Road Safety Data, Collection, Transfer and Analysis

Deliverable 2.4 Final Updated Protocol with Updates from the Pilot Review

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- Icelandic Road Accident Investigation Team
- Transport Malta
- Motor Transport Institute, Poland
- Norwegian Accident Investigation Board
- Norwegian Public Roads Administration
- Slovenian Traffic Safety Agency
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EXECUTIVE SUMMARY

In-depth data describing the causes of accidents and injuries provides a major contribution to the development of new safety policies. It is essential when conducting impact assessments of existing or future safety policies and it plays a vital role when developing and evaluating technology countermeasures. There is no in-depth data available to describe the causes of accidents and injuries for Europe as a whole although earlier studies have conducted pilot investigations to develop protocols. DaCoTA has built upon previous work with the intention of establishing the infrastructure for a future investigation system that will then be deployed beyond the completion of the project.

This deliverable contains the final update to the DaCoTA training manual and protocols for in-depth road accident investigations in Europe, which were tested and updated following a pioneering Europe-wide In-Depth Pilot Study during 2012. The results of this Pilot Study were used to further refine and improve the data collection methodology.

The DaCoTA training manual outlines all of the variables that are required to be gathered during in depth accident investigation and input into the DaCoTA database. Most of the latest methodology is included in this deliverable, although the full system can be viewed online in an interactive manner at the web address:

http://dacota-investigation-manual.eu

The online manual is divided into 5 sections that form the basis for most of the chapters in this document:

- DaCoTA Teams
- Variables (merged with the next section)
- Methodology Outline
- Detailed Methodology
- Forms and Documents

DaCoTA Teams (Chapter 2) describes the Pan-European In-depth Accident Investigation Network and the structure of the investigation teams. This includes information on team experience levels. The Variables section in the Online Manual provides a comprehensive list of approximately 1500 variables and their definitions that are possible to collect during an accident investigation.

The Variables section (Chapter 3) provides some additional information on the variables however due to the large number of variables a full list is not provided in this document. The Methodology Outline section (also Chapter 3) of the Online Manual gives an overview of the DaCoTA Methodology and provides an idea of the investigation requirements.

The Detailed Methodology section is the core text of the Online Manual as it provides detailed information about how to collect road accident data, what equipment is required and what precautions should be taken. The Detailed Methodology Text is presented in Chapter 4. The Forms and Documents section of the Online Manual contains a selection of accident investigation tools (forms/prompt sheets) that can be effective in helping the investigator collect data in a structured and organised manner. Further details can be found in Chapter 5 however the actual forms are not

included in this document. Recommendations from the pilot study review and the Network teams are contained in Chapter 6.

The recommendations have been collected from practically all the project partners and participants in the pilot study through a review process. The review was divided into two major parts; a case review made by the Core teams and a questionnaire concerning the experience all teams had during the pilot study. In the review of cases both core teams and new teams were reviewed and the aim was to find common mistakes to identify training needs and team capability. In the questionnaire all teams had the chance to give their own opinion about the system as a whole and the methodology, the on-line manual and the web application separately. The results from the review and the questionnaire were analysed and many issues were resolved within the project. Some issues are still open though and are presented in detail in Chapter 6.

In conclusion, a comprehensive, in-depth accident investigation methodology has been developed and tested as part of a full system ready for European wide implementation.

1. INTRODUCTION

This document presents the final updated protocol for in-depth road accident investigations as developed by the DaCoTA project. This protocol takes the form of an online manual, namely, the DaCoTA Online Manual. This Online Manual is a tool which presents the DaCoTA in-depth road accident investigation methodology, primarily to in-depth road accident investigators. Its aim is to indicate the scope, characteristics and practical requirements of the methodology. It also contains detailed information on all variables (or data fields) in the DaCoTA database.

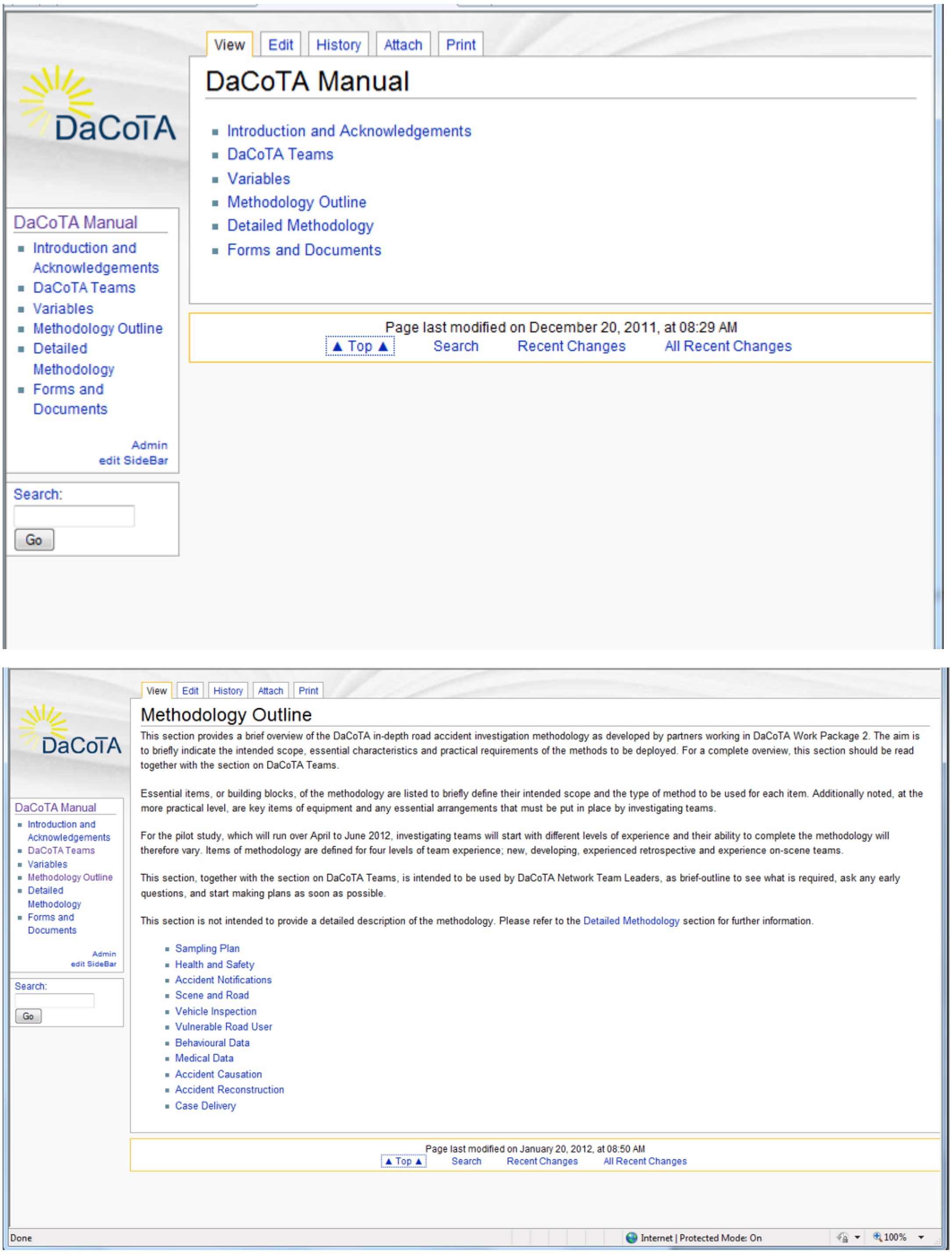

Figure 1: Screen shots of the DaCoTA online Manual

The manual can be viewed directly through a web browser (see Figure 1) at the following address:

http://dacota-investigation-manual.eu

It is also linked to the DaCoTA online database system that is designed to record accident data. This will allow investigators to see individual variable definitions when completing or browsing the database.

1.1. Pilot Review

The protocol documented in Deliverable 2.3: *Training package including training manual and Draft Protocols*[1] has been piloted by members of the Pan-European In-depth Accident Investigation Network. This network was created as part of the DaCoTA project to assist in establishing new and to develop existing road accident investigation teams. The aim was to provide road investigations teams in as many European countries with the knowledge and skills to conduct accident investigations in their country according to a European protocol. The pilot involved each team investigating a number of accidents and reviewing the investigation methodologies. Changes were made to the Online Manual as a result of this process and recommendations were made for future improvements. This document presents the updated protocol as is currently documented in the Online Manual.

