A Scientific Study
"ETAC"
European Truck Accident Causation

Full Report
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1 Introduction: presentation of the European Truck Accident Causation study

1.1 The project and its objectives

Currently, only limited statistics are available regarding accidents involving trucks and even less is known about the cause of these accidents. To fill in this lack of knowledge, the European Commission (EC) and the International Road Transport Union (IRU) launched a unique scientific study, the European Truck Accident Causation (ETAC) study. The aim of the study is to identify the main causes of accidents involving trucks. This information can be used to give guidance to policy and decision makers for future action which can contribute to the improvement of road safety. The detailed objectives of the study are presented below:

- To identify the main cause and the causal sequence of accidents involving trucks,
- To develop a scientific, widely accepted and internationally benchmarked methodology,
- To have expert teams investigating over 600 truck accidents,
- To make results available to the research community and other relevant parties,
- To recommend actions that could reduce truck accidents and/or their seriousness,
- To develop European homogeneous database:
  - Focussing on truck accidents,
  - Investigating in depth into the accident sites,
  - Identifying truck accident causation.

The results of the study were put together in a database containing road accident causation criteria and a final report. They were established in a scientific, unbiased, independent manner, which enables the identification of truck accident causation. The advantage of this new accident data collection is that the study focuses on truck accidents and allows an in-depth accident investigation, using the same methodology and data codification in many European countries. There are two levels: a global one (drive, behaviour, infrastructure, vehicles, environment…) and a more detailed one which focuses precisely on the causes to enable the development and implementation of effective countermeasure to target the main causes of accidents involving trucks.

Road safety is a major preoccupation of the European Commission and the road transport industry, and depends on numerous significant factors. Many projects and research initiatives have been launched (or will be launched) by the EC to reduce the number of road accidents. Although the main aim is always the same, the specific objectives of these projects are different: some of road safety problems can best be addressed by European regulations, others directly tackled by vehicle manufacturers by the improvement of passive or active safety (projects such as EACS, MAIDS, ECBOS), by infrastructure stakeholders by improvement of the road or the visibility of road markings, by trainers by driver training or pedestrian training and also from the road transport industry, road safety achievements, can be realised.
For each accident, over 3000 parameters are available and so the full database permits:

- The identification of main causes of accidents involving trucks
- The reconstruction of the pre-collision phases
- The identification of critical situations;
- The analysis of malfunctions;
- The definition of scenarios of accident types;
- The study of the information needed by drivers in the "pre-collision" phase;
- The quantification of the potential interest of certain means to help the driver.

In total, 624 accidents involving at least one truck have been investigated in depth, evaluating over 3000 parameters per accident. All the accidents were investigating on the scene of the crash.

Whereas there are other accident investigation studies, the ETAC is unique in its approach, due to its scientific complexity.

Despite the complexity, the study can be easily repeated due to easy access and usable guidances.
1.2 Technical support and coordination

IRU has involved CEESAR* in the co-ordinating activities and in the setting up of a commercial vehicle accident database, based on CEESAR’s previous experience in accidentology and its participation in several important European road safety projects. CEESAR has:

- Selected the truck accident investigation teams who participate in the project: each team is presented in the annex at the end of the report. All the teams are experts in the investigation of road accidents and especially in truck accident. They are well known in their countries and internationally, scientifically recognised and attend to many European project such as TRACE†, APROSYS‡, APSN§, CHILD**, SAFETYNET, PENDANT††…

The experts are coming from Germany, The Netherlands, Italy, Hungary, Slovenia, Spain and France. The accidents in all these countries are comparable. It means that you have accidents happening in similar infrastructure or conditions.

- CEESAR has established the ETAC database, checked and fine tuned by the other ETAC teams. This one is not a freezed database. Indeed it is a living one. You can add truck accidents to increase your sample to make studies,

- CEESAR provided the ETAC Questionnaire‡‡ and the ETAC database manual§§ to the truck accident investigation teams. Both questionnaire and manual have received feedback from the expert teams and were finalized by CEESAR. Overall, it can be set that the methodology of the accident investigation is systematic and a benchmarked methodology which has ever proved its ability internationally,

- Ensured the quality of all aspects of the survey, especially of the data entered into the database by the truck accident investigation teams.

The following table presents a complete summary of all accident collected and coded for the ETAC project by each teams.

<table>
<thead>
<tr>
<th>Accident distribution per country</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEESAR</td>
<td>26</td>
</tr>
<tr>
<td>CIDAUT</td>
<td>60</td>
</tr>
<tr>
<td>DEKRA</td>
<td>174</td>
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<tr>
<td>IDIADA</td>
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<tr>
<td>IBB</td>
<td>127</td>
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<tr>
<td>REKONSTRUKCIJA</td>
<td>140</td>
</tr>
<tr>
<td>TNO</td>
<td>40</td>
</tr>
<tr>
<td>PAVIA</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>624</td>
</tr>
</tbody>
</table>

* CEESAR is a non-profit making association created in 1993 to undertake research and studies into road accidentology and biomechanics.
† TRaffic Accident Causation in Europe
‡ Advanced PROtection SYStems
§ Advanced Passive Safety Network
** CHild Injury Led Design
†† Pan-European Co-ordinated Accident and Injury Database
‡‡ See Volume 2
§§ See Volume 3
The final delivery of the ETAC study contains:

- Volume 1: ETAC final report,
- Volume 2: ETAC Questionnaire,
- Volume 3: ETAC Manuel,
- 5 DVDs containing all the multimedia database linked to the accidents,
- 1 CD containing:
  - the database
  - the software to view the database,
  - the database in Access format,
  - the volume 1, 2 and 3, of the ETAC study, in pdf format.
2 Accident investigation procedure

2.1 The accident selection

2.1.1 The general requirements

- 624 truck accident cases have been collected over a 2 ½ years period. Data collection has started on the 1 April 2004 and has finished on the 30 September 2006.

- All truck accidents are investigated using the same methodology. This one has been proposed and developed by all the teams and approved by the European Commission and the International Road transport Union.

- Truck accidents are collected from sample areas which are statistically representative of the national truck accident situation (urban area, non urban area, highway, inter-urban road…).

- All accident cases are investigated on the spot as quickly as possible by a team composed of accidentology and data collection experts.

The sample area is chosen by each team. They considered it statistically representative of the national truck accident situation.

For example, Rekonstrukcija, in Slovenia, has chosen three sub-areas which are easy to access by their team and which as representative as possible of national truck accident.

The teams are warned of the accident by the authorities who can be able to know where and when there is an accident. According to the countries, it is the emergency service, urban police, highway road police or other system of police. The teams have established a connection with them. Then as soon as teams have been contacted, these ones compare the accident with the ETAC criteria selection and estimate the time to go on site and the type of the accident. In order to have the more information as possible, team go on site just after the call. The mean time to go there is from 30 minutes to 1 hour. Nevertheless, according to countries and its laws, sometimes it is not possible to go directly on the accident just after the warning. But in this case, teams have informed the policy (who is on site very quickly) to do the necessary things (road-marking, report, pictures…). Teams are able to go on scene later where they can still collect information. Further they can check the validity of this information with police report.

Moreover, each team has a link with the hospitals concerned with the accident. Then, they can have the injuries report.
Figure: Accident analysis procedure
2.1.2 The selection criteria

☑ Each studied accident involves at least one truck (commercial vehicle of Gross Weight >3.5t), the accident configurations are presented below:

- a single truck (rollover, against a fixed obstacle…) or
- The proportion of accident cases examined which involves one truck to the exclusion of any other vehicle(s) shall not exceed 10% of the cases studied by each truck accident investigation team. This limit is benchmarked to the national statistics.
- a truck and another vehicle (truck, car) or
- a truck and a vulnerable road user.

☑ All accidents involve at least one injured person. The ETAC study has chosen only severe accidents (as one of the criteria is that the accident involves at least one injured person) because if we want to save the life of road users, it is necessary to focus on only injured accident in order to well understand the specific mechanism of occurrence.

☑ On-spot investigation of the accident, possible if:

- The vehicles are still in their final position.
- The collection of information on infrastructure, vehicles and people involved in the accident (all together, they cover around 3000 parameters) can be fulfilled.

☑ The accident is studied in depth, covering both passive and active safety.

All these conditions must be fulfilled otherwise the accident won’t be investigated.
2.2 The data quality

2.2.1 On the spot

It has been proven that the best way to understand the causation process was to go on the scene of the accident as soon as the accident has occurred. Deferred investigations (several hours or even days after the accident) prevent the analysts from getting useful information such as occupant interviews, witnesses evidence, road state, vehicle marks on the road, traffic conditions and so on. It is true that some of the information can be found in police reports but experience has shown that police reports do not provide in-depth information. Policemen are not professional safety researchers. The police reports were only considered as additional information.

2.2.2 The accident investigators

The accident investigators are well known national experts. They collect the information directly on scene or later on at the hospital. They use the police report as seldom as possible. If they are called by the police and reach the accident scene after the driver has left or the vehicles have been moved and the crash or final positions of the vehicles or other participants in the accident cannot be determined, the accident must not be investigated. The objective is to obtain as much information as possible to enable cognitive and cinematic reconstruction of the accident.

After the collection of the information on scene, complementary information is collected at the hospital (especially second interview of the person involved and collection of the injury form) or at the local transport authority for further details about the traffic or road configurations.

2.2.3 The accident coding

Most of the information can be coded and entered into the database according to the instructions contained in the Guide. The coding is the essential link to be able to draw the conclusions to identify the main causes of accidents which is the aim of the study. Information that can not be coded is conserved in original files along with photos, sketches and video movies if necessary and can be indicated in the window reserved for the accident summary. All the information in the database, for each accident, consist around 3000 parameters.

2.2.4 The methodology assessment

This accident investigation methodology has several advantages. It is the best way to understand the accident because teams arrive at the same time as the police and the rescue services and collect as much information as possible on the spot. They have in depth knowledge of each accident and its causation. The only way to know more about accident causation is to be in the vehicle with the driver and to read his mind when he is confronted with an emergency situation.
2.2.5  The accident requirements

The teams follow defined requirements which are:

- Selection of **accidents investigated on site and in real time** (the earliest accidents for inclusion are those occurring after 1 February 2004 and still under investigation on 1 April 2004),

- Use of worksheets corresponding to the **questionnaire** (the questionnaire contains all essential accident information to identify the main truck accident causes (the questionnaire was available with the manual at the 1st seminar - 14th April 2004),

- Collection of data as much objective and descriptive as possible (on scene, by interviews or physical examination) according to the team’s experience and the **methodology** agreed by IRU and CEESAR for the ETAC project,

- **Study of the vehicle and the accident** scene according to the team’s experience and to the ETAC **methodology**,

- Respect of **encoding data** according to the instructions contained in the **Guide**,

- **Shot of pictures** as relevant as possible (see further details),

- Inclusion of the best photos in the ETAC databank (see further details),

- The systematically **interview** of all the people involved (drivers, passengers) and if it is possible the policemen, eye witnesses, doctors…

- Complement of all the information as soon as possible in order to have the less missing information,

- Collection of **medical information** directly from hospitals,

- **Drawing of the accident site map** and preparation of the **reconstruction** according to the ETAC methodology,

- **Reconstruction** of each accident and as many as possible simulation, according to the ETAC methodology,

- Writing of a short narrative of the accident (see further details),

- The not inclusion of incomplete or uncertain accident cases,

- Report of each team of its **National Accidents Statistics** and its **local Statistics** in relation to their survey area for the period 2004/2005,

- Respect by each team of team safety requirements as follows: safety during the journey there and back (compliance with speed limits and all relevant traffic rules), safety on the site of the accident (regulatory and phosphorescent clothing).
2.3 The accident investigation procedure

2.3.1 The general outline

The accident investigation procedure covers the investigation on the scene of the accident, the analysis of the collected information and the reconstruction.

Figure: In depth investigation methodology
2.3.2  First investigation - On the scene of the accident

The first investigation is on the spot of the accident, where and when you have lots of information needed to well understand the accident.

The “driver investigator” interviews non-injured drivers, on the scene of the accident, about the pre-crash, crash and post-crash situations. The driver thus benefits from visual references on the accident scene and his account of the accident scenario is richer. If the driver is injured, the length of the first interview depends on his state. If the driver needs immediate medical treatment, then the investigator collects as much information as possible on the scene of the accident from passengers and witnesses, and then he goes to the emergency ward of the hospital. If the driver is dead, teams see if it is possible to collect enough information to study in depth the accident, otherwise, they don’t study it.

The first interview takes place just before or after initial medical treatment, unless the driver is unconscious or undergoing emergency surgery, in which case the interview takes place after a few days.

The “road investigator” marks the rest position of the vehicles and all the marks that they have left before, during and after the crash. Then, he takes pictures of the accident scene from a road infrastructure point of view (final position, skid marks, road geometry, road surface, weather conditions…). Once all this volatile information has been photographed, he draws up a sketch of the accident scene which includes the approach path of each vehicle, the skid marks, their rest positions, the road and roadside geometry and road signs…

The “vehicle investigator” photographs the vehicles in their rest position, the deformations, the state and use of vehicle equipment, load etc. Once this is done, he examines in detail the use and the condition of the various equipment (lighting, radio / telephone, seat position and belt use, gear level position, tyre pressure, etc…). He also talks to the emergency services about their extraction methods and any other changes that they might have realised on the vehicle.

Reminder about SAFETY - Each team had to pay special respect to safety regulation regarding the on site accident investigation. This means safety during the journey (compliance with speed limits and all traffic regulations) and safety on the site of the accident (regulatory and phosphorescent clothing).
2.3.3 Second investigation - Further investigation

If necessary, investigators investigate again the accident on the scene or in another place (where the car has been impounded for example) but not in real time. During the first investigation, the main information investigators have to take are information you only have when you work in real time. That’s why sometimes it is essential to have a second investigation to well understand the accident and to be sure of what happened during the accident sequence.

The “driver investigator” meets the drivers once again to discuss personal and medical details, usual general driving, training, previous accidents and sanctions, before coming back to the accident situation. The information collected from the other driver and the other accident investigators is used to corroborate or to contradict the driver’s initial declarations.

The “road investigator” collects complementary information about the road geometry, pavement friction and traffic conditions (density, speed, etc.). He uses this information to complete his accident sketch and then draws up a plan of the accident scene to scale.

The “vehicle investigator” returns to see the vehicle and carries out a more in-depth study of the vehicle engine, braking, steering systems, other equipment and its condition. He also measures vehicle deformation and looks for impact zones inside and outside the vehicle, which may correspond to injuries sustained by the occupants or a pedestrian or the impact of another vehicle.

Figure: Plan of an accident scene
2.3.4 The accident analysis (primary and secondary point of view)

Experts encode the information about the crash: vertical and horizontal overlap of the crash, crushed surfaces, depth of the crash deformations,….

For instance, the encoding of the vertical overlap is available in the manual of the questionnaire.

Experts evaluate the energy dissipated through vehicle deformations (so called Equivalent Energy Speed) with the support of a crash test library, previous reconstruction and experience.

The reconstruction of the accident - The information collected by the three investigators is then used as the basis for a dynamic reconstruction using PC-Crash software or another software. The conservation of energy equations are used to give initial dynamic parameters. The scale 3D map serves as the background for a reconstruction which starts at the rest position of the vehicles, and goes back in time through the post crash, the crash and the pre crash phases. Each phase is based on the information collected by the investigators.

