIREN's ability to capture pre-crash medical issues for an occupant (like osteoporosis) aids in the understanding of an occupant's tolerance to crash forces. CIREN's multidisciplinary approach allows the proper experts to review an occupant's radiology and other medical documentation to determine if there are conditions in place to influence injury causation. This is important since the medical documentation is designed to capture diagnosis and treatment not causation. However, the pieces of the puzzle are there and when properly addressed by appropriate experts answers can be obtained. The combination of access to ALL the medical documentation and the review by proper experts (medical and engineering) allows CIREN to investigate injury and crashes at a very detailed level.

**Special Crash Investigations (SCI):**

Since 1972, the Special Crash Investigations (SCI) Program has provided NHTSA with the most in depth and detailed level of crash investigation data collected by the agency. The data collected range from basic data maintained in routine police and insurance crash reports to comprehensive data from special reports by professional crash investigation teams. Hundreds of data elements relevant to the vehicle, occupants, injury mechanisms, roadway, and safety systems involved are collected for each of the over 200 crashes designated for study annually.

SCI cases are intended to be an anecdotal data set useful for examining special crash circumstances or outcomes from an engineering perspective. The benefit of this program lies in its ability to locate unique real-world crashes anywhere in the country, and perform in-depth clinical investigations in a timely manner which can be utilized by the automotive safety community to improve the performance of its safety systems. Individual and select groups of cases have triggered both individual companies and the industry as a whole to improve the safety performance of motor vehicles, including passenger cars, light trucks, or school buses.

### **Case Selection**

Cases of interest are located from an extensive and diverse network of sources, including NHTSA's Auto Safety Hotline, the Department of Transportation's National Crash Alert System, NHTSA's regional offices, automotive manufacturers, other government agencies, law enforcement agencies, engineers, and medical personnel.

Actual case selection is based on the program manager's discretion. The program's flexibility allows for the detailed investigation of any new emerging technologies, including the safety performance of alternative fueled vehicles, child safety restraints, adapted vehicles, safety belts, vehicle-pedestrian interactions, and potential safety defects. Historically, resources have been concentrated on crashes involving automatic restraints (air bags and safety belts), and school buses.

### **Data Collection**

Professional crash investigators obtain data and photographs from crash sites, which include studying evidence such as skid marks, gouges, fluid spills, and broken glass. They locate the vehicles involved, photograph them, measure the crash damage, and identify interior locations that were contacted by the occupants. The investigators follow up their on-site investigations by interviewing crash victims and other involved parties, and by reviewing medical records to determine the nature and severity of injuries.

Interviews are conducted with discretion and are held confidential. The research teams are interested only in information that will help them understand the nature and consequences of the crashes. Personal information about individuals, such as names, addresses, license numbers, and even specific crash locations, are not included in any public SCI file. Each investigation provides extensive information about pertinent pre-crash, crash, and post-crash events involving the occupants, vehicles, rescue, and environmental factors which may have contributed to the event's occurrence or severity. Included in each report is an analysis and determination of the occupant kinematics and vehicle dynamics as they occurred throughout the crash. Detailed performance evaluations of the air bag and any other safety features (particularly those related to any of the Federal Motor Vehicle Safety Standards) are provided. The participation and cooperation of automotive manufacturers, suppliers, law enforcement agencies, hospitals, physicians, medical examiners, coroners, tow yard operators, and the individuals involved in crashes are essential to the success of the SCI program.

## **Air Bags**

More than 1,200 air bag investigations have been conducted to date, about 50 per year. The SCI program established a census of the early air bag vehicle crashes which played a pivotal role in the establishment of Federal Motor Vehicle Safety Standard 208. Due to the rapid growth of air bag equipped vehicles into the marketplace in 1988, the program shifted gears from investigation of each air bag vehicle crash to investigating special interest cases involving such issues as non-deployment crashes, air bag related injuries, interaction with child safety seats, and new air bag equipped vehicles crashes. These SCI air bag cases have been utilized by the agency and the automotive safety community to understand the real world performance of their air bag systems, and have been instrumental in influencing subsequent changes to a number of production air bag systems.

## **School Buses**

Thirty-nine school bus crash investigations have been conducted to date. Included in this count are incidents of children being killed or injured as they enter or exit the loading zone. These cases are a useful tool to NHTSA in assessing the real world performance of conventional, transit, and van-based school bus crashworthiness and crash avoidance issues. Such issues have included mirror systems, hand rail designs, video monitoring of pupils, safety belt use, and joint strength.

## **Emerging Technology**

The SCI program's flexibility allows for the detailed investigation of any new emerging technologies related to automotive safety. A number of incidents involving alternative fuel vehicles, passenger side air bag deployments, vehicle-to-pedestrian impacts, and child safety restraints have been investigated. As was the case with the early SCI air bag investigations, these anecdotal investigations will be utilized by NHTSA and the automotive safety community to understand the real world performance of these systems, and will result in increased safety from subsequent second and third generation improvements to these new technologies.

## **Availability of SCI Information**

Copies of completed SCI reports are made available to the crash victims, families of crash victims, and the investigating police jurisdiction upon request. Copies are automatically sent to the automobile manufacturer of the subject vehicle.

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