1.2. Purpose of document

This document is intended to be a comprehensive methodology for users of the DaCoTA system and for making in-depth accident investigations according to that method. It should also be noted that this version of the manual was prepared for teams undertaking the pilot study in 2012. For example guidance is given on the experience level of teams entering the pilot study (see Section 2.3 Team Experience, page 11) however this advice is generally applicable to any team whether new or experienced wishing to undertake the DaCoTA methodology. Some statements in the methodology were written during development of the pilot study and may be forward-looking in nature, now that the pilot study has successfully concluded.

As a methodology inevitably evolves with time, this document represents a “snapshot in time”. However the methodology is also available in an online version, which allows the possibility of constant updates.

Finally, the document aims to make recommendations for further on-going development of the methodology.

1.3. Structure of the Document

The online manual is divided into 5 sections and each of these sections, except ‘Variables’, forms a chapter in this document. Information about variables is included in the Methodology Outline chapter:

- DaCoTA Teams
- Variables and Methodology Outline
- Detailed Methodology

[1] Atalar, D., Talbot, R., Hill, J. (Eds) (2012) Training Package including training manual and draft protocols, Deliverable 2.3 of the EC FP7 project DaCoTA. Available at: http://www.dacota-project.eu/deliverables.html

- Forms and Documents

DaCoTA Teams (Chapter 2) describes the Pan-European In-depth Accident Investigation Network and the structure of the investigation teams. This includes information on the level of team experience and individual roles and expertise. The Variables section in the Online Manual provides a comprehensive list of approximately 1500 variables and their definitions that are possible to collect during an accident investigation. A brief description of this section is included in chapter 3 however due to the large number of variables a full list is not provided in this document.

The Methodology Outline section of the Online Manual gives an overview of the DaCoTA Methodology (Chapter 3). This can be read as a complete text and gives a broad introduction to the activities and requirements for an in-depth investigation team.

The Detailed Methodology section is the core text of the Online Manual as it provides detailed information about how to conduct in depth investigations and collect data from road accidents, what equipment is required and what precautions should be taken by team members. This section is for those planning or actively involved in in-depth accident investigation activities and can be used as a reference text. The full Detailed Methodology Text is presented in Chapter 4.

The Forms and Documents section of the Online Manual contains a selection of accident investigation tools (forms/prompt sheets) that can be effective in helping the investigator collect data in a structured and organised manner. Further details can be found in Chapter 5 however the actual forms are not included in this document. Recommendations for future road accident investigation activities are contained in Chapter 6. from the pilot study review and the Network teams

2. DACOTA TEAMS

2.1. The Network and Team Structure

The Pan-European In-depth Accident Investigation Network (the “Network”) is made up of investigating teams who are all based in different countries. Each investigating team has a Team Leader and investigators. The team leader can be an investigator. The Network, methodology and training are organised by the Core Team who are the partners in DaCoTA Work Package 2. Core Team member organisations also operate investigating teams in their local areas. Please see Methodology for further information about team structure.

2.2. Ways of Working

2.2.1. Data Collection and Case Analysis

The in-depth accident investigation process first requires investigators to make observations and gather information before going on to analyse the information to understand what happened and why. The methodology will therefore cover both the collection of data and case analyses. Data collection can involve a wide range of activities such as making notes, measurements, interviewing people, collecting injury details from hospitals, taking photographs and possibly making video recordings. Case analysis includes identifying and coding how and why events such as collisions between road users or injuries to road users occurred, and more specific analyses are involved, for example to calculate vehicle speeds. This document outlines the key methods investigators will need to follow to collect detailed data and photographs, and to go on to make the case analyses to reconstruct events and understand the causes of collisions and any injuries.

Teams will upload the data, photographs and analysis results into an on-line database system. Further information about the case completion process and the management of potentially sensitive data can be found in Chapter 3 Methodology Outline, in the section on Case Delivery.

Database Variables: The database system will provide approximately 1500 variables (or fields) for data entry per case. However, it must be noted that only a sub-set of available fields will be relevant to any individual case (for example, variables defined for trucks will not be needed when there are only passenger cars involved in an accident). As an approximate guide, normally around 200 variables will need to be collected to describe the overall accident and road characteristics. In addition, around 200 to 300 variables will be completed for each vehicle involved. When it comes to the humans involved, a further around 100 to 200 variables are required. The more experienced team may need to consider entering information against further variables in order to record all observations and conclusions that have been made.

2.2.2. On-scene and Retrospective Working

There are two different ways of working to gather information for accident investigations: on-scene and retrospective. It is possible to investigate accidents using one or a combination of both ways of working.

2.2.2.1. On-scene

On-scene work is carried out by accident investigators who arrive at the scene of the collision in time to record essential information before it is lost. On-scene working is the recommended way for teams to gather information to carry out the DaCoTA in-depth accident investigation methodology. Examples of information that an on-scene team will aim to gather quickly, include the rest position of vehicles, interviews with the road users and witnesses, light and weather conditions, and marks left on the road surface that may quickly fade. Previous work has shown the importance of arriving quickly after the incident has occurred, to gather the information required to understand what has happened and why. As a guide for the DaCoTA methodology, teams should arrive at the scene no more than 30 minutes after the time when the collision occurred. This requires teams to have a good system for being notified of accidents quickly and consistently. Depending on the size and type of road network to be covered, it may be necessary for teams to travel or work closely with their local emergency services in order to arrive in a safe and timely way. On-scene teams will, where possible, gather all necessary information during one scene visit. However it may sometimes be necessary, for practical reasons, to supplement investigations with less urgent activities on a retrospective basis. It is also recognised that less experienced or less well established teams may not be able to work on-scene.

2.2.2.2. Retrospective

Retrospective work includes any investigation activities carried out after the scene has been cleared of the people and vehicles involved. Examples of retrospective working include examining vehicles at a garage / recovery yard, interviewing people over the telephone or by using a postal questionnaire, and visiting the road location hours or days after the collision occurred. Retrospective work can be a more practical way to gather evidence that is not likely to move or change over time, and there are experienced and successful research projects that use only retrospective methods. Additionally, this method is a valuable way to supplement on-scene activities. It is also recognised that less experienced or less well established teams may only be able to work retrospectively.

2.3. Team Experience

For the pilot study, investigating teams will start with different levels of experience and their ability to complete the methodology will therefore vary. Four levels of team experience are therefore considered here: new, developing and experienced retrospective and experienced on-scene teams. Discussions will be held with teams in the early stages of the Network activity to determine and agree each team's appropriate level of experience going into the pilot study. Teams are expected to develop during the pilot study and to work towards reaching the experienced level for any future work beyond DaCoTA.

2.3.1. New Teams

These are teams who have sufficient personnel, facilities and equipment to undertake the pilot study activities, but have little or no experience at making in-depth investigations. There will be some access to a range of specialists in the areas of vehicle, road and human safety related factors, but these personnel may not be directly involved as investigators. Teams will be expected to establish the necessary infrastructure, including local agreements to do the work, acquire information and receive accident notifications, but these activities will be finalized in the months leading up to the start of the pilot study, planned in April 2012. Personnel will require training and support from the core DaCoTA team in order to conduct the pilot study.

New teams are encouraged to work on-scene, but it is recognised that working retrospectively may be advantageous until necessary permissions, training and experience are in place. New teams are encouraged to progress on to achieve "Developing Team" status by the end of the pilot study.

2.3.2. Developing Teams

These are teams who have sufficient personnel, facilities and equipment to undertake the pilot study activities and some experience at making in-depth investigations. There will be some experience with field work to study road or vehicle factors or to interview people, but this may not have been carried out for in-depth accident investigations. There will be some access to a range of specialists in the areas of vehicle, road and human safety related factors, but these personnel may not all be directly involved as investigators. Teams will have some infrastructure in place, including local agreements to do the work, acquire information and receive accident notifications, but these activities may need to be finalized in the months leading up to the start of the pilot study, planned in April 2012. For some areas of the methodology, personnel will require training and support from the core DaCoTA team in order to conduct the pilot study. Developing teams must attempt to work on-scene, but it is recognised that only retrospective working may be possible for at least some case investigations. Developing teams are encouraged to build on existing skills and experience during the pilot study.