The accident is analysed according to a sequential model based on:
- Accident type(s)
- Sequence of events

From a secondary safety point of view, the occupant’s medical report, which is supplied by the local hospital, is used to correlate the injuries sustained with the accident injury mechanisms and the zones impacted inside or outside the vehicle.

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2.3.5 **Accident definition**

Before beginning to explain the accident causations, it is necessary to well define the approach of the accident we have. In this project, an accident is considered as a sequence of several phases which are linked chronologically and by causalities, for each vehicle involved. The sequence is shared in 3 main parts which are: the pre-collision (before the collision), the collision (the main impact for each vehicle) and the post-collision (after the main impact, what was the kinematics of the vehicle). So, obviously, to understand why the accident happened, it is necessary to identify what happened during the pre-collision phase.

The progress of one vehicle involves in the accident is generally broken in the sequence of the accident by a rupture phase. This one happens just few seconds before the collision and characterizes a deteriorated driving situation. That’s why a driving situation, then a rupture phase (something happened), then the emergency phase (very deteriorated phase in which you try to control the situation), the collision phase (collision with another vehicle for example) and finally the post-collision phase (all the kinematics of the vehicle from the end of the collision until their rest position) have been distinguished.

In the project, the expert had the objectives to determine and to describe each phase of for each driver involved in the accident. So, they look for events which moved a situation to another. The events for the accident situation is called “precipitating event”. In the example, the precipitating event is “the secondary task”. After this event, the driver begins a reaction phase. Nevertheless, there is no collision yet because the driver can return to a normal driving situation thanks to avoidance actions during the emergency phase.

That’s why, after this step, the experts looked for components which were able to contribute to the accident. We call these components “The accident contributing factors”. These ones can explain the precipitating event or can make worse the driving situation. In our example, the secondary task or the high speed of the vehicle are accident contributing factors or the raining weather can be another factor. The combination of all these factors has contributed to the accident. If there were not these factors, the accident wouldn’t maybe have happened.

In a complementary way, experts have collected the medical reports which describe all the injuries of all the persons involved in the accident. The experts have determined too what was the main impact during the accident. The main impact is the impact which causes the more severe injury for a person in the vehicle.
3 Database: data coding and data manual

The Database, the questionnaire and the manual has been created by CEESAR. Indeed, CEESAR works on Truck accident for nearly 20 years. Nevertheless, CEESAR has relied on its French experience (RIDER†††...), its experience of other European projects (EACS‡‡‡, MAIDS§§§...), the database of TNO and databases published in the USA to have the possibility to realised and to optimised complete database, questionnaire and manual which are useful to identify the main causes of truck accident.

The first version of the manual and the guide has been send to the teams in May 2004. The database software has been created and developed at the beginning of the project in April 2004. After its creation, it has been tested, improved and sent to the teams in October 2004. These ones have given comments to it and the last version of the database software was given in December 2004. The presentation of the database has been done during the second meeting (October, 22 2004).

The database software has been created to be used by different countries and users. So its environment is friendly and its use is easy. Nevertheless, a questionnaire and a manual are provided with it, in order to help the users to well understand the question and to know what to answer. They will be described in the next two parts.

3.1 The database content

A common database, within around 3000 parameters per accident, has been created to record all accident cases. The standard format of the software is Windev but the final database is available in Access format. In this format, the database is easily accessible and usable for the accident research community.

Data are collected and encoded according to the common questionnaire. This questionnaire is the reference for the teams to know which information they need to collect.

The same data codification is used by all the investigation teams.

††† Research on Accident involving Motorcycles
‡‡‡ European Accident Causation Survey
§§§ Motorcycle Accident In-Depth Study
Digital photos:

**Vehicles** - photos around vehicle, the inside of the vehicle, specific information or vehicle defects, crash deformation…They give information about the violence of the collision and characteristics on the impacts on the vehicles.

![Figure: Pictures of the vehicles](image)

**Roads** - the surface and its state, the friction problems (if pertinent), visibility problems, road markings, the point of impact, skid marks, sliding marks, scratching marks…Moreover, road marks explain the kinematics and the positions of the vehicles during and after the collision.

![Figure: Road pictures](image)
**Environment** – the conditions of the journey just before the crash: photos of the immediate surroundings of the approach route (visibility, geometry of the road)…The geometry of the road, restrictive visibility might have contributed to the accident, that’s why pictures taken before the crash can explain what happened just before the accident.

![The curve before the crash](image)

*Figure: Environment pictures*

**Sketches of the accident scene drawn with specialised software:**

In order to have a general and precise overview of the accident, two sketches of the accident are requested:

1st sketch - an accurate drawing with the rest positions of the involved vehicles, the marks on the road surface (skid marks, scratching marks, sliding marks, point of impact…). Visibility problems, road friction coefficients, road and shoulder profiles (described in the database presentation), should figure on the sketch, as well as everything that can help to understand the accident. An indication of the scale is necessary.

![Sketch 4: Complete sketch of the accident scene](image)

*Figure: sketch – general overview*
2nd sketch - in relation to the reconstruction and the pre-crash table (further detailed in the database presentation), a sketch with the relative position of the vehicles linked to their time to crash and their distance to crash.

![Sketch with precise kinematics](image)

**Figure:** sketch – precise kinematics
3.2 The ETAC Questionnaire (Volume 2)

The common questionnaire, based on the common methodology for accident causation research, has been elaborated by CEESAR, improved by the European partners and approved by the EC and the IRU.

The questionnaire has been created to collect and code all pertinent information.

The questionnaire oriented to truck accident causation is divided into 5 different parts. Each part corresponds to a window in the database software. So the teams know which information they need to code the accident in the database, thanks to the questionnaire.

General information – these information are linked to the general accident information. So, it means that only one general information per accident are available. In this part, several general information are distributed in different fields:

- **Identification**: this is the code of the team which has coded the accident, the place, a description of the accident and the number of the accident,
- **Implicated**: this is about the total number of vehicles and pedestrian involved. The number of implicated are informed,
- **Date and location**: the date and the location (location type and type of area) are coded,
- **Weather conditions**: It is the description of the environment thanks to several variables (temperature, precipitation, wind, light condition…),
- **Accident type**: there is the information about the scene of the first impact, the accident configuration and the severity of the accident,
- **Summary and comments**: This is a free field in which relevant (but non coded) information can be added. It can help to explain the accident. Comprehensive and summary information are needed. Precise information without subjective judgements are required. This means that facts and expert analysis are expected.

Road & environment information for each vehicle – Each vehicle has its own infrastructure and environment (for example, in an intersection when two vehicles are coming from two different directions. All the information in this part are relative to the place and the infrastructure of the accident. The description of the infrastructure is divided in several fields:

- **Identification**: this is the accident number and the vehicle number which are linked to this infrastructure which is described,
- **Description of the road**: there are description of road type (road type, road access regulation…), road restriction (authorization to drive in this road, legal speed limit…), road geometry (type of geometry at accident scene, type of geometry during precollision phases…) and road description (number of lines in several directions…),
✓ Junctions: if the accident scene is a junction, the type of junction and characteristics linked to the junction (traffic lights, type of traffic control…) are informed,

✓ Curves: if the accident scene is a curve, the dimensions of the curve and the information about the road signs indicated are known,

✓ Straight lines: if the accident scene is a junction, this tab the length of the road before the collision are found there,

✓ Road geometric measurement: precise description of the road is lightened (width, elevation, gradient…of the road, the edges…),

✓ Road surface state: all the information relative to the surface state are explained (road state, road condition, condition of surface…),

✓ Road equipment: horizontal road markings (type of markings, visibility of markings…) and other equipments (vertical road signs, works…) are listed,

✓ Traffic: all the characteristics of the road are detailed (average of the traffic, percentage of truck traffic…),

✓ Change in the infrastructure: if the infrastructure changes within the accident zone, we identify it (change in the carriage way width, change in the number of directions…),

✓ Geometrical field of vision: this field talks about the geometrical visibility (permanent lateral visibility at junction, permanent longitudinal visibility, temporary cause / limitation to visibility…),

✓ Miscellaneous: all the comments which help to give more details are informed.

Vehicle information for each vehicle including the trailer – each vehicle has its own information according to the type vehicle it belongs to. That is why there are common information and non common information. For all type of vehicle, the common information are:

✓ Identification: this is the number of the accident which is linked to the vehicle which is described and the number of the vehicle,

✓ Accident severity: it is counted how many fatalities, injured occupants and no injured occupants there are,

✓ General information: it is about general information about the vehicle (body type, predominating colour, driver seat’s side…).

Concerning motor vehicle (except two wheelers), the following details are present:

✓ Identification: this is the number of the accident which is linked to the vehicle which is described and the number of the vehicle,

✓ General administrative and technical information: in this part, a description of general technical information are filled clarified (manufacturer, Vehicle Identification Number, year of 1st
registration, type of profile, colour and contrast, general weight and power information...),

- Design specifications: it is necessary to know if the vehicle was in a good state before the impact (mandatory technical control, apparent condition before the accident...),

- Vehicle parameters: This part is about the vehicle geometry (length, width, overhang, height from the ground of the vehicle ...),

- Axle description: In order to have the more details as possible, number of axles, track...are informed,

- Tyres, wheels, brake and suspension: For the tyres and the wheels, only defects are coded. Then, if there are defects, the axle number, the side of the wheel and the consequences of these defects are identified. Concerning the brakes and the suspensions, all of them are described, with a defect or not,

- Internal equipments: the information describe which equipment was in the vehicle and if it was used or not (music player, telephone, air conditioning...),

- Motorisation: there are two information which are the engine location and the type of transmission,

- Windows and Lights vision: all the details about the windows and the vision before and after the crash are in this part. (type of windscreen, position of windscreen after crash, cleanliness of the screen before the crash...). Concerning, the lights, we know which kind of light there is in the vehicle, if they were working before the crash...,

- Seats and load: It is about the organization of the seats in the vehicle and which load there was during the trip,

- Safety systems: all active safety equipments are listed: Anti lock braking system, Brake Assistance, Stability control system (ESP...),

- Miscellaneous.

As a truck or a bus has some different parameters, information linked to this kind of vehicle are added:

- Protections: through all this systems, we inform the influence on accident issues of the protections,

- Bumper, Front underrun protection, rear end protection, side underrun protection: dimensions and characteristics of each protection are detailed,

- Cab design: according to the truck, there is different type of cab. That is why, the cab (size, type...), the seats, the steering (power steering, steering equipment defect...) and the internal equipment (the same description as in the car part) are informed,

- Tachograph information: in order to know the type of trip that the rider has realized, speed before the braking, speed before the crash, respect of rest pauses, respect of speed limits, time after the last pause...are mentioned.
For the trailer, some details which has been presented before and some particular characteristics are presented below:

- **Identification**
- **General technical information**
- **Design specifications**
- **Axle description**
- **Coupling**: It is the description of the coupling between the truck and the trailer (coupling device, draw bar length…),
- **Tyres, wheels, brake and suspension**
- **Protection**
- **Load**
- **Miscellaneous**

The two wheels include motorcycle and bicycle. The characteristics are:

- **Bicycle**: this is a description of the bicycle (type, brake condition, lights, reflector…),
- **Motorcycle**: this is information about the manufacturer, the type, the style, the capacity, brake and defects…,
- **Characteristics**: whatever the two wheels, detail dimension (weight, wheelbase, length…) and the contact crash of the vehicle are presented,
- **Miscellaneous**

**Road User information** – For each person involved in the accident, driver or passenger, injured or unharmed, information are describe for them. As in the vehicle part, there are some common parameters whatever the road user is:

- **Identification**: these are the numbers of the accident and of the vehicle which are linked to the person which is described and the number of this person,
- **Personal status**: this part is divided on two fields which are the location (type of road user, side seated…) and the personal status (sex, age …of the person),
- **Vehicle occupant report / secondary safety**: it informs of the attendance and the running of secondary systems (airbag, seat belt type…),
- **Child restraint data**: if the occupant is a child, this part has to be completed. The aim of this description is about the restraint (child restraint model, restraint orientation…),
Two wheeler occupant data: equipments of the occupant are detailed (colour of the clothes, special clothes, helmet…),

Pedestrian: information about the impact with the pedestrian are given (visibility of clothes, direction pedestrian to vehicle, pedestrian throwing distance),

Injury report: It is a description of the participant injury. It is informed about the kind of injury it is and a description of it thanks to the scale AIS**** 98,

Miscellaneous.

If the participant is the driver, more specific details are given:

Identification: these are the numbers of the accident and of the vehicle which are linked to the person which is described and the number of this person,

Personal status: this part is not the same as there is in common parameters. There are more personal information (nationality, responsibility in the accident, profession…),

Long-term and short-term illness: It is listed all the problem the driver have which can have an effect on the accident (long term illness, injuries or inadequacies, short term illness, medication, spectacles…),

State of the driver or the rider: It is the state of the driver the day of the accident and just before the impact,

Driving license and experience: concerning the driver licence, we know the validity of the document and all the information in it (date, driver’s licence qualification) and concerning the experience, we are looking for the kilometres driven last year, the use of the vehicle…,

Truck and bus driver only: It is question only for truck and bus driver. It is a view of the experience of the driver with this kind of vehicle (number of experience year, usual truck…),

Previous accident: It is a description of the previous accident within the last five years,

Intoxication level: It informs if the driver had drunk some alcohols or had taken some drugs or medications,

Trip in progress: parameters about the trip of the driver are detailed (aim, origin, destination, use frequency…),

Accident and emergency situations: what the driver has done before the precipitating event (attention focused, driver’s or rider’s opinion speed…), after it and when he wanted to avoid accident is explained,

Miscellaneous.

If the participant is a pedestrian, the questionnaire is nearly the same as the one for the driver:

Identification,

Personal status,

**** Abbreviated Injury Scale, AIS 98
Health, long term and short term illness: the difference with the driver health state is that this part is more focus on the physical state of the pedestrian, state which can have an effect on the accident (impairment sensory, physical disability, handicap, one or many sense defect, long term or short term illness…),

Intoxication level,

Trip in progress: the other details, in this part concern the accompaniment and the behaviour (walkman, radio, mobile…) of the pedestrian,

Accident and emergency situations: It is information about the behaviour of the pedestrian during the accident and emergency situations (general manoeuvre in progress, pace, environmental or personal hindrance, evasive manoeuvre…),

Injury report.

Reconstruction information for each vehicle – Each vehicle has its own kinematics during the accident. That is why reconstruction information have been fulfilled for each vehicle. In order to be able to make a reconstruction of the accident for each vehicle - and therefore to be able to analyse path and speed from the rest position to the initial position – information on site and just after the accident are important.

Identification: there are the number of the accident and the number of the vehicle which correspond to the analyzed reconstruction,

Precollision phases: the precollision is divided into three parts. The first one is the precipitating event (description). It is the origin of the accident. The second one is the precrash motion, just prior to the precipitating event (description, speed…). The third one is the precrash motion, after the precipitating event (description),

Precollision description: the precollision is more described. For each vehicle, there is a description of the collision avoidance action (if there is one), the marks made by the vehicle, the behaviour of the vehicle before the impact (slide…), the distance between the first mark and the first impact,

Collision phase: for this phase, It is informed of the time from the precipitating event to the first impact, the number of main impact and a description of each impact (speed, type, grade of overlapping, EES††††…). For the truck deformation, different information are requested (direction of force, deformation location, lateral location…),

Cab deformation: It is a part which only concerns trucks and adds information. It is a description of the deformation inside the cab (intrusion of external objects, status of cab suspension after the crash) and of an eventual underrun penetration of adverse vehicle (under towing vehicle, under towed vehicle…),

Postcollision phase: this part is informed thanks to the detail of postcollision marks, distance from the first impact to the rest position, final position of the vehicle…,

Analyse: firstly, there is a listing of each accident contributing factors (falling asleep, faulty steering movement…). Secondly, each collision avoidance is described if it exists (proper action, efficiency…) and if there is no avoidance action, we explain why,

†††† Equivalent Energy Speed
✓ **Reconstruction phases**: Sub phases are described in the back in time order from the rest position of the vehicle to the position of the vehicle at the precipitating event or at the later estimated position that it can calculated for the total reconstruction (for both vehicles). Information for each sub phase are listed (physical equation used, speed, EES, initial speed, final speed...).

✓ **Miscellaneous**.

CEESAR has provided a questionnaire which takes into account each aspect of the accident. This questionnaire permits the identification of the principal causes and subsidiary causes of the truck accident.

The questionnaire form is based on the EACS\(^{‡‡‡‡}\) database, which is an European project, internationally recognised. But the coding form is lighter and easier to use than in the EACS project.

As the EACS project was created to investigate mainly car accidents, the ETAC database is adapted to truck accident investigation. CEESAR’s experience of truck accidents enables it to propose a comprehensive questionnaire which covers all aspects of truck accidents.

\(^{‡‡‡‡}\) European Accident causation Survey funded by the European Commission and the “Association des Constructeurs européens d’Automobiles”. 
3.3 The ETAC Manual (Volume 3)

CEESAR has written a data coding protocol explaining each item to ensure coherent coding by the different data collection teams. This report includes texts which explain clearly what is requested for the answer, pictures to illustrate the requests and sketches to show the meaning of a variable.

For instance, the Vehicle Identification Number (VIN) of the truck is lighted in the manual thanks to pictures:

![Figure: Supporting picture](Image)

**Texts** are also used to clarify what to answer to the question. For instance, it is explained what is the empty weight of the vehicle in kilogramme.

<table>
<thead>
<tr>
<th>TKERTO</th>
<th>Empty weight of the vehicle (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Empty weight is the complete vehicle dry weight plus the weight of the following elements:</td>
<td></td>
</tr>
<tr>
<td>- coolant;</td>
<td></td>
</tr>
<tr>
<td>- fuel (tank filled to at least 90% of the capacity specified by the manufacturer);</td>
<td></td>
</tr>
<tr>
<td>- spare wheel(s);</td>
<td></td>
</tr>
<tr>
<td>- fire extinguisher(s);</td>
<td></td>
</tr>
<tr>
<td>- standard spare parts;</td>
<td></td>
</tr>
<tr>
<td>- chocks;</td>
<td></td>
</tr>
<tr>
<td>- standard tool kit.</td>
<td></td>
</tr>
</tbody>
</table>

The complete vehicle dry weight is the weight of vehicle with body, fitted with all electrical equipment and auxiliary equipment necessary for normal operation of the vehicle.

*Figure*: Explanation
Sometimes, **sketches** are more useful to well understand what is asked from the users. For instance, different measurements of the truck axles are asked. Then, a sketch is more understandable than sentences.

![Figure: sketch](image)

All this details are also useful, in the way that we want a common database with homogeneous data. So each team has to understand the question and to code the different data collection in the same way.

This manual is integrated in the software and is available as soon as the coding task needs it. A paper manual has been also provided.
3.4 **The ETAC software**

To ensure common accident data coding of each investigation team, CEESAR provided an Electronic Data Template, based on the final version of the EACS. All the database information are anonymous.

Moreover, this software includes a tool which give the possibility to identify incoherent information, missing values and mistakes which is necessary to correct. The user of the software can use the tool himself.

In order to identify each team, a login and a password is asked to launch the software. Moreover, there is a special login for the administrator of the database (who is CEESAR) in order to make changes and improvements only by CEESAR.

The software shares the information as in the questionnaire. Each information field corresponds to a window in the software. You can surf in the window to fill in all data via tab. It is a good way to code because you have all specific information in one spot.

The windows which follow correspond to the 5 parts described in the questionnaire:

Information in the database is grouped according to the 5 following points:
- General information
- Road and environment information
- Vehicle information
- Road user information
- Reconstruction information

Screenshots of the database can be found on the following pages.

Examples of the software screenshots follow enclosed:
ETAC Final Report

General information

Infrastructure information
Vehicle information: the car

Vehicle information: the truck
Vehicle information: the bus

Vehicle information: the trailer
Vehicle information: the two wheelers

Number of users on the two wheelers:
- Adults: 1
- Children: 0

Road user information: the participant
- Sex: Female
- Age: 26 years, 4 months
- Height: 160 cm
- Weight: 60 kg
Road user information: the driver

Reconstruction information
3.5 The ETAC quality control

In order to monitor the quality of the database throughout the survey, CEESAR undertake the rigorous quality inspection which is presented below.

At the beginning of the project, a data collection schedule was agreed in order to ensure that objectives are reached in due time.

In order to assist in quality control process, each team must check its data before sending it to CEESAR. CEESAR has developed, in the software, requests to identify incoherent information, missing values and mistakes. The user of the database has a window in the software which is called “data verifications”. The user click on “analyse” and he can see all the problems he has and where and what he has to change in his coding data.

For instance, if the coding user declares that there are 4 cars and 2 trucks, the software makes sure that each vehicle is described.

![Data verification window](image)

**Figure:** Data verification window
There is a second quality control made by CEESAR. After each delivery, CEESAR conducts an in-depth review of all of the accident cases provided by each team. The objective of this review is to improve the international co-ordination of different groups that will be applying the common methodology. If necessary, the team return to their initial documents in order to find or to correct the information. The corrected cases have to be sent with the next delivery.

**Figure**: Quality control methodology
4 - RESULTS
4 RESULTS

4.1 Overview

<table>
<thead>
<tr>
<th>General content of the database</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of accidents</td>
<td>624</td>
</tr>
<tr>
<td>Number of vehicles involved</td>
<td>1288</td>
</tr>
<tr>
<td>Number of trucks</td>
<td>724</td>
</tr>
<tr>
<td>Number of cars</td>
<td>459</td>
</tr>
<tr>
<td>Number of Power-Two-Wheels</td>
<td>33</td>
</tr>
<tr>
<td>Number of bicycles</td>
<td>43</td>
</tr>
<tr>
<td>Number of buses</td>
<td>12</td>
</tr>
<tr>
<td>Number of other vehicles</td>
<td>17</td>
</tr>
<tr>
<td>Number of drivers</td>
<td>1274</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>402</td>
</tr>
<tr>
<td>Number of pedestrians</td>
<td>42</td>
</tr>
<tr>
<td>Number of killed</td>
<td>303</td>
</tr>
<tr>
<td>Number of injured</td>
<td>774</td>
</tr>
</tbody>
</table>

Table: General content of the ETAC database

Teams have analyzed 624 accidents with 1288 vehicles involved. The table above give an overview of the types of vehicle and involved persons. Furthermore, it shows that in all 624 accidents, 303 persons were killed and 774 injured. For further information on place of the accident and kind of the injury, see also 4.7.2 and 4.7.6. The table also shows that the number of drivers is lower than the number of vehicles because of the fact that the accidents include the accidents with parked vehicles.
4.2 Accident causations

4.2.1 Main cause / overview for all road users

Looking at all accidents, the main accident cause is linked to human error in 85.2% of all cases. The other factors play a minor role within 4.4%, 5.1% and 5.5%.

Truck is the main cause of the accident in 25% considering that the accident is linked to the human factor and at least two road users are involved.

The top 3 of the main causes for accidents between a truck and other road users are:

1- Non-adapted speed,
2- Failure to observe intersection rules,
3- Inattention.

However, these 3 main causes only show a tendency and the main cause of an accident for all road users varies according to the accident configuration. To target those causes with effective counter measures, it is necessary to look at the main causes of the accidents with various configurations.
4.2.2 Accident configuration

Each accident was classified in order to obtain a general overview of all accidents and then to categorize them into accident typologies. Single truck accidents and multi-vehicle accidents were distinguished.

All the above percentages refer to the total number of studied accidents. We determined the accident causation for the main accident configurations. Indeed, around 9 accidents out of 10 are covered by one of these accident configurations:

6- Accident at intersection: the accidents occurred at a junction,

7- Accident in queue: this configuration concerns a collision with a vehicle travelling on the same road into the same direction,

---

Figure: Accident configurations
8- Accident due to a lane departure: one of the vehicle swerves (maybe as a consequence of a loss of control) or makes a u-turn,

9- Accident after an overtaking manoeuvre, or after changing lane: accidents occurred in relation with an overtaking manoeuvre,

10- Special case - single truck accidents: only one vehicle (a truck) is involved in the accident.

For the accidents with a pedestrian, which cover 6.2% of all accidents, please refer to the chapter on blind spot accidents.

In the following chapters, you can find an overview of the main cause of accidents according to different configurations and who is causing it.
4.2.3 ACCIDENT CONFIGURATION 1:

Accident at intersection
4.2.3  Accident at intersection

For further reading regarding accidents at intersections which involve vulnerable road users and which are linked to the blind spot, please see chapter 3.10.

Driving situation

<table>
<thead>
<tr>
<th>Truck driver involved with</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A vehicle with right of way coming from the left or the right</td>
<td>31.8%</td>
</tr>
<tr>
<td>A vehicle not having right of way coming from the left or the right</td>
<td>29.8%</td>
</tr>
<tr>
<td>A vehicle driving behind or coming up from behind, going in the same direction</td>
<td>15.9%</td>
</tr>
<tr>
<td>A vehicle coming towards, in the opposite direction</td>
<td>13.2%</td>
</tr>
<tr>
<td>A vehicle driving in front, going in the same direction</td>
<td>4.0%</td>
</tr>
<tr>
<td>A stationnary vehicle</td>
<td>2.6%</td>
</tr>
<tr>
<td>Other</td>
<td>2.6%</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table: vehicles configuration for accident at intersection

One out of 3 trucks is involved in the accident with a vehicle with right of way coming from the left or the right.
One out of 3 trucks is involved in the accident with a vehicle not having right of way coming from the left or the right.
One out of 3 trucks is involved in the accident with a vehicle coming from behind or coming from the opposite direction.

Rupture phase

We distinguish two rupture phases points of view and for each of them, the list of the accident contributing factors:

- the rupture phase of the truck when it is causing the accident,

- the rupture phase of the other vehicle when it is causing the accident.

I remind you that the accident contributing factors explain why the accident happened (for example, a vehicle jump a stop, while a vehicle is coming from the right, because the driver of the vehicle was doing a secondary task) or make worse the driving situation (for example, the road is wet and you need more distance to brake)
Main accident causes / truck

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to observe intersection rules</td>
<td>20.1%</td>
</tr>
<tr>
<td>Non-adapted speed</td>
<td>13.0%</td>
</tr>
<tr>
<td>Improper manoeuvre when turning</td>
<td>7.8%</td>
</tr>
<tr>
<td>Restrictive visibility</td>
<td>4.5%</td>
</tr>
<tr>
<td>Lack of driving experience*</td>
<td>3.9%</td>
</tr>
<tr>
<td>Technical problems</td>
<td>3.3%</td>
</tr>
<tr>
<td>Lack of vehicle performance knowledge</td>
<td>3.3%</td>
</tr>
<tr>
<td>Inattention</td>
<td>2.6%</td>
</tr>
<tr>
<td>Habits and good knowledge of the site</td>
<td>1.9%</td>
</tr>
<tr>
<td>No information or badly given to the other vehicles</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Table: Main accident causes / truck

Main accident causes / other road user

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to observe intersection rules</td>
<td>28.2%</td>
</tr>
<tr>
<td>Non-adapted speed</td>
<td>10.9%</td>
</tr>
<tr>
<td>Lack of driving experience</td>
<td>9.2%</td>
</tr>
<tr>
<td>Improper manoeuvre when turning</td>
<td>4.6%</td>
</tr>
<tr>
<td>Insufficient safety distance</td>
<td>4.5%</td>
</tr>
<tr>
<td>Age</td>
<td>3.6%</td>
</tr>
<tr>
<td>Drugs, alcohol</td>
<td>3.6%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>1.8%</td>
</tr>
<tr>
<td>Inattention</td>
<td>1.8%</td>
</tr>
<tr>
<td>Restrictive visibility</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

Table: Main accident causes / other road user

In more than 30% of the accidents occurring at an intersection, regardless who the driver is (truck or other vehicle driver), the factors which contributed to the accident are:
- Failure to observe intersection rules (through signs regulating priority, traffic lights…),
- Non-adapted speed regarding the situation.

* e.g. the driver is not used to drive in such situation or has his driving licence recently.
**Emergency phase**

![Bar chart showing measures taken to avoid accidents and reactions](chart)

**Figure: Collision avoidance**

In 45% of the accident, the truck driver tries to avoid the accident: he brakes, turns, accelerates or combines some of them. And one out of 2, the truck driver is unable to describe its reaction or has no reaction. More than one out of 2 (65%) the other road user is not able to describe its reaction or has no reaction. And one out of 3 tries to avoid the collision.

**Collision phase**

The main impact according to passive safety is the impact which is responsible for the most serious injuries.

![Bar chart showing main collision impacts](chart)

**Figure: Main impact**
More than one out of 2, the main impact for the truck is the frontal impact. One out of 2, the main impact for the other road user is the side impact.

**Exemple**

![Accident sequence diagram]

1- **Driving situation**: the driver of the truck and its semi-trailer was driving in a straight line approaching an intersection.

2- **Rupture phase**: the driver of the car coming from the right didn’t observe the rules, then didn’t let the right of way to the truck and went straight through the junction. We have to note that the truck is over the legal speed which worsened the accident violence.

3- **Emergency phase**: the truck driver turned to the left and braked.

4&5- **Collision and post-collision phase**: the truck impacts frontally the left side of the other vehicle. The truck driver brakes till its rest position.
4.2.4 ACCIDENT

CONFIGURATION 2:

Accident in queue
4.2.4 Accident in queue

Driving situation

For an accident in queue, a truck is more often impacted by a vehicle driving behind or coming up from behind, going in the same direction compared to a truck impacting a vehicle driving (or being stopped) in front, going in the same direction. Nevertheless, there is no big difference between the two figures.

Rupture phase

In this part, we will distinguish the reasons why the truck impacted a vehicle driving (or stopped) in front going in the same direction and the reasons why the other vehicles impacted a truck driving (or being stopped) in front going in the same direction.

<table>
<thead>
<tr>
<th>Main accident causes / truck</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adapted speed</td>
<td>22.1%</td>
</tr>
<tr>
<td>Insufficient safety distance</td>
<td>16.2%</td>
</tr>
<tr>
<td>Inattention</td>
<td>12.8%</td>
</tr>
<tr>
<td>Lack of knowledge in driving experience</td>
<td>4.6%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>3.5%</td>
</tr>
<tr>
<td>Insufficient safety measures in the case of vehicles stopping or broken down</td>
<td>3.5%</td>
</tr>
<tr>
<td>Lack of knowledge in vehicle performance</td>
<td>2.3%</td>
</tr>
<tr>
<td>Overfatigue/falling asleep</td>
<td>2.3%</td>
</tr>
<tr>
<td>Braking mistakes</td>
<td>1.2%</td>
</tr>
<tr>
<td>Technical problems</td>
<td>1.2%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Table: Main accident causes when the truck impacts a vehicle driving (or being stopped) in front going in the same direction
Main accident causes / other road user

<table>
<thead>
<tr>
<th>Non adapted speed</th>
<th>28,8%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient safety distance</td>
<td>12,0%</td>
</tr>
<tr>
<td>Inattention</td>
<td>11,0%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>6,8%</td>
</tr>
<tr>
<td>Overfatigue/falling asleep</td>
<td>5,4%</td>
</tr>
<tr>
<td>Falling ill</td>
<td>4,2%</td>
</tr>
<tr>
<td>Lack of knowledge in driving experience</td>
<td>4,2%</td>
</tr>
<tr>
<td>Restrictive visibility</td>
<td>2,7%</td>
</tr>
<tr>
<td>Mistake when overtaking</td>
<td>1,4%</td>
</tr>
<tr>
<td>Drugs, alcohol</td>
<td>1,4%</td>
</tr>
</tbody>
</table>

Table: Main accident causes when another vehicle impacts a truck driving (or being stopped) in front going in the same direction

Whatever the scenario is (a truck or another vehicle impacts a vehicle driving in front going in the same direction), around one out of 2 accidents happen due to these 3 following main causes

- Non adapted speed,
- Insufficient safety distance,
- Inattention.