2.3.3. Experienced Retrospective Teams

These are established in-depth accident investigation teams who work retrospectively. Teams with a full range of knowledge and experience gained over a continuous operating period of at least two years. Teams will have the well-established capability to be notified about accidents and to gather a broad range of data within around 5 days of the accident occurring. There will be at least 2 experienced team members who have investigated at least 50 in-depth accidents each. Teams will have agreements in place for access to all necessary police, hospital and other information required. Personnel will only require training for the purpose of gaining familiarization with DaCoTA project's specific aims and procedures. While experienced teams are encouraged to work on-scene at all times, it is recognised that this may not be possible under some local circumstances.

2.3.4. Experienced On-Scene Teams

These are established in-depth accident investigation teams who work on-scene. Teams with a full range of knowledge and experience gained over a continuous operating period of at least two years. Teams will have the well-established capability to be notified about accidents and to travel onto the scene within around 30 minutes of the accident occurring. There will be at least 2 experienced team members who have investigated at least 50 in-depth accidents each. Teams will have agreements in place for access to all necessary police, hospital and other information required. Personnel will only require training for the purpose of gaining familiarization with DaCoTA project's specific aims and procedures. Only experienced on-scene teams have the capability to carry out the full investigation methodology in all accident investigations, as recommended by DaCoTA.

2.4. Team Structure

2.4.1. Purpose/Aim

To have an organisation and combined expertise that will enable all DaCoTA accident investigation tasks to be completed

2.4.2. Methods

- All Teams: A team should consist of at least two investigators. A Team Leader must be identified who can be one of the investigators. At least one of the investigators should have successfully completed the DaCoTA training and be responsible for guiding others in their team. See also additional team experience notes in the previous section.
- New Teams and Developing Teams: The team should have access to experts with knowledge of medicine, human factors, roads and vehicles.
- Experienced Teams: Specialists in road, vehicle and human factors should be integrated into the team. Immediate access to experts in medicine, accident causation and reconstruction.

2.4.3. Equipment

Secure office space with computers and file storage, access to a vehicle, DaCoTA training manual.

2.4.4. Arrangements

- The team must consist of at least two members to perform challenging tasks in a safe and qualitative way.
- It is recommended to recruit team members from a range of relevant specialities.
- Arrange for at least one team member to attend formal DaCoTA training and organise dissemination to any additional team members within 2 weeks.

2.5. Investigator Roles

This section describes the tasks of each investigator (by investigator role) involved in the DaCoTA project. Each task can be assigned to a DaCoTA accident collection shift or a DaCoTA case life cycle. A DaCoTA case life cycle starts with an accident notification that fulfils the sampling criteria and ends with the completion of all required entries in the DaCoTA database and publication of the case.

Below is a list of all investigator roles in DaCoTA. The roles will be described further below.

- Team Leader
- Case Leader
- On-Scene Investigator
- Retrospective Vehicle Investigator
- Retrospective Accident Site Investigator
- Interviewer
- Road User Contact Questioner
- DREAM Analyst
- Reconstruction Analyst
- Injury Mechanism Analyst

It is recommended that each team has at least two active investigators working each case, one of whom must be designated as Case Leader. Investigators can take on more than one role within a case (e.g. the same person may conduct interviews, injury analysis and DREAM analysis).

There is always only one Case Leader in a DaCoTA shift and case respectively, although there might be two or more persons working together with sufficient experience to be considered for the Case Leader role.

2.5.1. Team Leader

The Team Leader is the overall coordinator of a local investigation team. This person is identified at the point of application to join the DaCoTA network. The Team Leader responsibilities include:

- Recruitment and management of their investigation team
- Ethical and data handling agreements
- Nomination of Case Leaders
- Securing funding for the team where necessary
- Liaison with authorities, emergency services, recovery garages etc. to develop core infrastructure
- Reporting on team progress including accident notifications, time to investigation, case completion and training/support needs.
- Conducting case review meetings with their investigation team
- Organising all necessary equipment for conducting investigations
- Arranging counselling for investigators where necessary
- Organising an investigation plan/schedule
- Final quality control of cases and upload to the shared DaCoTA database
- Reporting to the Network Leader on investigation related issues

2.5.2. Case Leader

The DaCoTA investigation shift plan defines which person is the Case Leader on a specific shift. It is recommended that the Case Leader should be the most experienced team member on that shift. The Case Leader is in general responsible for the organization of the shift and the data collection and entry into the database for cases that are started during the shift. Before and during the shift the Case Leader has the following tasks:

- Assign tasks between on-scene or retrospective investigators
- Check that all equipment is present and working
- Check if notified cases fulfil the sampling criteria
- Fill out the accident log

During a case investigation the Case Leader has the following tasks:

- Crisis handling, if other investigators have physical or emotional issues which affect their ability to conduct the investigation
- Decision according to the sampling plan if accident data will be further collected if the accident site is already cleared up and neither police / rescue or accident participants are available
- Decision when the on-scene and retrospective data collection is finished

During the case life cycle the Case Leader has the following tasks:

- Check the case status overview and identify issues in case completion
- Decide if a retrospective accident site investigation is necessary
- Liaise with all individuals contributing to the case
- Invite and conduct the case analysis meeting

2.5.3. On-scene Investigator

It is recognised that new teams may not work on-scene during the DaCoTA pilot, but this is the recommended primary methodology.

The DaCoTA investigation shift plan defines which persons are the On-Scene Investigators on a specific shift. The On-Scene Investigators are responsible for collecting the on-scene data for a DaCoTA case. If more than one person is scheduled the task split will be defined by the Case Leader. Before and during the shift the On-Scene Investigators have the following tasks:

- Prepare the forms and writing materials for the shift
- Check own equipment, including cameras, measuring and marking equipment

During a case investigation the On-Scene Investigators have the following tasks

- Talk to police, fire brigade, witnesses and road users involved in the accident and prepare for follow up interviews
- Take photos of the accident location and vehicles, identify and highlight fast changeable marks and traces
- Measure all relevant parameters of the accident scene and prepare scene sketch or photogrammetry
- Fill out the vehicle forms and conduct inspection of involved vehicles as per the DaCoTA training
- Fill out the accident site form and prepare a hand drawing of the accident scene, check for restriction in visibility and weather conditions
- Fill out the road and lane forms

After a case investigation the On-Scene Investigators share the following tasks:

- Check petrol and equipment in the investigation car

During the case life cycle the On-Scene Investigators have the following tasks:

- Complete all relevant forms and upload the data to the local database
- Select on-scene photos, sanitise (blur faces, street names, logos etc.) and upload the photos to the database

2.5.4. Retrospective Vehicle Investigator

The DaCoTA investigation shift plan defines which persons are the Retrospective Vehicle Investigators on a specific shift. Retrospective investigation is necessary if it was not possible to conduct a full investigation on-scene. The Retrospective Vehicle Investigators are responsible for collecting vehicle data after an accident involved vehicle has left the scene. If more than one person is scheduled the task split will be defined by the Vehicle Investigators themselves.

Before the investigation the Retrospective Vehicle Investigator has the following tasks:

- Prepare the forms and writing materials for the vehicle investigation

- Check own equipment, including cameras, measuring and marking equipment

During the investigation the Retrospective Vehicle Investigators have the following tasks:

- Take photos of the accident involved vehicle(s)
- Measure all relevant damage to the vehicle(s)
- Fill out the vehicle investigation form (s)

After the investigation the Retrospective Vehicle Investigators have the following tasks:

- Check for petrol and equipment in the investigation car

During the case life cycle the Retrospective Vehicle Investigators have the following tasks:

- Complete all relevant forms and upload the data to the local database
- Select vehicle photos, sanitise (blur licence plates, company names/logos) and upload the photos to the database

2.5.5. Retrospective Accident Site Investigator

The Case Leader together with the Team Leader decides which team members are the Retrospective Accident Site Investigators (where required) to collect site data after the accident has been cleared. (This is a road engineer type role). Before the investigation the Retrospective Accident Site Investigators have the following tasks:

- Prepare the forms and writing materials for the vehicle investigation
- Check own equipment, including cameras, measuring and marking equipment

During the investigation the Retrospective Accident Site Investigators have the following tasks:

- Take photos of the accident site and approach of the involved vehicle(s)
- Measure all relevant parameters of the road and environment
- Fill out the road form(s)

After the investigation the Retrospective Accident Site Investigator has the following tasks:

- Check for petrol and equipment in the investigation car

During the case life cycle the Retrospective Accident Site Investigator has the following tasks:

- Complete all relevant forms and upload the data to the database
- Select site photos, sanitise (blur licence plates, street names, company names/logos) and upload the photos to the database

2.5.6. Interviewer

The Case Leader together with the Team Leader decides which person(s) is/are the Interviewers for a specific case. It is recommended where possible that the interviewer should have some background in human factors, psychology or a related discipline. This is an expectation for experienced teams. The Interviewer(s) is/are generally responsible to organize the interview(s) for relevant persons in a DaCoTA case. If more than one person is scheduled the task split will be defined by the Interviewers themselves. The interviewer has the following tasks:

- Gain written consent for interviews where necessary
- Prepare and conduct the interviews (on-scene and/or retrospectively, face to face and/or on the phone)
- Fill out the interview forms
- Store the interview data in line with local data handling agreements
- Liaise with other investigators regarding core findings
- Ensure core interview findings are reflected in the case as entered onto the database

2.5.7. Road User Contact Questionnaire Handler

Where teams choose to collect road user data through questionnaires, a team member will need to be designated who takes responsibility for the following tasks:

- Manage questionnaire materials
- Send out questionnaires (and where appropriate reminders) to contacts identified by the investigation team
- Securely store questionnaires
- Transcribe appropriate questionnaire data to the database and liaise with other team members regarding core findings

2.5.8. DREAM Analyst

The Case Leader together with the Team Leader decides which person(s) is/are the DREAM Analysts for a specific case. The DREAM Analyst(s) is/are responsible for organizing the DREAM Analysis for relevant persons in a DaCoTA case. If more than one person is scheduled the task split will be defined by the DREAM analysts themselves. The DREAM analyst has the following tasks:

- Prepare and conduct the DREAM analysis
- Fill out the DREAM analysis forms
- Enter the DREAM analysis on the database

2.5.9. Reconstruction Analyst

This role should be integrated into all developing and experienced teams. New teams must collect data that an external reconstruction analyst could use, but are not expected to complete their own full reconstructions. The Reconstruction Analyst is generally responsible for the reconstruction of a DaCoTA case. The Reconstruction Analyst has the following tasks:

- Quality check the data collected for reconstruction – review with investigators where necessary
- Prepare and conduct the accident reconstruction
  - Enter the reconstruction analysis into the DaCoTA database

2.5.10. Injury Analyst

This role should be integrated into all developing and experienced teams. New teams must collect data that an external injury analyst could use, but are not expected to complete their own full injury analysis. The Injury Analyst is generally responsible for coding the injury data using the AIS method, and the individual causes (mechanisms) of each injury – as suggested by the evidence and in discussion with the investigators of each DaCoTA case. The Injury Analyst has the following tasks

- Collect injury information
- Code injury information according to the Abbreviated Injury Scale (AIS) 2005 (Update 2008)
- Invite and conduct injury analysis meetings with investigators where necessary
- Enter the injury data on the DaCoTA database

3. VARIABLES AND METHODOLOGY OUTLINE

This chapter provides a brief overview of the DaCoTA in-depth road accident investigation variables and methodology as developed by partners working in DaCoTA Work Package 2.

3.1. Variables

The Variables section provides a comprehensive list of approximately 1500 variables and their definitions that are possible to collect during an accident investigation. A set of core variables will be mandatory to be collected for all teams with additional variables being collected as the team gains experience. No one accident case would ever contain all of the variables as many relate to a specific type of road user and/or accident. It is intended that the variable list and definitions will continue to be developed and added to in the future. The variable section includes notes about how to collect the necessary information when investigating accidents but they are intended to be considered alongside the more detailed methodology guidelines provided in the other sections of the on-line manual. Variables can be viewed directly through a web browser however viewing variables through the database system is the best way of identifying groups of variables. The following list illustrates the categories of variables included in the manual. A brief description of the type of variables included in each category is given in brackets by way of an example.

- **Accident** (Date of accident, weather conditions)
- **Road** (Road layout, speed limit)
- **Road User** (age, injury severity)
- **Element** (Information relating to the investigation e.g. date of site inspection)
- **Vehicle** (general condition, general damage)
- **Car** (safety technologies fitted, number of seats)
- **Truck** (Mirror type, underrun protection)
- **Bus** (Emergency exits, number of occupants)
- **Other** (miscellaneous)
- **Seat** (Belt information, position)
- **Airbag** (Damaged, activated)
- **Wheel** (Tyre depth, make)
- **Analysis** (Deformation measures, calculations)
- **PTW** (Rider clothing, make/model)
- **Photo** (information to capture)
- **Reconstruction** (Whether performed for case)
- **Dream** (Accident causation analysis)

The Methodology Outline sections below aim to briefly indicate the intended scope, essential characteristics and practical requirements of the methods to be deployed. For a complete overview, this section should be read together with the section on DaCoTA Teams.

Essential items, or building blocks, of the methodology are listed to briefly define their intended scope and the type of method to be used for each item. Additionally noted, at the more practical level, are key items of equipment and any essential arrangements that must be put in place by investigating teams.

For the pilot study, which ran over April to June 2012, investigating teams will start with different levels of experience and their ability to complete the methodology will therefore vary. Items of methodology are defined for four levels of team experience; new, developing, experienced retrospective and experience on-scene teams.

This section, together with the section on DaCoTA Teams, is intended to be used by DaCoTA Network Team Leaders, as a brief outline to see what is required, ask any early questions, and start making plans as soon as possible.

This section is not intended to provide a detailed description of the methodology. Please refer to the Detailed Methodology (Chapter 4) for further information.

3.2. Sampling Plan

3.2.1. Purpose/Aim

The purpose of the Sampling Plan is to create a method of investigation that will be broadly representative for coverage of various accident types occurring across participating states, within the practical limitations imposed by the pilot study. For future investigations beyond DaCoTA, the purpose of the Sampling Plan is to make on-scene investigations that closely represent all types of traffic accidents occurring on the public roads of Europe, adequately covering all hours of the day, all days of the week and all levels of injury severity.

3.2.2. Methods

The DaCoTA Pilot Study investigation teams should produce at least five cases, covering a range of different types of crashes (e.g. different crash configurations, vehicle types, road users and levels of injury severity).

At least one case should involve a moving motor vehicle or pedal cyclist on a public road. Accidents selected may include fatal, seriously injured, slightly injured or non-injured road users. At least 3 out of 5 cases must include a road user who was taken to hospital immediately after the accident.

Accidents selected may include trucks, buses, cars, powered two wheelers, pedal cycles, pedestrians or other types of road users. The sampling area should have a clear geographical boundary in which the team has a high probability of obtaining all necessary information.

The resulting sample can be compared with police recorded accident data across Europe (CARE database), especially by use of the accident-type and other variables to be recorded in the same way for both DaCoTA and CARE (as CADAS Glossary v3.11).

For On-scene Teams, the geographical boundary of the sampling area must give a high probability that the team will arrive on the scene in time to capture all essential information, especially to capture information that is quickly lost (as a guide, teams should arrive no more than 30 minutes after the time when the collision occurred where possible).

If more than one accident occurs at the same time, the team must investigate the accident which they received the notification from first.

A case cannot be included unless there is at least one vehicle or at least one road user or witness still at the scene when the team arrives. However, in some exceptional situations, a case may be included without any vehicles or road users present on-scene if there are other sources of reliable information allowing adequate conclusions to be drawn about the circumstances and causes of the accident.

3.2.2.1. Beyond DaCoTA Methods

All teams are to go on-scene as described above. In addition, the sample will closely represent all types of traffic accidents occurring on the public roads, adequately covering all hours of the day, all days of the week and all levels of injury severity.

3.2.3. Equipment

Please refer to the Accident Notifications section of the main Equipment List for the Sampling Plan equipment list. This can be found at the end of Chapter 4 Detailed Methodology.

3.2.4. Arrangements

Investigation teams should examine local accident statistics before the study commences to identify a suitable sample region with accident types broadly matching accidents occurring over the whole country and provide these findings in a report together with a description of the sampling procedure to be used.

Furthermore, investigation teams should establish a fast and reliable system that will notify the team when accidents occur (please refer to the Accident Notifications section later in this chapter).

3.3. Health and Safety

3.3.1. Purpose/Aim

To ensure all teams have the knowledge, equipment and support necessary to work safely.

3.3.2. Methods

- Complete a full risk assessment.
- Train investigators in health and safety specific to vehicle examination
- Provide investigators with appropriate personal protective equipment (PPE).
- Ensure investigators have appropriate inoculations
- Road and on-scene investigators should be trained in health and safety at accident scenes, including working in live traffic conditions, team-vehicle positioning and giving first aid.
- Maintain a record of any team incidents.