Emergency phase

![Collision avoidance](chart)

Figure: Collision avoidance

In 70% of the accident, the truck driver tries to avoid the accident. And in only 39% of the accident the other road user tries to avoid the accident. We can notice that one out of 3, the other road user is not able to describe his collision avoidance. It can be due to the severity of the accident.
Collision phase

Whatever the configuration is, a truck or another vehicle impacting a vehicle driving (or being stopped) in front, going in the same direction, in more than 95% of the main impacts, the main one is the frontal one. It is not a surprising result considering the accident configuration.

Exemple

Figure: Accident sequence when the truck is impacted by a vehicle driving behind or coming up from behind, going in the same direction

1- Driving situation: the driver of the car is driving along a straight road. The accident happened during the night.

2- Rupture phase: the driver of the car was disturbed by his cd reader and was doing something else instead of driving. He didn’t notice the truck in front of him.

3- Reaction phase: there is no reaction due to the secondary task.

4- Collision phase: the car is jammed under the rear of the semi-trailer.

5- Post-collision: the car is under the truck tills its rest position.
4.2.5 ACCIDENT CONFIGURATION 3:

Accident due to a lane departure
4.2.5  Accident due to a lane departure

In this configuration of accident, we consider two points of view:

- the accident when the truck is causing the accident
- the accident situation when the other vehicle is causing the accident.

Driving situation

<table>
<thead>
<tr>
<th>Driving situation</th>
<th>Constant speed</th>
<th>Throttle off</th>
<th>Braking</th>
<th>Accelerating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving in straight line</td>
<td>68,4%</td>
<td>0,0%</td>
<td>31,6%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Negotiating a bent</td>
<td>35,7%</td>
<td>21,4%</td>
<td>42,9%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Make a U turn</td>
<td>7,7%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Travelling in wrong way</td>
<td>7,7%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

Table: Driving situation for truck driver

<table>
<thead>
<tr>
<th>Driving situation</th>
<th>Constant speed</th>
<th>Throttle off</th>
<th>Braking</th>
<th>Accelerating</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving in straight line</td>
<td>63,9%</td>
<td>2,8%</td>
<td>30,6%</td>
<td>2,8%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Negotiating a bent</td>
<td>70,4%</td>
<td>7,4%</td>
<td>18,5%</td>
<td>3,7%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Travelling in wrong way</td>
<td>7,0%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Make a U turn</td>
<td>4,2%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

Table: Driving situation for other road users

Whatever vehicle is causing the accident, in more than 80%, the driver was driving in a straight line or was negotiating a bent.
Rupture phase

<table>
<thead>
<tr>
<th>Main causes / truck</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-adapted speed</td>
<td>19.7%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>13.7%</td>
</tr>
<tr>
<td>Technical failure</td>
<td>9.1%</td>
</tr>
<tr>
<td>Crossing lines such as approaching the bend, cutting too tightly</td>
<td>7.6%</td>
</tr>
<tr>
<td>Improper manoeuvre when turning</td>
<td>7.6%</td>
</tr>
<tr>
<td>Lack of driving experience</td>
<td>7.6%</td>
</tr>
<tr>
<td>Inattention</td>
<td>3.0%</td>
</tr>
<tr>
<td>Restrictive visibility</td>
<td>3.0%</td>
</tr>
<tr>
<td>Braking mistakes</td>
<td>1.5%</td>
</tr>
<tr>
<td>Overfatigue / falling asleep</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Main causes / other road user</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-adapted speed</td>
<td>14.4%</td>
</tr>
<tr>
<td>Crossing lines such as approaching the bend, cutting too tightly</td>
<td>9.4%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>8.5%</td>
</tr>
<tr>
<td>Lack of driving experience</td>
<td>7.6%</td>
</tr>
<tr>
<td>Improper manoeuvre when turning such as strong delayed</td>
<td>6.8%</td>
</tr>
<tr>
<td>Technical problems</td>
<td>5.1%</td>
</tr>
<tr>
<td>Overfatigue / falling asleep</td>
<td>4.2%</td>
</tr>
<tr>
<td>Restrictive visibility</td>
<td>4.2%</td>
</tr>
<tr>
<td>Inattention</td>
<td>2.5%</td>
</tr>
<tr>
<td>Drugs, alcohol</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Table: Main accident causes / truck

Table: Main accident causes / other road user

Whatever vehicle is causing the accident, in more than 50% of all the cases the accident is caused by:
- Non adapted speed,
- Bad manoeuvre (crossing lines too tightly…),
- Loss of road friction,
- Lack of driving experience,
- Improper manoeuvre when turning.
**Emergency phase**

![Bar chart showing the distribution of actions taken during the emergency phase.](chart)

**Figure: Collision avoidance**

63% of the truck drivers try to avoid the accident whereas only 36% of the other road users try to avoid the accident. This figure is explained by the fact that 38% of the other road users are unable to describe his/her reaction; probably because of the severity of the accident.

**Collision phase**

![Bar chart showing the distribution of collision impacts.](chart)

**Figure: Main impact**

Whatever the vehicle is, the main impact is the frontal one.
Exemple

**Figure: Vehicle sequence**

1- Driving situation: the driver of the car is driving along a straight line approaching a right curve.

2- Rupture phase: At the approach of the curve, the car driver brakes. It is raining and the car driver is driving too fast. This one loses the control of her vehicle.

3- Emergency phase: the car driver turns right then left in order to control her vehicle.

4&5- Collision & post-collision phases: the car impacts its left side against the front of the truck. For information, the truck driver sees the driver of the car loosing the control of her vehicle and coming in front of him. The truck driver brakes and turns right in order to avoid the collision.
4.2.6 ACCIDENT CONFIGURATION 4:

Accident during an overtaking manoeuvre
4.2.6  Accident after an overtaking manoeuvre or changing lane

In this configuration of accident, we consider two points of views:

- the accident when the truck is causing the accident,
- the accident when the other vehicle is causing the accident.

Driving situation

<table>
<thead>
<tr>
<th>Driving situation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing lane (left or right)</td>
<td>53,6%</td>
</tr>
<tr>
<td>Moving in straight line</td>
<td>39,3%</td>
</tr>
<tr>
<td>Other</td>
<td>7,1%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

*Table: Driving situation for truck driver*

<table>
<thead>
<tr>
<th>Driving situation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing lane (left or right)</td>
<td>43,2%</td>
</tr>
<tr>
<td>Moving in straight line</td>
<td>43,2%</td>
</tr>
<tr>
<td>Other</td>
<td>13,5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

*Table: Driving situation for other road user*

More than 80% of the drivers, from the two points of views, are changing lane or moving in straight line.

Rupture phase

<table>
<thead>
<tr>
<th>Main causes / truck</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper manœuvre when overtaking/changing lane</td>
<td>15,7%</td>
</tr>
<tr>
<td>Overfatigue / falling asleep</td>
<td>8,8%</td>
</tr>
<tr>
<td>Non-adapted speed</td>
<td>6,7%</td>
</tr>
<tr>
<td>Lack of driving experience</td>
<td>6,7%</td>
</tr>
<tr>
<td>Crossing lines such as approaching the bend, cutting too tightly</td>
<td>6,7%</td>
</tr>
<tr>
<td>Insufficient safety distance</td>
<td>4,4%</td>
</tr>
<tr>
<td>Insufficient safety measures in the case of vehicles stopping.</td>
<td>4,4%</td>
</tr>
<tr>
<td>Mechanical problems</td>
<td>4,4%</td>
</tr>
<tr>
<td>Drugs, alcohol</td>
<td>2,2%</td>
</tr>
<tr>
<td>Mistake in use of pedals</td>
<td>2,2%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

*Table: Main accident causes / truck*
Main causes / other road user

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper manœuvre when overtaking/changing lane</td>
<td>30.0%</td>
</tr>
<tr>
<td>Non-adapted speed</td>
<td>22.5%</td>
</tr>
<tr>
<td>Lack of driving experience</td>
<td>10.0%</td>
</tr>
<tr>
<td>Crossing lines such as approaching the bend, cutting too tightly</td>
<td>6.2%</td>
</tr>
<tr>
<td>Insufficient safety measures in the case of vehicles stopping.</td>
<td>6.2%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>2.4%</td>
</tr>
<tr>
<td>Lack of knowledge of the vehicle performances</td>
<td>2.4%</td>
</tr>
<tr>
<td>Braking mistakes</td>
<td>1.3%</td>
</tr>
<tr>
<td>Mistake in use of pedals</td>
<td>1.3%</td>
</tr>
<tr>
<td>Overfatigue / falling asleep</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Table: Main accident causes / other road user

When the truck is causing the accident, 45% of the main causes are due to:
- Improper manœuvre when overtaking/changing lane,
- Overfatigue/falling asleep,
- Non-adapted speed,
- Lack of driving experience,
- Crossing line

The accident causes are quite different when other vehicles are causing the accidents. In those cases, 50% of the causes are due to:
- Improper manœuvre when overtaking/changing lane,
- Non-adapted speed.

Emergency phase

![Collision avoidance graph]

Figure: Collision avoidance

Around one out of 2 the driver of both vehicles tries to avoid the accident.
**Collision phase**

Main impacts for both vehicles are frontal and lateral one. Both impacts cover 80% of the main impacts.

**Exemple**

1- Driving situation: the truck driver is driving along a straight line.

2- Rupture phase: the vehicle drivers, on the truck lane, are driving slowly. So the truck driver decides to change lane. He doesn’t control vehicle coming from rear in the left lane.

3- Emergency phase: there is no reaction phase while the truck driver didn’t see the other car.

4/5- Collision and post-collision phase: accident is not avoidable. The collision is a side wipe. The truck driver brakes and turns right.
4.2.7 ACCIDENT CONFIGURATION 5:

Single truck accident
### 4.2.7 Single truck accident

In 75% of all cases, a single truck accident is due to a loss of control of the vehicle. In 20% of all cases, the truck tips or rolls over in a roundabout or in an entrance or an exit of a slip road.

**Driving situation**

This is the driving situation of the truck driver before the deterioration of this situation.

<table>
<thead>
<tr>
<th>Driving situation</th>
<th>Distribution</th>
<th>Kinematics</th>
<th>Distribution by moving</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving in straight line</td>
<td>48,4%</td>
<td>Constant speed 86,7%</td>
<td>41,9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Throttle off 6,7%</td>
<td>3,2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Braking 6,7%</td>
<td>3,2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 100,0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turning right</td>
<td>19,3%</td>
<td>Constant speed 16,7%</td>
<td>3,2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Throttle off 16,7%</td>
<td>3,2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Braking 33,3%</td>
<td>6,4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accelerating 33,3%</td>
<td>6,4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 100,0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turning left</td>
<td>9,7%</td>
<td>Constant speed 100,0%</td>
<td>9,7%</td>
<td></td>
</tr>
<tr>
<td>Negotiating a bent</td>
<td>9,7%</td>
<td>Constant speed 100,0%</td>
<td>9,7%</td>
<td></td>
</tr>
<tr>
<td>Changing lanes to left</td>
<td>3,2%</td>
<td>Constant speed 100,0%</td>
<td>3,2%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>9,7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100,00%</td>
<td></td>
<td>100,0%</td>
<td></td>
</tr>
</tbody>
</table>

**Table: Driving situation**

48% of the truck drivers before the accident were moving in straight line.

**Rupture phase**

<table>
<thead>
<tr>
<th>Main accident causes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-adapted speed</td>
<td>20,3%</td>
</tr>
<tr>
<td>Overfatigue / falling asleep</td>
<td>18,6%</td>
</tr>
<tr>
<td>Loss of road friction</td>
<td>11,9%</td>
</tr>
<tr>
<td>Improper manoeuvre when turning</td>
<td>8,5%</td>
</tr>
<tr>
<td>Inattention</td>
<td>8,4%</td>
</tr>
<tr>
<td>Falling ill</td>
<td>5,1%</td>
</tr>
<tr>
<td>Technical problems</td>
<td>3,4%</td>
</tr>
<tr>
<td>Load, passenger</td>
<td>3,4%</td>
</tr>
<tr>
<td>Drugs, alcohol</td>
<td>3,4%</td>
</tr>
<tr>
<td>Crossing lines such as approaching the bend, cutting too tightly</td>
<td>3,4%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

**Table: Main accident causes / truck**

In 50% of all cases, a single truck accident is due to:
- Non-adapted speed according to the situation,
- Overfatigue or falling asleep of the truck driver,
- Loss of road friction,
In 64% of all cases, the truck was not driving in a straight line immediately before the precipitating event but was changing direction or negotiating a bend.

**Emergency phase**

![Collision avoidance](image-url)

*Figure: Collision avoidance*

2 collision avoidances out of 3, the truck driver tries to avoid the accident.

**Collision phase**

![Main impact](image-url)

*Figure: Main impact*

The main impact for 1 single truck accident out of 2 is a rollover or a tip-over and 3 out of 4 are a rollover or a tip-over or a frontal impact.
Exemple

Figure: Truck accident sequence

1 – Driving situation: the driver of the truck and its semi-trailer was driving in a straight line on the highway.

2- Rupture phase: the driver was very tired and felt asleep. The driving situation is now deteriorate because he didn’t control the vehicle anymore.

3- Emergency phase: when the driver woke up, it was too late. He has had no reaction, and then he crashed the barriers and went outside the road.

4/5- Collision and post-collision phase: due to the profile of the edge, the truck and its trailer tip-over on the right side.
4.3 Load

The study looked specifically at the truck load and investigated if:
- Loss of load,
- Overload,
- Unbalance of the load,
- Insufficient safety measures with regard to load,
was the main cause of the accident.

The load of the truck is the main cause of the accident in only 1.4% (9 accidents) of all accidents in the database. Only in 3 accidents (among the 9 accidents), the truck had tipped over.

Carriage of dangerous goods by road

Following the ADR agreement article 1.8.5.1, special attention was given to transport of dangerous goods.

Only 14 trucks were involved in the accidents and were carrying hazardous loads. 5 of them were a truck and 9 were a truck and a semi-trailer.

50% of these heavy goods vehicles were carrying inflammable loads, 36% explosive loads and 7% poisonous and corrosive loads.
4.4  Fatigue

Based on the 624 accidents of our database, fatigue was the main cause in 6% of the accidents. 37% of these accidents were fatal.