3.3.3. Equipment

Please refer to the Health and Safety section of the Equipment List (Chapter 4) for the Health and Safety equipment list.

3.3.4. Arrangements

- It will be the Team Leaders' responsibility to ensure all local health and safety regulations and requirements are met.
- Health and safety training.
- Counselling available.
- Inoculations (e.g. Hepatitis-B and tetanus are recommended).

Retrospective Teams

Training to work safely alongside live traffic conditions

On-scene Teams

On scene teams should have training on coning out roads/managing live traffic and parking project vehicles in fend-off position.

3.4. Accident Notifications

3.4.1. Purpose / Aim

The purpose of the Accident Notifications section is to ensure that investigation teams are aware of the accidents as they are occurring. Furthermore, it is valuable to ensure that the teams are meeting their sampling criteria in a timely manner and are able to monitor and report sampling rates.

3.4.2. Methods

Retrospective & On-scene

It is important to ensure that the accident notification information adequately identifies all accidents that meet the sampling criteria. Also, the alarms must provide detailed information on the location of the accident.

Teams must record notifications about all accidents occurring in the sample region during the pilot study and note which accidents were accepted and rejected, and the reasons why. The accident notification data should be used to produce a brief report at the end of the pilot study.

Investigation teams should also consult the Sampling Plan to determine whether the accident notifications meet the sampling criteria.

Retrospective

Accident notification should be received within 24 hours of the accident occurrence to allow the team adequate time to collect as much of the remaining information from the scene of the accident as possible.

On-scene

For on-scene investigations, instant notification (e.g. by e-mail, two-way radio, SMS, etc.) from the police or other emergency services when an accident occurs are required to enable the team to reach the scene of the collision before it is cleared.

Experience has shown that real-time accident notification information can lack important details. Some teams may therefore need to go on-scene to determine if accidents are to be investigated without knowing beforehand whether they fit within the Sampling Plan requirements (i.e. if the accident is on a public road, road user hospitalisation status, if vehicles or road users are on-scene, etc.).

3.4.3. Equipment

Please refer to the Accident Notification section of the Equipment List (Chapter 4) for the Accident Notifications equipment list.

3.4.4. Arrangements

Cooperation/agreements with the police or other emergency services to receive accident notification as soon as possible.

3.5. Scene and Road

3.5.1. Purpose/Aim

To collect data that describes the scene for each accident, including road layout, vehicle positions and where possible transient data such as skid marks and environmental conditions, to a level that will allow case analysis and reconstruction.

3.5.2. Methods

Retrospective & On-scene

- Take photographs of road layout, sightlines, skid marks, contact marks, point of collision, rest positions of vehicles and parts.
- Take measurements of road layout and markings showing paths taken by road users before and after collision to make a scaled sketch of the accident later.
- Take adequate photographs of approaches to the point of collision.
- Additionally, if possible, make video recordings. Record other road data (e.g. type and position of signs or safety rails or fences).
- Determine the type of collision that has occurred and code using the accident-type coding system.
- Back at the office: Open the case in the database system and enter a minimum set of variables without delay, quality check of data, entering full data into the system (database) and draw a scaled scene sketch.

Retrospective

- Find safe parking.
- Search for marks and traces and identify the exact position of the accident.

On-scene

- Find safe parking
- Contact the person in charge at the accident scene to get information on circumstances and participants
- Make sure not to hinder the rescue or police investigation.
- Identify priorities for taking measurements and photographs.
- In support of vehicle and human factors methodology: make a quick inspection of vehicles to catch transient data such as weather and road conditions, vehicle positions, debris, loads, leakage and trailers.

- Talk to police, rescue services, involved road users and witnesses to collect contact information.

3.5.3. Equipment

Please refer to the Scene and Road section of the Equipment List (Chapter 4) for the Scene and Road equipment list.

3.5.4. Arrangements

- Permission from authorities to be on-scene.
- Information leaflets about the research project.
- Consent forms for road users (if and when required locally).

3.6. Vehicle Inspection

3.6.1. Purpose/Aim

To collect data that describes all types of vehicle involved in each accident, including specification, condition, damage, safety equipment performance and occupant information, to a level that will allow case analysis and reconstruction. This item also includes the investigation of children in cars, especially the use of child restraints (please also refer to the Vulnerable Road User section below).

3.6.2. Methods

Retrospective & On-scene

- Take photographs of the vehicle exterior and interior according to the photo Routine.
- Measure and collect data for exterior and interior variables.
- Search for clues to understand:
  - Pre-crash distractions such as food, phone, etc.
  - In-crash information such as roll direction, passenger kinematics and contact marks from collision objects. Seat belt use and cause of injuries to occupants (inside) and vulnerable road users (outside).
  - Collecting child restraint information such as type of restraint, usage and damage.
  - Post-crash information such as rescue damage.
  - Make sure to follow the safety routines (Item 3).

Retrospective

- Locate vehicle and, where necessary, gather approval from vehicle owner and repair shop/recovery yard for vehicle inspection.
- Collect basic vehicle data at office before leaving for inspection.
- If possible and necessary move vehicle to get more working space around it.

On-scene

- With appropriate permission, on-scene teams are to record key transient information that will not be seen retrospectively (e.g. pedestrian swipe marks on the bonnet, paint transfer between vehicles or tyre pressures).

- Completing the vehicle inspection can be done on-scene or retrospectively at the repair shop/recovery yard with approval from the vehicle's owner.

Experienced Teams

- Advanced examination of vehicle damage and safety systems.

3.6.3. Equipment

Please refer to the Vehicle Inspection section of the Equipment List (Chapter 4) for the Vehicle Inspection equipment list.

3.6.4. Arrangements

- Inspections should be performed by two trained investigators.
- Useful to establish agreements to examine vehicles with relevant organisations (e.g. vehicle recovery or repair companies/organisations or government/police vehicle-examiners).

3.7. Vulnerable Road User

3.7.1. Purpose/Aim

The purpose of the Vulnerable Road User section is to collect data that describes all Vulnerable Road Users (VRU) (pedestrians, motorcyclists, pedal-cyclists) involved in the accident, including their role in the accident causation, sources of injury, whether they were equipped with protective clothing, a record of any contact marks and other related scene evidence.

3.7.2. Methods

Retrospective & On-scene

- All Teams
  - General vehicle examination for motorcycles (Powered Two Wheelers) and pedal-cycles.
  - Identification of vehicle safety features (ABS, Traction Control, Adaptive lights).
  - Examine if tyres or rims (and other vehicle parts) were damaged due to the accident, checking for scrape marks and cracks.
  - Check if the upper protective system integrates an airbag or neck protection
- Experienced Teams
  - Examination of the PTW for motor power enhancement
  - Inspect the fuel management system for enhancement
  - Evaluation of the effectiveness of systems such as brakes and suspension.

On-scene

- All Teams
  - In addition to scene/road examinations (item 5), examine and record approach paths for PTWs, pedestrians and bicyclists, and take measurement, such as throw distances and skid marks at scene.
  - Look for evidence of locked wheels on tyres
  - Exterior contact marks from VRU's on opponent vehicle.
  - Look for helmet damage caused in the accident.

    - Examination of helmets, body armour and protective clothing.
    - Examine if helmets and visors were certified for PTW use.
- Developing Teams and Experienced Teams
    - In addition to injury coding described in medical data, identify the body regions that contacted the other vehicle or object on the road.
- Experienced Teams
    - Examine the protective equipment (helmets and clothing) to assess impact performance
    - Examine if the Personal Protective equipment was fitted correctly and worn in the correct place

3.7.3. Equipment

Please refer to the Vulnerable Road User section of the Equipment List (Chapter 4) for the Vulnerable Road User equipment list.

3.7.4. Arrangements

All Teams

At least one team member trained in collecting VRU specific variables

Experienced Teams

PTW specialist on team

3.8. Behavioural Data

3.8.1. Purpose/Aim

To collect data (mainly from interviews/questionnaires) to understand and describe road user behaviour and relevant background information in support of the overall accident analysis.

3.8.2. Methods

Interviews are the main method for collecting road user behavioural data but all data collection can give information valuable for evaluating road user behaviour. Interview material should be stored locally and as complete as possible for later re-analysis by the team, if local laws and guidelines allow. Database entries to be made fully anonymous, without any personal names, addresses or vehicle registration numbers included.