When fatigue plays a role in the accident, 68% of these accidents involved a truck and another vehicle (car, two-wheels, motor two-wheels…) and in 29% of the cases the accident is a single truck accident.
Regarding the time of the accident where fatigue was the main cause, two hours have been identified as crucial. Most accidents happen between 02:00 and 02:59, obviously a time when the biorhythm is at a low point, and from 15:00 to 15:59 when it is nearly the end of the working day.

![Accident place](image)

**Figure: Accident place**

Nearly 90% of the accidents in which fatigue is the main cause, happen on highways or on inter-urban roads.

However, it must be stated, that to prove that fatigue is the main cause of the accident is very difficult because the expert based their judgement on what they saw and what the drivers told them. Moreover, fatigue is a complex system in which you can find different vigilance states from slightly fatigue to sleeping and fatigue is often linked to other issues as being inattentive.
4.5  **Infrastructure**

The information about the infrastructure in the accident was described for all the vehicles involved. The reason is that you can have an accident with two vehicles coming from two kinds of infrastructures such as an accident in an intersection.

In 5% of the accidents, the road conditions were the main cause of the accident.

![Figure: Road type](image)

Half of these accidents happened on an inter-urban road.

In 8% of the accidents, there was engineering work on the infrastructure and in 1/3 of them the engineering work was the main cause of the accident.

When an engineering work was the main cause of the accident, in one out of 3 cases, the accident occurred in an intersection.
4.6 **Blind spot accidents**

**Blind Spot:** Areas around a commercial vehicle which are not visible for the driver neither through the windshield, side windows nor the mirrors.

Among the accidents (30) occurring in an intersection and involving at least one vulnerable road user (a pedestrian or a two-wheels), in 47% of them, blind spots from the truck driver’s view, was the main cause of the accident. When blind spot is the main cause of the accident in this configuration, 2/3 of the accidents are fatal accidents. That means that the accidents with a vulnerable road user and a truck at an intersection are very severe accidents.

![Figure: Truck motion](image)

In 75% of the cases, the truck driver was turning to the left or to the right when he had an accident with a vulnerable road user because of blind spots.

The following figures show where the truck has impacted or has been impacted by the vulnerable road user: 24,3% of the impacts are on the side of the truck, 61,9% are at the front of the truck and 13,8% are unclassifiable impacts.
4.7 Additional information

4.7.1 General information

Due to the ETAC objectives, most of the vehicles involved in the accidents are trucks (56%). More than 80% of the heavy vehicles involved in our accident are trucks or trucks and with their semi-trailer.
59% of the accidents involve two vehicles (with no pedestrian and no two-wheels). 12% involve 3 vehicles (with no pedestrian and no two-wheels) and 7% are single truck accidents. It is to note that 18% of the accidents involve a vulnerable road user (pedestrian and/or two-wheeler).

4.7.2  Urban and rural areas

2/3 of the accidents occur outside an urban area and so 1/3 inside an urban area. 40% of the accidents outside urban area are fatal accidents whereas 29% of the accidents inside an urban area are fatal accidents.

For outside urban areas, the figures regarding fatalities are as follow:
Regarding the figures above, it must however be noted that the ETAC study looked only at accidents with at least one injured person. The figures above do not take into account the high number of accidents involving a truck where no person was injured.

4.7.3 Weather conditions

82% of the accidents occur in good weather conditions. Of those occurring in bad weather, in 50% of them the weather has had an effect on the accident’s development.
4.7.4 Lighting conditions

More than 70% of the accidents occur during the day, so in good conditions of lighting and visibility.

4.7.5 Time of the accident

Three maximums are well identifiable: from 10:00 to 10:59, from 14:00 to 14:59, just after the lunch when you are tired and the traffic goes back and from 17:00 to 17:59 during rush hour.
4.7.6 Injuries

![Injuries for different road user](image)

There are more truck road users injured, from minor to moderate injuries, than the other road users. While from critical to dead injuries, there are more other road users injured than truck road users. This is not surprising regarding the difference of size in case of a collision between them.
5 RECOMMENDATIONS

According to the results of the project and the different actors of road safety, here is a list of recommendations. It does not aim to be exhaustive and a study on the effectiveness of each recommendation is needed in order to establish the priorities of safety measures.

Manufacturers

Several technical improvements could be supported by vehicle manufacturers to help the drivers or to protect the other vehicles or vulnerable road users involved in the accident:

✓ Active safety system to avoid the accident or to reduce the violence of the impact:
  o ABS: Anti-lock Braking System,
  o ESP : Electronic Stability System,
  o Lane guard system,
  o Speed control system related to the used infrastructure,
  o Turning and lane change assistance,
  o Emergency braking assistance,
  o Adaptive cruise control,
  o Traction and stability control system,
  o Headway detection,
  o Tyre pressure monitoring,
  o Active roll stabilisation,
  o Night vision support,
  o Ultrasonic guard system for collision zones with vulnerable road users,
  o Warning of local dangers by vehicle to vehicle communication,
  o Rear camera,
  o Hypovigilance warning (warning system preventing falling asleep).

✓ Passive safety system in order to reduce the injuries of the participants in the vehicles:
  o Front underrun protection,
  o Rear underrun protection,
  o Side underrun protection,
  o Special passive safety systems for accident involving vulnerable road users,
  o Airbags system,
  o Seat belts.

Infrastructure providers/developers

✓ In an intersection, we can notice that most of the main causes are linked to a failure to observe intersection rules. In this context, the visibility of the vertical signs may help the driver to observe the traffic rules.

✓ Loss of road friction is a cause often occurring. A special focus on the state of the road is necessary.

✓ Effective traffic signing and traffic warning.

Government

✓ We saw in the results that most of the main causes of the accident is linked to human error. This means that it is necessary to focus on the training of drivers in order to respect
intersection rules, to have an adapted speed and to fill the lack of driving experience, the driving itself, etc,

✓ Increase enforcement specifically on speed and safety distance,

✓ The ETAC study has proven that the European Legislation on blind spot mirrors is effectively targeting the main cause of the accident in the configuration of accidents at intersections with vulnerable road users,

✓ Revising driving schools regulations to help understand truck manoeuvres,

✓ Awareness campaign regarding speeding, safety distance and driving manoeuvres of truck,

✓ Plan and maintain safe road infrastructure appropriate to current and foreseeable traffic demand,

✓ Appropriate incentives should be given to transport operators to purchase safe vehicles,

✓ To reduce the severity of accidents, seat belt usage should be improved.

Drivers

Truck drivers

✓ A better training of the truck driver could prevent accidents in different configurations such as accidents during a passing manoeuvre or single truck accidents where drivers often make improper manoeuvres.

✓ Fatigue is often a main cause of the accident. Truck drivers should be able to take a rest when necessary by respecting driving and resting times.

✓ Providing life style information for drivers (e.g. influence of eating habits on driving ability).

Other road users

✓ A better knowledge of the behaviour of trucks on the road could help to anticipate conflicts,

Media

The media should report objectively and undertake awareness campaigns based on facts and figures.

FINAL CONCLUSION

All partners in the road transport industry and the private sector, civil society and government have to take up their responsibility to improve road safety by cooperating with one another. Furthermore, the various recommended actions should not stand alone but be analyzed for their effectiveness, should be prioritized accordingly and finally linked with one another.
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8 – RISER Database overview

9 – RIDER database overview

10 - EACS database overview

11 – US department of transportation database overview – NHTSA


13 – Effectiveness of ADR 69: A case-control study of crashes vehicles equipped with airbags – Andrew Morris and al. – Department of transport and regional services - Australian Transport Safety Bureau – 2001

14 – Collision deformation classification – E J Allen & al.


16 – Rétroviseur angle mort – www.autopress.be

17 - Improved Visibility for Operating Large Haulage Equipment - C.M.K. Boldt, Civil Engineer, Spokane Research Center, Spokane, WA - MSHA State Grant Program For Michigan

18 – La sécurité avant tout pour tout le monde – Van Dievel transport - www.vandievel.be

Annex 1: Cidaut – sampling area

CIDAUT (Centre for automotive research and development) was founded in 1993 as a non-profit making organisation. Its main objective is to increase competitiveness and industrial development of companies operating mainly in the automotive sector, but also in the railway and aircraft sector, through strengthening their industrial fabric by increasing their technological capabilities, in such a way that they are able to develop new products and processes.

Technological Research and Development is the main activity carried out by the Centre where several broad areas are covered: Crashworthiness and Occupant Safety, Products & Processes Design and Development, Materials (energy absorption foams, plastics, light alloys…), Acoustics and Vibration Dynamics, Environment and Engines & Energy systems.

Regarding Transport Safety expertise, CIDAUT is experienced in real world road accidents investigation and injury data, biomechanics, dummy development and test methods, virtual testing and modelling, preventive and active safety, material technologies, vehicle structural crashworthiness and restraint systems (passive safety), road furniture, human behaviour, HMI and ergonomics. Both experimental and virtual testing means are always used.

Road accident investigation and reconstruction constitute one major research line within CIDAUT. It permits us to know in detail the causes, consequences and circumstances of road accidents, embracing the key three factors: human behaviour, vehicle and infrastructure. CIDAUT is capable to analyse all kind of accidents for all vehicle types.

CIDAUT counts with accident investigation teams that travel immediately to the accident scene to perform an ‘in-depth investigation’, in close cooperation with police forces, medical services, garages and scrap yards. When it is not possible to travel immediately to the accident spot, a retrospective investigation is made if sufficient information can be gathered. We make use of a complete scene & vehicle analysis equipment and reconstruction software. All information gathered is stored in an own ORACLE database (called DIANA) for further exploitation jointly with access to other accident databases, as for example the national one coming from the DGT (Dirección General de Tráfico) which provide information on every injury accident.

Besides this project, CIDAUT has been involved in quite a number of European Projects with Accident Analysis Tasks, as could be PRISM, ROBUST, RISER, from the Fifth Framework Programme, and APROSYS (particularly SP4 Motorcycles Accidents and SP8.3), STORHY and RANKERS within the currently Sixth Framework Programme.

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SAMPLING PLAN

- The sampling area is located within the Valladolid province (8202 km²), covering both urban and non-urban roads. Here are some parameters in order to compare our sampling area to the whole Spanish accident situation, which show a close situation between both, i.e. Valladolid province is quite representative from the Spanish accidental situation.

<table>
<thead>
<tr>
<th></th>
<th>Valladolid</th>
<th>SPAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles / 1,000 inhabitants</td>
<td>504</td>
<td>590</td>
</tr>
<tr>
<td>Accidents / 100,000 inhabitants</td>
<td>220</td>
<td>254</td>
</tr>
<tr>
<td>Accidents / 10,000 vehicles</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Deaths / 100,000 inhabitants</td>
<td>15.8</td>
<td>14.5</td>
</tr>
<tr>
<td>Deaths / 1,000 accidents</td>
<td>72</td>
<td>57</td>
</tr>
<tr>
<td>Deaths / 10,000 vehicles</td>
<td>2.5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

- Accident selection is based on random notification from police control rooms, as the responsibility for accidents within urban areas rely on Urban Police (Policía Municipal) and accidents occurred within non-urban areas rely on other kind of police (Guardia Civil de Tráfico).

- CIDAUT's Road Accident Investigation Team is able to carry out an exhaustive scientific analysis of each topic underlying road accidents according to pre-defined sampling plans with required accident selection criteria as those fixed for this ETAC project: accidents involving at least one truck (commercial vehicle of Gross Weight > 3.5t) and one injured person. To accomplish this, an expert team investigates the accident cases, in collaboration with police forces and medical services.

- One of the most important tasks, data gathering, is carried out through 'in-depth' accident investigations, immediately on the scene, in which a huge amount of data is registered for each element involved. These investigations comprise the analysis of the three key factors: occupants, vehicles and infrastructures. Data covers general information, infrastructure and environment information, vehicles information, road users information and reconstruction. When possible, the Accident Investigation Team interviews the people involved in the accident within the scene or later in the hospital. If in the scene it is not possible to collect all vehicle data, the team goes later to the garages / scrap yards where the vehicles have been transferred to, in order to finalise the vehicle analysis.

- After data collection, an accident reconstruction is carried out with the aim of finding out what happened and assessing the causes that led to the accident. Accident reconstruction allows to discover the collision severity and to obtain a detailed simulation of the accident dynamics. It is carried out based on vehicle deformations, vehicle marks and remains, etc.

DATA CODING AND QUALITY CONTROL

- Information collection of all elements involved in the accident is made using different registration forms based on the common questionnaire provided by the co-ordinator and enhanced by the other teams. Accident investigation teams analyse the evidences left in the accident scene immediately after it happens, so any essential information is not missed.

- Furthermore, interviews to the people involved in the accident and witnesses (if any) are performed in order to collate both sources also together with police information. When it is not possible to interview these people, we ask for their statements to different sources, such as police forces or medical services.
- Police reports are always obtained by accident investigation teams, and later are contrasted with the in-depth information gathered on the spot by themselves.

- Complementary information is collected at the hospital in order to obtain both the injured people statements and the injury report with the AIS codifications. Furthermore, if available, we collect some information at the Valladolid Traffic Management Centre, such as for instance the road traffic density in the precise moment of the accident.

- Accidents with a low level of information are systematically rejected, so we keep only those ones in which we are able to get the information of all vehicles and participants involved in the accident.

- After the collation of all information sources, data coding and data entering into the database is made up strictly according to the instructions contained in the Guide provided by the co-ordinator. Since both of these tasks are essential, we perform a cross-check by at least two people in order to ensure data quality.

- Accident investigation teams have rigorously checked the data entered into the ETAC database, before sending to the co-ordinator. Each accident case has been checked several times at least by two people, in order to identify possible mistakes or blanks.

- In short, CIDAUT sends the intermediate database to the co-ordinator containing the foreseen number of cases after an exhaustive data quality control process.
Annex 2: DEKRA – Sampling area

DEKRA Automobil GmbH
Accident Research & Crash Test Center
Handwerkatr 15, D-70565 Stuttgart, Germany

The German company DEKRA was founded 1925 in Berlin as a registered association. The members are fleets and companies with motor vehicles used for commercial purposes. The first task was the regular testing of vehicles by engineers. Currently there are 40 000 vehicle fleets with 580 000 motor vehicles member of the DEKRA e. V. DEKRA comprises out of different companies which are working also outside the automotive area (see www.dekra.com).

Today the DEKRA Automotive GmbH engineers are working besides the periodical testing of vehicles and the valuation of cost repairs also in the area of accident reconstruction. This last field of work comprises 25 000 written reports per year and it is the main basis for the activities of the DEKRA department “Accident Research & Crash Test Center”. This department is located in the DEKRA headquarter in Stuttgart.

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\section*{Sampling Area}

The DEKRA employees are located at 83 DEKRA branches with 116 satellite stations which are distributed all over Germany, see \textbf{Picture 1}. This guarantees also that the accidents are coming from all over Germany.

\textbf{Picture 1}: Map of all DEKRA branches

The currently collected 25 accidents are coming from 9 branches. It is expected, that at the end of the project roughly 40 branches are involved in the data investigation.

\section*{Accident investigation procedure}

\textbf{Team members}

The team is separated in two groups.

The first group contains roughly 500 special trained engineers who are working at the branches. They are investigating the data and they are also making the first reconstruction which is asked by the police.

The second group is including the members of the accident research unit. They get all information of the investigated cases from the engineers of the branches. They are transferring the interesting information to the paper version of the questionnaire. This is also including a modification of the reconstruction. This work is made by engineers supported by skilled student assistants. Finally the filled-out paper is transferred to the database. DEKRA co-operates with the GiR (Gesellschaft für Reallunfallforschung = Company researching real world accidents). The intention is to add the medical information like AIS where possible.