On-scene

- On-scene contact and if possible ask questions concerning the course of events and possible causes of the accident.
- Full interview according to a semi structured form to be conducted as soon as possible, on-scene, at hospital, or retrospectively by phone/face to face.

On-scene and retrospective

- Interviews should be conducted as soon as possible after the accident and if possible face to face.

- As it is not always possible to conduct an interview on-scene, the methods recommended here are to be tried in following order:

1. On-scene interview
2. Interview at hospital
3. Retrospective interview face to face or by phone
4. Postal questionnaire

3.8.3. Equipment

Please refer to the Behavioural Data section of the Equipment List (Chapter 4) for the Behavioural Data equipment list.

3.8.4. Arrangements

- Check national legislation and guidelines for possibility to process potentially sensitive personal findings as anonymised data.
- Ethical approval if necessary.
- Consent forms to perform interview if needed.
- Investigators trained in conducting interviews.

3.9. Medical Data

3.9.1. Purpose/Aim

To collect and code injury data (according to the Abbreviated Injury Scale) and perform injury mechanism analysis – to classify accidents by medical injury severity and allow analysis on the potential for injury reduction.

3.9.2. Methods

Database entries to be made fully anonymous, without any personal names, addresses or vehicle registration numbers included.

All Teams

- Note Police recorded injury severity for each person involved.
- Attempt, with permission, to collect medical records from hospitals or other appropriate sources (e.g. pathologist or doctors) and describe the injuries.
- To follow all necessary ethical and data protection procedures both in the acquisition, processing and storage of any information on both paper and electronic media.

Developing and Experienced Teams

- Code injuries according to AIS 2005 (update 2008) manual by trained medical personal.
- Carry out a case by case analysis of the possible mechanisms or causes of injuries.

3.9.3. Equipment

Please refer to the Medical Data section of the Equipment List (Chapter 4) for the Medical Data equipment list.

3.9.4. Arrangements

All Teams

- Ethical approval if necessary.
- Consent forms to obtain medical records including routines on how to send and receive these forms.
- Agreement with local hospitals to access medical records.
- Please note: the DaCoTA training programme will cover the collection and basic description of injuries, but will not be able to provide authorised AIS training. Additionally, it is recommended that at least one investigator from each team should receive official AIS training and acquire the necessary manual.
- A list of authorized training organisations can be provided upon request.

Experienced Teams

- Fully trained and experienced medical personnel for AIS coding and analysis of the causes of injuries.

3.10. Accident Causation

3.10.1. Purpose/Aim

The purpose of the Accident Causation section is to use the DREAM methodology to analyse and code the cause of each accident in a uniform and comparable way.

3.10.2. Methods

- When all relevant pre-crash information is collected the DREAM method is used for categorising contributing factors.
- Reconstruction can validate the result.
- One DREAM analysis is completed for each road user such as driver, powered two wheeler rider (driver), pedal-cyclist and/or pedestrian (not passengers) regardless of blame.
- Enter the DREAM codes in the database system.

3.10.3. DREAM

The Driving Reliability and Error Analysis Method (DREAM) was first developed by Ljung and later developed in the EC SafetyNet project to make it possible to systematically classify and store accident causation information which has been gathered through in-depth investigations by providing a structured way of sorting the causes behind the accident into a set of formally defined categories of contributing factors. The methodology has since been further developed, including updates for use in the DaCoTA project.

For further information on DREAM, please visit the website:

http://www.dreamwiki.eu

3.10.4. Equipment

Please refer to the Accident Causation section of the Equipment List (Chapter 4) for the Accident Causation equipment list.

3.10.5. Arrangements

Training and support from the DaCoTA partnership.

3.11. Accident Reconstruction

3.11.1. Purpose/Aim

To utilise all available evidence to best analyse and reconstruct the accident such as to calculate vehicle impact speeds and evaluate the sequence of events.

3.11.2. Methods

- Assure that data needed to perform reconstructions is available, such as a scaled sketch, pictures and a coded sequence of events.
- Basic calculations on braking and skidding distances etc.
- Consider using other information sources such as the police.

Developing and Experienced teams

- More specialized data collection
- More specialized calculations, including energy based reconstructions (calculating the change of velocity from vehicle damage).

Experienced teams

- Full momentum based reconstructions by software.

3.11.3. Equipment

Please refer to the Accident Reconstruction section of the Equipment List (Chapter 4) for the Accident Reconstruction equipment list.

3.11.4. Arrangements

- Training and support from the DaCoTA partnership.
- Explore the possibility to view scene plans and results calculated by other local reconstruction experts, e.g. police experts (while maintaining the independence of the research study).

3.12. Case Delivery

3.12.1. Purpose/Aim

To coordinate all case findings to ensure the team fully complete and enter all data and other materials onto the web-based database, and ensure cases have been subject to adequate quality control.

3.12.2. Methods

- A case leader is appointed for each accident investigated.
- The case leader is responsible for the completeness and the quality of the case inserted.
- The case leader has to open the case, in the database system, on the day of data collection, whenever possible.

- The web-based database will check some data elements at the data entry stage.
- Database entries including pictures have to be fully anonymised without any personal names, addresses or vehicle registration numbers included.
- The database system will not allow incomplete cases to be submitted as completed (a core set of data has to be inserted before the case can be completed).

3.12.3. Equipment

Please refer to the Case Delivery section of the Equipment List (Chapter 4) for the Case Delivery equipment list.

3.12.4. Arrangements

- Ensure that all necessary data elements and photographs may be uploaded into the shared database area to be seen by other members of the network.
- Any local requirements for data sharing or ethical agreements must be put in place before the pilot study commences.
- Identify a local IT technician able to install and maintain operation of the DaCoTA database system (technical advice will be available from the technical experts in the DaCoTA team).

4. DETAILED METHODOLOGY

This section provides a detailed description of the DaCoTA in-depth road accident investigation methodology as developed by partners working in DaCoTA Work Package 2. The aim is to describe the intended scope, characteristics and practical requirements of the methods to be deployed. For a complete overview, this section should be read together with the DaCoTA Teams section.

Essential items of the methodology are listed to define their intended scope and the type of method to be used for each item. Additionally noted, at the more practical level, are key items of equipment and any essential arrangements that must be put in place by investigating teams.

This section is intended to be used by DaCoTA Network Team Leaders to see what is required, ask any early questions, and start making plans as soon as possible.

The Detailed Methodology section attempts to accurately describe the investigation methodology in detail. For a brief overview of the methodology, please refer to the Methodology Outline section (Chapter 3).

Investigation teams will differ in level of experience (e.g. New, Developing and Experienced). Furthermore, the investigators will also sometimes be divided into On Scene and Retrospective teams. For these reasons, some methodology sections are only relevant to certain teams. The Detailed Methodology attempts to detail a complete methodology, covering all teams. Investigation teams should refer to the applicable Methodology Outline section as the Methodology Outline is divided by level of experience and On Scene/Retrospective. This should enable teams to determine the methodology that applies to their requirements.

4.1. Sampling Plan

4.1.1. Purpose/Aim

The purpose of the Sampling Plan is to create a method of investigation that will be broadly representative for coverage of various accident types occurring across participating states, within the practical limitations imposed by the pilot study. For future investigations beyond DaCoTA, the purpose of the Sampling Plan is to make on-scene investigations that closely represent all types of traffic accidents occurring on the public roads of Europe, adequately covering all hours of the day, all days of the week and all levels of injury severity.

4.1.2. Methods

DaCoTA Pilot Study Methods

The DaCoTA Pilot Study investigation teams should produce at least five cases, covering a range of different types of crashes (e.g. different crash configurations, vehicle types, road users and levels of injury severity).

At least one case should involve a moving motor vehicle or pedal cyclist on a public road. Accidents selected may include fatal, seriously injured, slightly injured or non-injured road users. At least 3 out of 5 cases must include a road user who was taken to hospital immediately after the accident.

Accidents selected may include trucks, buses, cars, powered two wheelers, pedal cycles, pedestrians or other types of road users. The sampling area should have a clear geographical boundary in which the team has a high probability of obtaining all necessary information.

The resulting sample can be compared with police recorded accident data across Europe (CARE database), especially by use of the accident-type and other variables to be recorded in the same way for both DaCoTA and CARE (as CADAS Glossary v3.11).