\textbf{Accident selection criteria}

The DEKRA engineers are called by the police to come to the accident scene and to reconstruct the accident. They are called to every kind of accident, on every kind of road, on all days of the week, at every time. The engineer knowing the selection criteria of the ETAC project decides to investigate this case if it is fulfilling the restrictions.
**Accident investigation procedure**
The expert is mainly looking to fulfill the tasks given by the police. He/she has to investigate the necessary information for the report asked by the police. Additionally he/she is looking for the data needed by ETAC. He/she has a special version of the questionnaire (in German) to collect the additionally needed information. The expert is part of the inquiry process. Therefore he/she has some rights and duties. On the one hand for example he/she is not allowed to talk to the involved parties directly. On the other hand he/she has also the right (if ordered by the police) to investigate possible technical defects.

**Accident analysis**
The normal accident reconstruction is using the so-called backward calculation. It starts with the final position of the involved parties and goes back to the point of collision. This is done by using the connecting factors like skid marks to get the speeds and moving directions just after the collision. The following collision analysis results in collision speed and moving direction just before impact. Adding information about pre-crash braking, steering and others the reconstruction results in the speed at the point of reaction. This could be completed by special reconstruction to estimate the spatial or temporal avoidability. The used reconstruction software is Analyser Pro, Carat, DUR (DEKRA accident reconstruction program) or PC-Crash. The selection of the software depends on the task which is given by the customer (eg police man) and also on the preferences of the expert.

---

**Data coding and quality control**

**Data coding**
The data coding is done as agreed in the questionnaire. The DEKRA accident research team is working with a paper version of this questionnaire for every case. The advantage is to give first an answer to every feature before transferring it to the database.

**Data entry**
The completed questionnaire is transferred to the database by using the ETAC software.

**Data quality control**
The first quality control is done during the process of data entry by regarding whether every feature is answered. The second is done by in the ETAC software included controls. The third is done after completing the data entry. Special logical control queries are showing possible problems inside the database. Additional it is planed to add logic controls§§§§ outside the ETAC software to reduce the logical mistakes in the database.

§§§§ with the background knowledge of DEKRA
Annex 3: Idiada – Sampling area

Applus+IDIADA
L’Albornar – P.O. Box 20
E – 43710 Santa Oliva (Tarragona) - Spain

IDIADA

Applus+IDIADA is one of the most significant independent specialized organisations in Europe providing engineering, testing and homologation services for the automotive industry. Indiana’s main fields of activity are homologations, engines, emissions, noise & vibration, vehicle dynamics, fatigue & durability and passive safety.

Among the passive safety engineering services provided by Idiada, there are: full-scale crash tests (Euro NCAP and FIA official test house) and vehicle and occupant protection simulation; dynamic impact tests and simulation for pedestrian and interior protection; sled tests (reverse acceleration and deceleration sled facilities) and simulation for restraint system development; misuse tests for airbag sensor development; analysis and optimization of bus and coach structures; design and optimization of HGV chassis and trailers. These testing and simulation capabilities combined with project management services have permitted IDIADA to become an overall passive safety engineering supplier. On the other hand, IDIADA has a multidisciplinary accident investigation unit operating since 1999.

On an innovative level, Applus+IDIADA has a multi-disciplinary accident investigation unit operating since 1999. Until now, the accident investigation unit has worked under specific research projects with the traffic authorities existing in Spain at local, regional and national level. In the period 2000-2001 IDIADA carried out at national level an in-depth study of 10 accidents in which buses and coaches were involved. This work was commissioned by the Spanish Home Office through the State Traffic Office. In the same way, since the setting up of the team, IDIADA has conducted several accident reconstructions ordered by either the Catalan Traffic Office (regional level) or the City Council of Barcelona (local level).

Currently, IDIADA continues its close work with the regional and local traffic authorities carrying out new accident reconstructions. In the same way, IDIADA acts a consultant to the different traffic authorities in Spain either conducting specific studies or giving advice in the preparation of their road safety campaigns. On the other hand, IDIADA is currently taking part in two EC funded projects within the 5th Framework Programme (CHILD and Rollover). Its contribution to these projects consists, among other tasks, of accident data collection and physical and virtual accident reconstruction. In addition, IDIADA includes in its Training on Accident Reconstruction and Vehicle Defect Investigation one subject focusing on heavy-duty vehicles.

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Description of the Local Network

The organisations that co-operate with IDIADA’s reconstruction team could be structured in the following way:

Traffic Police:
At urban level - “Guardia Urbana”, Barcelona (Barcelona Local Police)
At regional level - “Mossos d’Esquadra” (Catalonia Traffic police)
At national level - “Guardia Civil” (Spanish Traffic police)

Hospitals:
IDIADA co-operates with the “Institut Municipal de la Salut Pública”, (organisation representing five hospitals from Barcelona) as well as with many others hospitals from Catalonia and rest of Spain.

Administration:
At urban level the “Regidoria de Mobilitat i Transport” as an organisation of the City Council of Barcelona.
At regional level the “Servei Català de Transit” as an organisation of the Government of Catalonia.
At national level the “Dirección General de Tráfico (DGT)” as an organisation of the Ministry of Interior. Concerning the infrastructures, IDIADA also co-operates with the Ministry of Development.

Methodology

Accident Investigation Unit
IDIADA has a multidisciplinary accident investigation unit operating since 1999. The team consists of six full-time accident investigators supported by an experienced group of homologation, simulation and test engineers and other technicians.

The following organisation chart describes the accident research unit which is responsible for the ETAC project.

Project Manager: Gonçal Tejera
Accident Researchers: Víctor Salvachua, José Manuel Barrios, Xavier Artacho, José Luis Gámez, Miquel Sanabra, Phillip Mandhu.
Database responsible: Ignacio Lázaro
Passive Safety Engineer (supporting accident researchers): Ricardo Satué
Truck Homologation Engineer (supporting accident researchers): Ignacio Lafuente
The Accident Investigation Unit designed custom forms for on site investigators to fill in, as well as additional forms for post investigation analysis. The former is filled in at the crash site, and the later may be completed by investigator later. These questionnaires are divided in: Accident Notification, Police Form, Driver Form, User Form, Pedestrian Form, and Vehicle Form. The forms were tailored to provide information according to the requirements of the ETAC database but retain flexibility for wider application. The first sheet of the Police Form is attached.

**Sampling Area**

The contribution of Applus’IDIADA in the ETAC Project is focused in the accidents occur in Catalonia. The regional traffic map is divided into seven policed Regional Traffic Areas. Each area has a responsible police investigation team, and IDIADA has an Accident Investigation Unit team member assigned to each.

There is frequent liaison between the Police and IDIADA, which maintains a high standard communication channel between the Police and the area representative from the Accident Investigation Unit. The police advise IDIADA of cases that fall into the category relevant for study. In each case, a team of investigators works with the representative from IDIADA to collect the relevant data.

**Quality Control**

The criteria for qualifying a case for investigation purposes is that the vehicles involved in the crash still have to be in the rest position after the crash. The investigation of each case is to be before any vehicle recovery. In this initial step two things that the investigators and the police check are the involvement of a truck as relevant to ETAC, and that the vehicles are still in-situ.
The Police investigation team works in collaboration with the Applus+IDIADA investigator assigned to the respective regional area to conduct an on-site investigation that involves filling forms, taking measurements and recording key defining parameters of each case.

After the crash site investigation the investigation team reviews the information gathered, and prepares for input into the database. Following ratification of each case by a senior engineer at Applus+IDIADA, each qualifying case is then uploaded on the database.
Annex 4: IBB – Sampling area


In circle of the Ibb – Network there are traffic accident reconstruction and expertise treating firms, institute, engineer offices and independent experts, at the moment already from seven European countries and in the U.S..

The Ibb Hungary fifteen years ago took the traditional seminar, conjoint the University Széchenyi Istvan, where is primarily purpose the extension of knowledge of the experts, with yearly flare technical offer.

The Ibb Hungary is member and domestic representative of the European Accident Analyzer and Accident Research Association (IRU – International Road Transport Union – Genf).

The Ibb specialists can provides help through the spacious international connections, as well as the more age-old technical experience, personal searching and development for international road transporters and other customers the next one territory:

- *Analysis of traffic accident*: photogrammetric survey, computer simulations, accident experiments, expertise of traffic systems…
- *Damage expertise – Market value determination with moder / eurokonform / method*,
- *Technical expertises in case of warranty problems*,
- *Research - analysis* – experiments in field of vehicle safety: load securing – load failing examination, vehicle crash tests, interdisciplinary analysis…,
- *Compatibility analysis, when well founded the suspicion for a manipulation / tachograph analysis*,
- Development and employment of softwares which is used in accident of traffic,
- *Continuing education with co-operation the University Széchenyi Istvan (Gyor) on a level with the University,*
- *Compatibility analysis of the traffic accident*,
- *Commercial vehicle risk management*,
- *Driving style education in field of Motor vehicle safety*,
- *Damage service* through Ibb – network.

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European Truck Accident Causation Project

Hereinafter we give a summary of our applied work method and techniques.

In the next part we review the processed 19 cases and parts of the local surveys, cars damage pictures and the reconstruction of the accidents via simulations (Carat 3 and PC-Crash 7.1.).

The database contains the 18th and 19th cases. After monitoring and validation of the these cases the 17 cases will be also transferred to the database.

We are constantly working on the next 15 cases which require local filed work.

Work method

Phase 1 - Gathering data on accidents (from October 2004):

- studying and taking notes on minutes taken by authorities (police, public prosecution organisation, court),
- data from site inspections (drawings, photographs, recording traces, etc.),
- report of drivers,
- report witnesses,
- tachograph data,
- posterior assessment of site – road line,
- data of vehicles, recording deformations (measurements – photographs, brake measurement….),
- registration and documentation of injuries suffered by drivers and passengers (AIS).

Phase 2. Data sorting and processing (from January 2005)

Phase 3. Accident reconstruction (from January 2005 Falle 19)

- compatibility check based on images of the damage in cars and HGVs measurements,
- movement and collision analysis using computer simulation (plausibility test),
- avoidability calculations (reaction time, reaction place, evasive manoeuvres – steering, braking, etc.).

Phase 4. Data entry into the ETAC data bank (from March 2005 continued)
Annex 5: REKONSTRUKCIJA – Sampling area

REKONSTRUKCIJA

Rekonstrukcija
Iztok Ciglarič, MSc, PhD
Road accident reconstruction expert group
Ribniška 6, 2000 MARIBOR - SLOVENIA

The head of the office is Iztok Ciglarič. The head of the office has been lectured at the Faculty of mechanical engineering at the University of Maribor and at the University of Ljubljana for 16 years. He is also officially nominated for witness expert in the field “road traffic” and in the field “accident reconstruction” by Ministry of justice. He was officially nominated for the first time in 1997. Additional information could be obtained at Slovenian Ministry of justice homepage http://www.sigov.si/mp/.

Staff
The office staff is highly educated and subject to permanent expert and advanced study courses. The office activities are carried out by the following staff:
- Three mechanical engineers with finished PhD,
- One mechanical engineer with finished MsC,
- Two mechanical engineers,
- One medical doctor,
- Secretary.

Technical capability of the office
Available hardware:
- 5x PC computer,
- 3x laptop computer,
- 2x digital camera,
- Basic geodesic tools.

Available software for accident reconstruction:
- 5x PC Crash licenses,
- 2x CARAT licenses,
- 1x MADYMO license for PC Crash,
- 1x Photo modeler Pro.

References
Our office permanently collaborates with district and regional courts of law all over the Slovenia, providing road accident reconstruction expertise and witness expertise. Through this collaboration we are familiar with the work of all police administrative areas in the field of road accident scene processing and road accident data acquisition. Each year we provide
- In depth reconstruction of +100 cases for courts of law.
- Counseling in +100 cases per year (short expertise).

In additional office collaborate with Technical University Graz (Austria) on EU projects concerning vehicle and road safety (See: http://www.vsi.tugraz.at/). We also collaborate with faculty of mechanical engineering in Ljubljana and Maribor (both from Slovenia), as well as with faculty of mechanical engineering in Zenica (Bosnia and Herzegovina).

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E-mail: ibbkofal@axelero.hu
**General information**

According to data published by Slovenian general police administration ([http://www.policija.si/si/statistika/promet/2004/stat04.html](http://www.policija.si/si/statistika/promet/2004/stat04.html)) the road accident statistic in Slovenia for year 2004 is as follow from table 1

**Table 1: Road accident statistic for year 2004 and comparison with previous years**

<table>
<thead>
<tr>
<th>Year</th>
<th>All road traffic accidents</th>
<th>Accidents where at least one person has been killed</th>
<th>Accidents with injury</th>
<th>Only material damage</th>
<th>Killed all together</th>
<th>Severe injury</th>
<th>Minor injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>39.733</td>
<td>240</td>
<td>10.065</td>
<td>29.428</td>
<td>269</td>
<td>1.561</td>
<td>12-538</td>
</tr>
<tr>
<td>2003</td>
<td>41.319</td>
<td>220</td>
<td>11.595</td>
<td>29.504</td>
<td>242</td>
<td>1.411</td>
<td>15.487</td>
</tr>
<tr>
<td>2004</td>
<td>43.004</td>
<td>254</td>
<td>12.467</td>
<td>30.283</td>
<td>274</td>
<td>1.391</td>
<td>17.332</td>
</tr>
<tr>
<td>difference 03/04</td>
<td>+ 4 %</td>
<td>+ 15 %</td>
<td>+ 8 %</td>
<td>+ 3 %</td>
<td>+ 13 %</td>
<td>- 1 %</td>
<td>+ 12 %</td>
</tr>
</tbody>
</table>

Comparison with previous years show that the amounts of road traffic accidents increase by all statistical categories. It could be observed that there is slight decrease of severe injured people.

**Figure 1: Fatalities regarding to different traffic participants**

Following figure 1 one could see how fatalities are distributed according to different traffic participants. All data in table 1 and figure 1 are collected data from all police administrative areas in Slovenia.

In Slovenia there are 11 police administrative areas (AA) as shown in figure 2. As our office permanently collaborates with district and regional courts of law all over the Slovenia, providing road accident reconstruction expertise and witness expertise, we are familiar with the work of all police administrative areas in the field of road accident scene processing and road accident data acquisition.
Although our office is active in all administrative areas, regarding to project ETAC we start to collaborate with police in only three administrative areas. These are shown in figure 2:

1. Administrative area MARIBOR,
2. Administrative area CELJE,
3. Administrative area KRANJ.

The main reason is because those administrative police areas are very easy to access for our employees during the year in all weather conditions. The short overview of data for each administrative area shows the following table

<table>
<thead>
<tr>
<th>Administrative area</th>
<th>Road accidents</th>
<th>Fatalities and injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of accidents with fatal outcome</td>
<td>Number of accidents with injuries</td>
</tr>
<tr>
<td>Celje</td>
<td>1.670</td>
<td>33</td>
</tr>
<tr>
<td>Koper</td>
<td>533</td>
<td>13</td>
</tr>
<tr>
<td>Kranj</td>
<td>665</td>
<td>20</td>
</tr>
<tr>
<td>Krško</td>
<td>348</td>
<td>8</td>
</tr>
<tr>
<td>Ljubljana</td>
<td>3.895</td>
<td>62</td>
</tr>
<tr>
<td>Maribor</td>
<td>3.131</td>
<td>39</td>
</tr>
<tr>
<td>Murska Sobota</td>
<td>568</td>
<td>22</td>
</tr>
<tr>
<td>Nova Gorica</td>
<td>387</td>
<td>14</td>
</tr>
<tr>
<td>Novo mesto</td>
<td>763</td>
<td>26</td>
</tr>
<tr>
<td>Postojna</td>
<td>247</td>
<td>10</td>
</tr>
<tr>
<td>Slovenj Gradec</td>
<td>514</td>
<td>7</td>
</tr>
<tr>
<td><strong>TOGETHER</strong></td>
<td><strong>12.721</strong></td>
<td><strong>254</strong></td>
</tr>
</tbody>
</table>

Following results represent in table 2 it could be calculated, that within all three administrative areas (MARIBOR, CELJE and KRANJ) included in ETAC project there are 43% of all accident cases with fatalities and/or injury outcome. From this point of view it is clear that these three areas are statistically representative. Also it could be seen that according to the number of cases three different sizes of administrative areas are included (MARIBOR considered as big, CELJE as medium and KRANJ as small).
Activities description and future plans

Activities within first and second period

In year 2004 we deal with 85 cases that are relevant for ETAC project. We work on 50 cases in AA Maribor, 26 cases in AA Celje and 9 cases in AA Kranj. In table 3 it is shown how many cases has been treated each month. Following experience in year 2004 we found out that regarding to the other activities we have in our office it is reasonable to treat no more cases per month as have been treated in April 2004 and August 2004.

Table 3: Cases that has been treated in Slovenia for ETAC project in year 2004

<table>
<thead>
<tr>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>together</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4: All cases that has been treated within the first period

<table>
<thead>
<tr>
<th>Scene examination and data preparation</th>
<th>AA Maribor</th>
<th>AA Celje</th>
<th>AA Kranj</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>14</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>11</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Entering data into data base</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total No. of cases</td>
<td>14</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5: All cases that has been treated within the second period in year 2004

<table>
<thead>
<tr>
<th>Scene examination and data preparation</th>
<th>AA Maribor</th>
<th>AA Celje</th>
<th>AA Kranj</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases</td>
<td>36</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>36</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Entering data into data base</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total No. of cases</td>
<td>36</td>
<td>20</td>
<td>9</td>
</tr>
</tbody>
</table>
In second period additional cases has been treated in year 2005. Cases treated in 2005 (till April 2005) has been collected, however all of them have not been transformed in an electronic form suitable for entering into ETAC database nor evaluates regarding to ETAC project criteria. Also we found out that the quality of cases could be considerably improved if the police teams that process the accident scenes are detailed informed about ETAC research project and demands regarding to accident scene processing and data acquisition as defined in ETAC project. Because of this, we plan and also start activities in a form of workshops at all three police administrative areas that collaborate in ETAC project. In agreement with all three police administrative area we define one day workshops as follow:

1. 16.03.2005 AA Maribor
2. 12.04.2005 AA Kranj
3. 18.04.2005 AA Celje
4. 16.05.2005 AA Maribor
5. 20.06.2005 AA Kranj
6. 20.07.2005 AA Celje

As could be seen from dates the first workshop has been already carried through and all others will be in the near future.

**Future plans and activities**

Till now contractor from Slovenia deliver 5 completed cases entered into database as prepared by project coordinator, however together with cases in year 2005 more than 85 cases has been collected. Out of these, 85 cases are prepared and reconstructed and therefore ready to enter into the database.

As we notice some problems with current version of ETAC database exist, that result in possibility to lost entered data. Because of this our decision was to put more effort into collection, preparation and reconstruction of cases within the first and second period of the project. Also we are completely aware that database should be completed at the end of the project. Because of this we anticipate increased amount of work related to entering data into database as soon as updated and final version ETAC database will be distributed. Because of this we start the following activities:

1. Our office define person that is in charge to study ETAC database in details and define the most efficient way to enter data into database. This person is also in charge to make internal quality control for cases entered into ETAC database.
2. We start internal courses for those who will enter data into ETAC database. The course is lead by person that is in charge to perform detailed study of ETAC database. The aim is to get at least 4 persons that could perform high quality management of ETAC database and enter data in a shortest possible time. Each of these persons also perform accident reconstruction.
3. We improve content of workshops for police administrative areas in order to provide relevant and high quality data necessary to complete ETAC database.

It should be noted, that there is some delay in entering data into ETAC database, however till the end of second period of the project (till the end of June 2005) it could be anticipated that more than 100 cases will be prepared to be entered into ETAC database. From this point of view it is clear that more cases have been prepared as it is defined for the second period of ETAC project. How many cases will be actually entered into ETAC database till the end of second period could not be predicted accurately, however it is estimated that at least the number of cases that should be finished within first period of ETAC project will be completed.
Annex 6: Pavia - Sampling area

The Centre of study and research on road safety was established in September 2001 and located at the Department of Applied Health Sciences. The Centre is multidisciplinary and it is composed of the following scientific-administrative structures: Dipartimento di Scienze Sanitarie Applicate e Psicocomportamentali; Dipartimento di Medicina Legale e Sanità Pubblica; Dipartimento di Ingegneria Edile e del Territorio. The Centre works in collaboration with many different structures and centres.

**Aims**
The Centre has the following goals:
- highlight of the main risk factors of road accidents related to environmental conditions, individual behaviours, drug influence, vehicle mechanical performance;
- realization of methodology for road accidents reconstruction;
- supply public and private bodies with safety issues;
- organize training courses and masters to train and update experts on road safety;
- put up Italian and foreign undergraduates and graduates to carry out research and training.

**Centre activities**
The Centre aims at the following actions:
- planning and understanding the links between accident risk exposure and road safety policy
- It also aims at improving competence in the following fields:
  - **accident epidemiology** and road risk modelling;
  - **assessment of driving impairment** as significant source of road accident risk;
  - **assessment of drug-related impairment** at the roadside;
  - **assessment of accident injuries** on the people involved: fatal/non-fatal-injury.

**Training**
- **arrangement of didactic modules** about different road accidents issues (accident reconstruction; identification of risk factors, etc.);
- training courses and masters to train and update experts on road safety.

**Scientific-administrative structures of the Centre**
The Centre is composed of the following structures:
- Dipartimento di Scienze Sanitarie Applicate e Psicocomportamentali;
- Dipartimento di Medicina Legale e Sanità Pubblica;
- Dipartimento di Ingegneria Edile e del Territorio;
- Computer science laboratory and multimedia laboratory where the accident reconstruction activity is made;
- Epidemiological and statistics laboratory where the planning of researches, quality control and analysis of data is carried out;
- Toxicological laboratory where the data on the impairing effects of alcohol, drugs and medicines on driving performance are collected;
- Psychodiagnostic laboratory where tests for licences are carried out;
- Psychological techniques laboratory to investigate driver behaviour-accident relationships;
- Library with about 6,000 books and 80 journals of which 30 on line.

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- **Pr. MARINONI**
  - Tel.: +39 03 82 50 75 34
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  - E-mail: marinoni@unipv.it
Team Members
- Scientific Manager: Mattia Sillo (Engineer)
- Accident Investigator: Ivan Colombara (Engineer)
- Involved Person Interviewer: Marinoni Paola (Psychologist)
- Involved Person Interviewer: Sessarego Fiorella (Biologist)
- Contact Manager: Virginia Borasi

The project is supported in Pavia area by the authorities of the Police of Pavia, the Italian State Highway and Motorway Police.

Police collaboration:
- Town Police of Pavia covers the urban area of the city.
- Highway Road Police and Carabinieri investigate accidents on all non-urban roads of the Pavia Province.

A direct contact with the medical rescue unit of the Province gives information of accidents in other urban towns of the Province. Collaboration with local Police of these towns is required if an accident happens.

Investigation Area - Pavia Province is 190 km².

Sampling Method and Investigation Procedures

Information about the accident event is passed on by the Police or by the medical rescue unit via telephone within 24 hours. In the team headquarters the calls received are to be processed to check the defined sampling criteria. A team member goes to Police to take the preliminary report and, eventually, the team is activated to investigate the accident. See following flow-charts for procedures. Injuries reports are obtained from medical rescue unit and are also included in Police accident reports.
Notification of the accident

Information collection (from phone call or police report)

Case qualification

no

Registration and file storage

Investigation Team Assignment

yes

On scene team (engineer staff)

Interviewer Team

Data Collection On-Scene

On site measurement and photographs

Vehicles mechanical review and photographs

Worksheet filling in

On scale drawing of accident scene

Involved Persons Interviews (specific questionnaire – see Annex A)

Database Coding
Scientific Manager decide the accident has to be collected

It is possible to arrive on the accident scene quickly

Communication at data manager. Leaving for the scene

Datas survey according to what it’s possible to record on accident scene

Wait for offices’ opening or police appointment

If it is possible to get police report immediately

Informations are sufficient?

Yes

Accident investigation: Worksheet compilation (all parts) and delivery to scientific manager

No

Leaving for police station

Decision on what’s necessary to record firstly (Scene or vehicles)

Contact the repair garage or the involved persons to make an appointment

Go to accident scene or vehicles inspection

YES

NO

NO

NO

YES

YES

NO

Communication of the accident from Scientific Manager (how many persons are to be interviewed)

Is it possible to interview persons on scene?

Interview by telephone or by appointment,

Other interviews

On scene with Engineers team to interview

Filling in the interview questionnaire

Database Coding
Annex 7: TNO – Sampling area

TNO Automotive is a part of the Organisation for Applied Scientific Research (TNO) in The Netherlands. TNO is an independent, non-profit organisation with 20 research institutes. TNO Automotive particularly performs a wide range of contract research and development work on road vehicles and internal combustion engines.

The accident analysis within TNO is organised through the Dutch Accident Research Team (DART), which is a part of the Crash Safety department of TNO Automotive. In 1999, DART started its activities. Since then traffic accidents were investigated according to an in-depth protocol. For this, extensive contacts with the police in the province Zuid-Holland was set up. A co-operation was also started with about 20 hospitals of the region for obtaining the medical information. DART is staffed with 5 permanent employees (all engineers) and apart from them, is also staffed with temporary employees.

Until now, DART is investigating up to 100 accidents per year of all vehicle types: motorcycles (MAIDS), passenger car (EACS), heavy truck (AAHT), sport utility vehicles (SUV) city trams (TRAMS). DART is also involved in PENDANT, SafetyNet and RISER projects

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Mobile : +31 65 33 79 362
Boudewijn.hoogvelt@tno.nl
**Sampling region**

The size of the sampling region can be established by examining the mean number of accidents occurring per year in the area around the team location. For this the National accident statistics of 1994-1998 in the Netherlands were taken (AVV-VOR). These figures are averaged. Presented is the average number of accidents over the years 1994-1998. The proposed sampling region includes the police regions Haaglanden and Rotterdam-Rijnmond.

**Severity**

In table 1 the average number of accidents with a maximum injury level of the HGV occupant are shown. The proposed region seems to have about the same distribution as the rest of the Netherlands. On average one fatal, 6 seriously injured and 24 slightly injured truck occupants per year can be expected in the proposed collection area. On average 2943 notifications of an accident are to be expected in the collection region when notified by the police.

Table 1  HGV occupant maximum injury level. Average numbers per year over 1994-1998.

<table>
<thead>
<tr>
<th>HGV injury level * Regio Crosstabulation</th>
<th>Outside region</th>
<th>Haaglanden</th>
<th>Rotterdam -Rijnmond</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No injury</td>
<td>16630</td>
<td>1076</td>
<td>1836</td>
<td>19542</td>
</tr>
<tr>
<td>% within Regio</td>
<td>98.8%</td>
<td>99.3%</td>
<td>98.8%</td>
<td>98.8%</td>
</tr>
<tr>
<td>K</td>
<td>9</td>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>% within Regio</td>
<td>.1%</td>
<td>.1%</td>
<td>.1%</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>52</td>
<td>1</td>
<td>5</td>
<td>58</td>
</tr>
<tr>
<td>% within Regio</td>
<td>.3%</td>
<td>.1%</td>
<td>.3%</td>
<td></td>
</tr>
<tr>
<td>SLI</td>
<td>147</td>
<td>7</td>
<td>17</td>
<td>171</td>
</tr>
<tr>
<td>% within Regio</td>
<td>.9%</td>
<td>.6%</td>
<td>.9%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16838</td>
<td>1084</td>
<td>1859</td>
<td>19781</td>
</tr>
<tr>
<td>% within Regio</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

In table 2 the average number of accident with a maximum level of injury for the collision partner occupant is shown. The severity level is lower than in the rest of the Netherlands. This is probably due to less secondary roads in the collection area (see also §2.1.2. Per year, on average 15 fatal, 41 seriously injured and 129 slightly injured collision partner occupants can be expected in the proposed collection region.

Table 2  Collision partner occupant maximum injury level

<table>
<thead>
<tr>
<th>CP injury level * Regio Crosstabulation</th>
<th>Outside region</th>
<th>Haaglanden</th>
<th>Rotterdam -Rijnmond</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No injury</td>
<td>15572</td>
<td>1014</td>
<td>1744</td>
<td>18330</td>
</tr>
<tr>
<td>% within Regio</td>
<td>92.5%</td>
<td>93.5%</td>
<td>93.8%</td>
<td>92.7%</td>
</tr>
<tr>
<td>K</td>
<td>125</td>
<td>6</td>
<td>9</td>
<td>140</td>
</tr>
<tr>
<td>% within Regio</td>
<td>.7%</td>
<td>.6%</td>
<td>.5%</td>
<td>.7%</td>
</tr>
<tr>
<td>SI</td>
<td>400</td>
<td>16</td>
<td>25</td>
<td>441</td>
</tr>
<tr>
<td>% within Regio</td>
<td>2.4%</td>
<td>1.5%</td>
<td>1.3%</td>
<td>2.2%</td>
</tr>
<tr>
<td>SLI</td>
<td>742</td>
<td>48</td>
<td>81</td>
<td>871</td>
</tr>
<tr>
<td>% within Regio</td>
<td>4.4%</td>
<td>4.4%</td>
<td>4.4%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Total</td>
<td>16839</td>
<td>1084</td>
<td>1859</td>
<td>19782</td>
</tr>
<tr>
<td>% within Regio</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
1. Road type
As can be seen in table 3 the accident distribution with trucks in the proposed region is biased towards local roads (urban area) and highways (100 km/h roads with or without level intersections). Secondary roads and motorways are under represented with respect to the whole of the Netherlands. An extreme difference is found for Rotterdam-Rijnmond with accidents on highways.

Table 3 Road types vs. region. Average number of accidents per year over 1994-1998

<table>
<thead>
<tr>
<th>Road type * Regio Crosstabulation</th>
<th>Regio Outside region</th>
<th>Regio Haaglanden</th>
<th>Regio Rotterdam -Rijnmond</th>
<th>Regio Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>local road</td>
<td>Count 10689</td>
<td>837</td>
<td>1138</td>
<td>12664</td>
</tr>
<tr>
<td>% within Regio</td>
<td>63.5%</td>
<td>77.1%</td>
<td>61.2%</td>
<td>64.0%</td>
</tr>
<tr>
<td>secondary road</td>
<td>Count 4062</td>
<td>160</td>
<td>350</td>
<td>4572</td>
</tr>
<tr>
<td>% within Regio</td>
<td>24.1%</td>
<td>14.7%</td>
<td>18.8%</td>
<td>23.1%</td>
</tr>
<tr>
<td>highway</td>
<td>Count 929</td>
<td>64</td>
<td>359</td>
<td>1352</td>
</tr>
<tr>
<td>% within Regio</td>
<td>5.5%</td>
<td>5.9%</td>
<td>19.3%</td>
<td>6.8%</td>
</tr>
<tr>
<td>motorway</td>
<td>Count 1158</td>
<td>24</td>
<td>12</td>
<td>1194</td>
</tr>
<tr>
<td>% within Regio</td>
<td>6.9%</td>
<td>2.2%</td>
<td>6%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Total</td>
<td>Count 18838</td>
<td>1085</td>
<td>1859</td>
<td>19782</td>
</tr>
<tr>
<td>% within Regio</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

2. Collision partner type
In table 4 the average number of collision partner types are shown. Overall the distribution is approximately the same. The number of two wheelers and pole/tree impacts are overall slightly under represented. The number of passenger cars is slightly over represented.
Table 4  Average number of collision partners per year over 1994-1998.