On-scene Teams

The geographical boundary of the sampling area must give a high probability that the team will arrive on the scene in time to capture all essential information, especially to capture information that is quickly lost (as a guide, teams should arrive no more than 30 minutes after the time when the collision occurred where possible).

If more than one accident occurs at the same time, the team must investigate the accident which they received the notification from first.

A case cannot be included unless there is at least one vehicle or at least one road user or witness still at the scene when the team arrives. However, in some exceptional situations, a case may be included without any vehicles or road users present on-scene if there are other sources of reliable information allowing adequate conclusions to be drawn about the circumstances and causes of the accident.

Beyond DaCoTA Methods

All teams are to go on-scene as described above. In addition, the sample will closely represent all types of traffic accidents occurring on the public roads, adequately covering all hours of the day, all days of the week and all levels of injury severity.

4.1.3. Equipment

Please refer to the Accident Notifications section of the main Equipment List for the Sampling Plan equipment list.

4.1.4. Arrangements

Investigation teams should examine local accident statistics before the study commences to identify a suitable sample region with accident types broadly matching accidents occurring over the whole country and provide these findings in a report together with a description of the sampling procedure to be used.

Furthermore, investigation teams should establish a fast and reliable system that will notify the team when accidents occur (please refer to the Accident Notifications section).

4.2. Health and Safety

4.2.1. Purpose / Aim

All who participate in investigations of traffic accidents in DaCoTA must have the knowledge and equipment to be able to conduct these investigations in a safe manner. The purpose of this document is to provide all investigators with information on how to perform investigations in the safest possible way at an accident site. All investigators who work with accidents in DaCoTA must have read and know this routine. Team leaders have a duty, so far as is reasonably practicable, to ensure the health, safety and welfare of their team.

Each team member has a duty to co-operate with his or her team leader and to take reasonable care of their own safety and that of others who may be affected by their acts or omissions at work.

Team members should notify the team leader of any short-comings in the health and safety arrangements so that the team leader can take such remedial action as may be needed. In order to meet this requirement it is necessary for each individual to observe safe working practices at all times, and to be aware of any potential hazards, risks or dangers which are present, or may arise, in the course of their duties.

PERSONAL SAFETY IS PARAMOUNT; IF A SITUATION DEVELOPS, PERSONAL SECURITY MUST TAKE PRIORITY OVER ALL ELSE.

4.2.2. Methods

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

4.2.2.1. Travelling to the Scene of an Accident

The vehicle used for on scene investigations should ideally be equipped with warning lights on the roof and high visibility reflective material on the body. The lights may be used when they are needed to improve safety for the investigators or other road users by enhancing visibility and acting as a warning (please check for local laws/guidelines in your country regarding light colour and acceptable use). Unless you have an emergency services vehicle, driven by appropriately trained and authorised emergency services personnel, then local speed limits must be adhered to at all times. The driver must have a valid driving licence and insurance (insurance should usually be provided by the employer).

The vehicle should be kept in a safe, legal and roadworthy condition. It must not be loaded over its design carrying weight and tyre pressures must conform to the vehicle loading. All equipment must be evenly distributed and restrained where necessary. No load should be placed or carried on the back seat of the vehicle and if possible, loose items should be stored in a closed container in the rear of the vehicle. If using a saloon car then all equipment should be stored in the boot. If using an estate car or van then a suitable load restraint must be fitted. Emergency equipment must be kept readily available (e.g. first aid kit, fire extinguisher, torches).

The driver and passengers must wear their seatbelts at all times while in the vehicle and try to avoid carrying large items in pockets while restrained. If using a handheld video camera in the front passenger seat, then consider disabling the front passenger airbag.

In the case of adverse weather conditions, if the driver or other team members do not feel comfortable travelling, the driver should either slow down to an appropriate speed or the job should be abandoned. If the driver feels over tired, ill or unfit in any other way they must not drive.

4.2.2.2. Arrival on Scene and Scene Safety

There must always be at least two investigators working at an accident site. One of the investigators is the case leader and is in charge of the investigation team. The first thing to be done when an investigation team arrives at an accident site is for the case leader to assess the situation and whether it is possible to work safely. If the accident site is regarded as too dangerous, the investigators must not stop but keep on driving. If possible, the investigators should stop nearby and wait and see if the situation improves, e.g. if emergency services take control of the accident site and manage the traffic. If the accident site is regarded as safe, then the vehicle should be parked safely and in such a way that it does not hinder the entrance and exit of emergency vehicles. Team members should not open the vehicle doors while it is still moving. The driver and passengers should be able to exit the vehicle without walking directly into a live carriageway. At an accident site, the vehicle should preferably be parked in front of a heavy vehicle (such as a fire engine), in a restricted area or at least ahead of police vehicles (Figure 1). If possible the vehicle should be parked at an angle with the front wheels turned so the vehicle does not continue straight ahead if it is hit. When parked, the vehicle should preferably be locked.

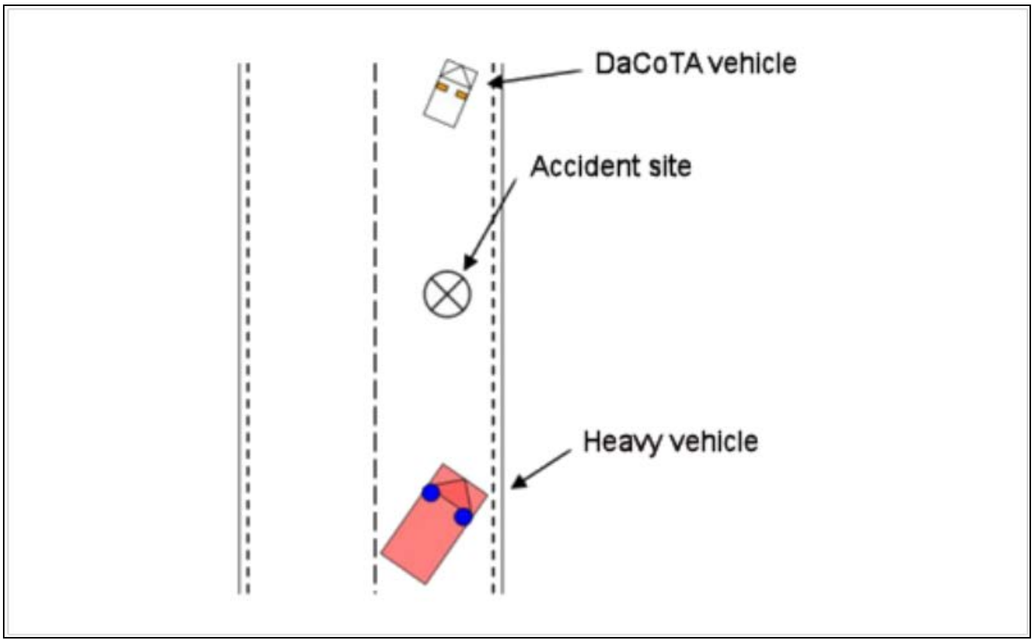

Figure 2: Safe Parking Technique

The next thing to do is make contact with the rescue services commander or police. The investigators should introduce themselves, check where they are allowed to work, ask about any restrictions and make sure that the DaCoTA vehicle is not parked so it interferes with rescue operations. Teams should consider the use of two-way radios to stay in contact when working on a large scene. It is recommended that all team members will have a key to the vehicle while on shift – for safety, convenience and to maintain access to equipment. All team members should carry and use torches at night – batteries should be checked at the beginning of each shift. There may be flammable liquids on scene. Do not smoke at the crash scene and be aware of others smoking i.e. bystanders or others involved in the collision. Also be aware of fumes on scene, particularly from exhaust emissions. Teams should try to ensure that where possible they move around the scene (even rotating roles) and take breaks away from areas where fumes may be particularly high. When noisy equipment is in use, team members should consider wearing ear defenders.

If at any time any team member feels unsafe or threatened (and this cannot be resolved immediately) then the team should stop the investigation and leave the scene (this also applies to post-crash scene visits, retrospective interviews and vehicle follow ups)

PERSONAL SAFETY IS PARAMOUNT; IF A SITUATION DEVELOPS, PERSONAL SECURITY MUST TAKE PRIORITY OVER ALL ELSE INCLUDING THE COLLECTION OF EQUIPMENT USED ON SCENE.