<table>
<thead>
<tr>
<th>Collision partner</th>
<th>Regio Crosstabulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outside region</td>
</tr>
<tr>
<td>BICYCLE</td>
<td>Count</td>
</tr>
<tr>
<td>BUS</td>
<td>Count</td>
</tr>
<tr>
<td>HGV</td>
<td>Count</td>
</tr>
<tr>
<td>MOFA</td>
<td>Count</td>
</tr>
<tr>
<td>MOPED</td>
<td>Count</td>
</tr>
<tr>
<td>MOTORCYCLE</td>
<td>Count</td>
</tr>
<tr>
<td>OBJECT</td>
<td>Count</td>
</tr>
<tr>
<td>OTHER</td>
<td>Count</td>
</tr>
<tr>
<td>PASSENGER CAR</td>
<td>Count</td>
</tr>
<tr>
<td>PEDESTRIAN</td>
<td>Count</td>
</tr>
<tr>
<td>POLE/TREE</td>
<td>Count</td>
</tr>
<tr>
<td>VAN</td>
<td>Count</td>
</tr>
<tr>
<td>unknown or N/A</td>
<td>Count</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
</tr>
</tbody>
</table>

3. Collision points

In table 5 the average number of times a collision point on the HGV is hit. The distributions are approximately the same. Some over and under representation exist in the collection region.

Table 5  The average number of collision points per year on the HGV over 1994-1998

<table>
<thead>
<tr>
<th>HGV collision point</th>
<th>Regio Crosstabulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outside region</td>
</tr>
<tr>
<td>Bottom or top</td>
<td>Count</td>
</tr>
<tr>
<td>Left side</td>
<td>Count</td>
</tr>
<tr>
<td>Mid front</td>
<td>Count</td>
</tr>
<tr>
<td>Mid rear</td>
<td>Count</td>
</tr>
<tr>
<td>Multiple</td>
<td>Count</td>
</tr>
<tr>
<td>N/A or unknown</td>
<td>Count</td>
</tr>
<tr>
<td>Right side</td>
<td>Count</td>
</tr>
<tr>
<td>Trailer</td>
<td>Count</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
</tr>
</tbody>
</table>

- 102 -
In table 6 the average number of times a collision point on a collision partner is hit. The distributions are approximately the same. Some over and under representations exist.

Table 6  Average number of times a collision point on a collision partner is hit over 1994 1998.

<table>
<thead>
<tr>
<th>CP collision point</th>
<th>Outside region</th>
<th>Haaglanden</th>
<th>Rotterdam-Rijnmond</th>
<th>Regio Crosstabulation Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom or top</td>
<td>30</td>
<td>2</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>% within Regio</td>
<td>.2%</td>
<td>.2%</td>
<td>.2%</td>
<td>.2%</td>
</tr>
<tr>
<td>Left side</td>
<td>3076</td>
<td>227</td>
<td>397</td>
<td>3700</td>
</tr>
<tr>
<td>% within Regio</td>
<td>18.3%</td>
<td>20.9%</td>
<td>21.4%</td>
<td>18.7%</td>
</tr>
<tr>
<td>Mid front</td>
<td>5117</td>
<td>295</td>
<td>529</td>
<td>5941</td>
</tr>
<tr>
<td>% within Regio</td>
<td>30.4%</td>
<td>27.2%</td>
<td>28.5%</td>
<td>30.0%</td>
</tr>
<tr>
<td>Mid rear</td>
<td>2862</td>
<td>200</td>
<td>370</td>
<td>3432</td>
</tr>
<tr>
<td>% within Regio</td>
<td>17.0%</td>
<td>18.4%</td>
<td>19.9%</td>
<td>17.3%</td>
</tr>
<tr>
<td>Multiple</td>
<td>311</td>
<td>25</td>
<td>40</td>
<td>376</td>
</tr>
<tr>
<td>% within Regio</td>
<td>1.8%</td>
<td>2.3%</td>
<td>2.2%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Right side</td>
<td>1726</td>
<td>135</td>
<td>197</td>
<td>2058</td>
</tr>
<tr>
<td>% within Regio</td>
<td>10.3%</td>
<td>12.4%</td>
<td>10.6%</td>
<td>10.4%</td>
</tr>
<tr>
<td>Trailer</td>
<td>402</td>
<td>14</td>
<td>46</td>
<td>482</td>
</tr>
<tr>
<td>% within Regio</td>
<td>2.4%</td>
<td>1.3%</td>
<td>2.5%</td>
<td>2.3%</td>
</tr>
<tr>
<td>N/A or unknown</td>
<td>3314</td>
<td>187</td>
<td>276</td>
<td>3777</td>
</tr>
<tr>
<td>% within Regio</td>
<td>19.7%</td>
<td>17.2%</td>
<td>14.9%</td>
<td>19.1%</td>
</tr>
<tr>
<td>Total</td>
<td>16838</td>
<td>1085</td>
<td>1858</td>
<td>19761</td>
</tr>
<tr>
<td>% within Regio</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Accident investigation procedure

Accident selection and notification
The accidents will be notified to The Dutch Accident Research Team (DART) by the technical police departments in the regions Haaglanden, Rotterdam-Rijnmond, Hollands Midden, and Zuid-Holland-Zuid (in total the province of Zuid-Holland) when an accident with a truck will occur. The technical police departments in these regions are notified of almost all truck accidents and measure accident (skid) marks in detail and photograph the accident scene using high tech equipment. The DART will respond within a short period of time after the accident occurred.

Encountered problems
During the study the police will not notify DART of every accident occurrence, especially in the beginning of the study. Therewith introducing a sampling bias. This has to be avoided, however in this case the missing accidents seem to be quite random. A possible solution for this problem might be that in the first two weeks or month of a new study a call is made to the police departments for remembrance.

Also accident collection is hardly possible to plan, because accident occurrence is a stochastic process. In some months hardly any accidents occur, but therewith making it impossible for deadlines.

Data collection
After notification the accident scene will be inspected. The environment will thoroughly be inspected, including road layout, defects and environment. Also accident (skid) marks on the road will be measured. Photos and videos will be made and will also be obtained from the police. The police also deliver a detailed road drawing.
Further more the involved vehicles are inspected for deformations, defects and possible injury-causing locations. Forms for measurements and data will be developed for both environment and vehicle inspection.

All involved people will be interviewed, by sending them a questionnaire including questions about the accident, health before and after the accident and work related questions. When needed, involved victims are asked for their permission to retrieve injury information from the hospital. If permission is granted, the hospital will be visited and injury information will be obtained. Otherwise, injury information will be obtained by questioning the victim by telephone.

After all data are available, the accident reconstruction will take place and the accident information will be filled in the database.
The CEESAR association (European Center for Safety Studies and Risk Analysis) was founded in 1992 following a call for tenders for the Vehicle and Road Safety program included in the national Research and Development Program for Inland Transportation Innovation and Technology.

Funding for the current research projects comes primarily from the French car manufacturers Renault and PSA – Peugeot – Citroën via a joint venture called the Laboratoire d’Accidentologie et de Biomécanique, whose origins can be traced back through to the 1970’s when it started passive safety and human tolerance investigation. Other sponsors include the ACEA (Association of Constructeurs Européen d’Automobiles), national insurance companies, engineering schools and well-known scientific personalities. Funding for specific projects also comes from Renault VI and the ACEM (Association de Constructeurs Européens de Motocycles).

The CEESAR is a partner for safety and accident risk research and experimentation programs in compliance with research ethic guidelines.

CEESAR focus on:
- Knowledge exchange, sharing of experience and savoir-faire to improve safety, primarily Road Safety.
- Research and experimentation for accident risk and injury reduction.
- Biomechanical research for the study and analysis of human body and dummy movement during crashes.
- Training methods for socio-economical specialists in accidentology.
- Driver and road user teaching programs.

CEESAR has a good experience in European project (EACS, MAIDS) and French project (RIDER, SUMOTORI, PROTEUS)

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- Laboratory of Accidentology an Biomechanics
- Renault Heavy Goods Vehicles
- European Accident Causation Survey
- Motorcycle Accident In-Depth Study
- Research on accidents involving motorcycles
- Safety, security of the system motorcyclist and motorcycle against risks linked to the environment
- Vulnerable passenger head Protection
Sample Area

The CEESAR works on one accident investigation site in the North of France (see map). The Amiens site was set up in 1980 for truck accident investigation and then expanded at the start of the 1990’s to include car accidents. It currently studies truck, coach, car and pedestrian accidents.

The site has been chosen for a number of reasons:

- Large town with good hospital facilities
- Urban and rural road network including motorways and expressways.
- Comprehensive emergency service system
- High accident potential
- Proximity to Paris (CEESAR and car manufacturers’ head offices)

Accident investigation procedure

Team members

The site has a team of three accident investigators. The team consists of a psychologist who collects information from the drivers, passengers, pedestrians and witnesses; a road infrastructure investigator; and a vehicle investigator. The tasks carried out by each team member will be examined in detail below.

The teams are supervised by a project manager, who is also the ETAC co-ordinator.

Local conventions with the highway authorities mean that road geometry data and infrastructure plans are available for use by the teams. In addition, the CETE§§§§§ in Rouen and the local County Councils have financed a road geometry survey of approximately 300 kilometres on selected roads around each site. By choosing the roads with the highest representation in their accident databases, the teams have

§§§§§ Centre d'Etudes Techniques de l'Equipement
accurate information on road slope and banking, as well as bend radius and grip coefficients for a large number of cases.

Since the change in French working time legislation at the beginning of 1999, the teams work approximately 40 weeks a year and are on 24-hour duty for 20 weeks a year. Working hours during the non-duty weeks are from 8:30 until 17:30 from Monday to Friday. The duty week is non-stop from 8:30 on Monday morning until 21:30 on Saturday evening. Accidents are no longer investigated on Sundays. During the duty week, team members carry a pager and mobile phone at all times.

**Accident selection criteria**

As soon as the local Fire Service receives a call for a road traffic accident, it enters the information into a computer before sending out the necessary rescue teams. If the accident meets the CEESAR accident investigation criteria, then the computer automatically pages the team. The selection criteria are based on the accident type and the locality.

The team phones the fire services to find out where the accident site is before leaving. The restricted accident zone means that the CEESAR team arrives on the scene of the accident only a few minutes after the emergency services, and sometimes even before the Police Force.

When the team arrives, a rapid analysis of the accident scene is carried out to see if there is sufficient information to merit a case study. The team needs to know if:
- The emergency call was accurate concerning vehicle type and injuries.
- The vehicles are still in their final position.
- The point of impact is identifiable.
- The driver’s are willing to co-operate.
- The accident scene is safe enough to work on.

All these conditions must be fulfilled for the team to begin investigating.

**Accident investigation procedure**

On the accident site, the team members wear fluorescent clothing. Their vehicles are equipped with orange flashing lights.

The investigators park their vehicles near the accident scene, so as not to impede the emergency services and the Police Force. They then present themselves to the representatives of the Police Force to make sure that they are authorised to work on the accident scene and to collect as much information
as possible about the accident. The team then checks that the accident meets the above criteria, before separating and starting to work individually. A regular exchange of information on the scene is important so that the three investigators may follow up all possible leads.

The “driver investigator” interviews uninjured drivers on the spot about the pre-crash, crash and post-crash situations. The driver thus benefits from visual references on the accident scene and his recital of the accident scenario is richer. If the driver is injured, the length of the first interview depends on his state. Because the emergency services are aware of the importance of accident research (through regular presentations by the team) they allow the investigator into the ambulance if the driver is able to speak. If the driver needs immediate medical treatment, then the investigator collects as much information as possible on the scene of the accident from passengers and witnesses, and then heads to the emergency ward of the hospital. The first interview takes place just before or after initial medical treatment, unless the driver is unconscious or undergoing emergency surgery, in which case the interview takes place after a few days.

The “road investigator” marks the final position of the vehicles and all the marks that they leave before, during and after the crash. He then takes photos of the accident scene from a road infrastructure point of view (final position, skid marks, road geometry, road surface, weather conditions…). Once all this volatile information has been photographed, he draws up a sketch of the accident scene which includes the approach path of each vehicle, the skid marks etc…, their final positions, the road and roadside geometry and road signs.
The “vehicle investigator” photographs the vehicles in their final position, the deformations, the state and use of vehicle equipment, load etc.. Once this is done, he examines in detail the use and the condition of the various equipment (lighting, radio / telephone, seat position and belt use, gear lever position, tyre pressure, etc…). He also talks to the emergency services about their extraction methods and any other changes that they light have made to the vehicle.

Back in the office, the three team members discuss their findings and form their first hypothesis. Over the next few days each investigator collects complementary information based on the initial findings and hypothesis.

The “driver investigator” meets the drivers once again to discuss personal and medical details, general driving habits, training, previous accidents and sanctions, before coming back to the accident situation. The information collected from the other driver and the other accident investigators is used to corroborate or to contradict the driver’s initial declarations.

The “road investigator” collects complementary information about the road geometry, the grip and the traffic. He uses this information to complete his accident sketch and then draws up a scale map of the accident scene.

The “vehicle investigator” returns to see the vehicle and carries out a more in depth study of the type of equipment on the vehicle and its condition. He also measures vehicle deformation and looks for impact zones inside and outside the vehicle, which may correspond to injuries sustained by the occupants or a pedestrian.
**Accident analysis**
Throughout the data collection and analysis process, the team members work together closely to find the most probable accident scenario.
The information collected by the three investigators is then used as the basis for a dynamic reconstruction using PC-Crash software*****. The conservation of energy equations are used to give initial dynamic parameters. The scale 3D map serves as the background for a reconstruction which starts at the rest position of the vehicles, and goes back in time through the post crash, the crash and the pre crash phases. Each phase is based on the information collected by the investigators.

The accident is analysed according to a sequential model
- Accident type
- Failure type
- Failure function
- Failure mechanism
- Sequence of events

The results of these cinematic and cognitive reconstructions are used for the determination and application of active safety countermeasures.

From a secondary safety point of view, the occupant’s medical report, which is supplied by the local hospital, is used to correlate the injuries sustained with the accident injury mechanisms and the zones impacted inside or outside the vehicle.

**Data coding and quality control**

**Data coding**
Data is coded according to the recommendations of the ETAC software manual.

**Data entry**
Data is entered into the database using the ETAC software. In addition to the data checks in the software, regular data input checks are carried out.

**Data quality control**
The investigation teams choose ETAC accident cases amongst those with a maximum amount of information available. The cases are coded exactly according to the recommendations of the software manual. Once data entry is finished, quality control checks are carried out on the variables within and between the various tables of the database

All accident cases from Phase 1 and 2 have been brought up to date using the ETAC software. This includes an accident summary, photos and sketches and addition of new accident variables.

***** Dr Steffen Datentechnick, Linz, Austria