Making the Site Safe

Teams should always be aware of the risk of moving traffic, and the possibility of further vehicles intruding into the accident scene. Vehicles parked in ‘fend-off’ position (at an angle which deflects away from the scene) provide some protection. Where appropriate, the team leader should discuss with police whether the road, or part of the road can be closed to traffic. The team should place cones and signs where appropriate (where the road is still at least partially open and has not been coned out by other services attending). Cones should be placed ahead of the first emergency service vehicle (in a fend-off position) and be staggered from the nearside kerb (or offside kerb if the situation occurs) to a safe width into the road.

Figure 3: Coned Accident Site

The cones should be placed out from the “front” of the crash scene rearwards. This protects the person coning out, as they are placed within the coned-off area heading forwards. Similarly, when retrieving the cones, the person collecting them in should start at the rear of the scene and walk forwards; again this is to protect them from walking in live traffic. Emergency lights should be set up if required. If necessary, have someone alerting oncoming traffic ahead of the potential danger of the team working on the road.

If the scene is contaminated with any hazardous substances then the DaCoTA team should stay well clear until the area is deemed safe by fire services. Also be alert to the risk of electric shock. Consider carefully the positioning of electrical goods, and keep them out of direct rain. Electrical equipment must be maintained and tested by the authorised service agent according to national safety requirements. If running cables, also try to avoid creating trip hazards.

Investigators should familiarise themselves with the site, checking that the ground is clear and consider using illumination where necessary. Before moving any debris, ensure that its position is measured and photographed, and check with police at the scene that it does not need to be left in place as evidence. Team members should not risk their health to assist with moving damaged vehicles.

4.2.2.3. Examination of Vehicles

When examining vehicles on scene, where possible, always exit and enter vehicles and deal with occupants from the side away from the live traffic lane (if the road has not been closed). If possible, do not work in a live traffic lane. If unavoidable, use another team member as look out whilst carrying out work – they should do no other task while acting as look out. Also consider using two way radios to alert each other of potential hazards.

Be aware of the potential risk of personal injury from airbags and pretensioners. Do not tamper with undeployed airbags or pretensioners. Do not work directly in front of an undeployed airbag and keep fingers clear of pretensioners.

Always assess the stability of a vehicle (and any load) before investigation – Seek safety advice if the vehicle or its load seems unstable - if it is not safe do not risk your health to examine it.

Ensure the vehicle handbrake is properly applied and ignition switched off (be aware of preservation of evidence, if unsure check with the police at the scene). Investigators should always liaise with police officer in charge before moving or destroying evidence in and around the vehicle.

Wear suitable protective clothing to avoid contamination by oils, fuel, greases etc., pay particular attention to wearing thick protective gloves and kneepads/protectors when working around broken glass and jagged metal edges. Try to avoid direct contact with sharp surfaces where possible.

Loose debris and fluid around vehicles can cause damage to the eyes. Investigators should wear eye protection (goggles/safety glasses) which will also help to prevent accidental contamination of their eyes by rubbing. Remember that some parts of the vehicle may still be very hot – such as the exhaust. Try to wait for such parts to cool and wear thick protective gloves when handling. Be particularly cautious when dealing with fire damaged vehicles due to the serious contamination risk (see Fire section).

Be aware when examining vehicle components for the risk of injury due to unexpected operation of the item being examined or tested. Again, use protective gloves and goggles and liaise with other on scene services for advice where appropriate.

Fire

It is recommended that a fire extinguisher should be carried in the project vehicle. In the case of an uncontrolled fire, risks include burns, smoke inhalation and explosion. The DaCoTA team should immediately evacuate the area. After a vehicle has caught fire there is a risk of injury from hot vehicle parts. The team must wait for the vehicle to cool down. After a burnt out vehicle has cooled there is still a contamination risk from hydrofluoric acid – which is released at high temperatures from the rubber-like materials used for many gaskets, O-rings and seals. Hydrofluoric acid is very toxic and can cause severe burns. Impermeable gloves and goggles must be worn for examination of burnt out vehicles. Contaminated gloves must be safely disposed of. It is very important to ensure there is no skin contact with hydrofluoric acid. If a person believes they have been contaminated then affected clothing should be removed and the body areas involved washed thoroughly with water. All persons suspected to be contaminated must be taken to their nearest hospital as quickly as possible. Teams should also be aware of the risk of electrical fire and under no circumstances should a battery be reconnected once it has been disconnected.

4.2.2.4. Dealing with People

At most investigations, teams will be speaking directly with members of the public. Where possible, they will be talking to the accident involved road users and any available eyewitnesses about the circumstances of the collision. They may also need to direct other road users away from the scene and respond appropriately to questions from bystanders. Investigators should be professional and courteous, but should be aware that tensions can run quite high at accident scenes and they may sometimes be faced with high levels of emotion, and even aggression. If at any time they feel under threat they should remove themselves from that situation and ensure that the case leader and all other team members on scene are aware. Investigators should not put themselves at risk and if they feel there is a continued threat, the team should leave the scene immediately. Where interviews are conducted on scene, the investigator must find a safe place away from moving traffic and any other risks associated with the accident scene to conduct the interview. In the interests of personal safety and legal protection, it is recommended to stay within sight of other personnel on the scene.

4.2.2.5. General Safety and Welfare of DaCoTA Personnel

Personal Protective Clothing

Clothing

Investigators must always wear clothing with fluorescent areas on the upper body when working on an accident site. The clothing must conform to EN 471 class 3. All fluorescent material on the clothing should be yellow and/or orange. The top should have long sleeves. In darkness, bad weather or poor visibility, trousers with fluorescent areas must be used. The trousers should conform to EN 471 class 2. Although, it is recommended that trousers be used at all times though. High visibility clothing must be kept clean to ensure that it remains effective.

Shoes

Investigators who work on scene should wear shoes with steel toes and nail-resistant soles.

Gloves

To prevent cuts, other injuries and exposure to blood-borne pathogens, gloves must be used on vehicle inspections. Thicker protective gloves made of leather or similar must be worn on all vehicle inspections to prevent cuts and other injuries. If a vehicle is suspected to be contaminated with blood-borne pathogens (e.g. hepatitis), protective gloves made of latex must be worn under the thicker gloves to provide an additional barrier to provide protection against contamination and/or infection.

Communicable Diseases

Team members should be aware of the risk of contracting communicable diseases from direct contact with blood and other bodily fluids. As well as wearing all necessary personal protective clothing, it is also recommended that teams have an inoculation policy. Recommended inoculations include Hepatitis B and Tetanus. Occasionally road users may conceal needles or other dangerous items within their vehicle. Investigators should be very careful when examining vehicle interiors – particularly when looking for seatbelt labels at night – always use a torch when dark.

Weather Protection

In hot weather, teams working out in the open should use sunscreen and wear appropriate hats. They should be provided with lightweight high visibility clothing. Take breaks from working in direct sun where possible and keep hydrated – keep bottles of water in the DaCoTA vehicle. For cold/wet weather teams should be provided with a good standard of high visibility weather protective garments. The team should take regular breaks in a warm vehicle if exposure is prolonged and it is recommended that a flask of hot water is carried in the car for making warm drinks.

Dealing with Distressing Accidents

Investigators may feel distressed by any of the sights, sounds or smells experienced whilst on scene or at any time afterwards and this is not always predictable. If any team member feels uncomfortable about anything they are being exposed to from attending a crash scene, then they must make their feelings known to the case leader (and the case leader should inform the team leader). Some team members may find attendance at collisions involving death and serious injury quite stressful. There should be routine de-briefing within teams. Independent counselling should be freely available, and where appropriate, staff should be instructed to attend.

4.2.2.6. Visitors/Guests

Introduction

All who participate in investigations of traffic accidents in DaCoTA must have the knowledge and equipment to be able to conduct these investigations in a safe manner. This includes third persons who accompany an investigation team to an accident site or a vehicle inspection. A third person can be either an investigator-in-training or a guest. An investigator-in-training is someone who is accompanying a DaCoTA investigation team to an accident site or a vehicle inspection as part of his/her training. All other third persons are guests. The purpose of this routine is to provide third persons with information on how to behave in the safest possible way at an accident site or vehicle inspection site. All third persons who accompany a DaCoTA investigation team must have read and know this routine.

Behaviour

At an accident site

The case leader on site is responsible for and in charge of the investigation team. A third person who accompanies a DaCoTA investigation team to an accident must follow the case leader's instructions on where it is safe to be and what to do. If possible and applicable, the third person should accompany the case leader. A third person who is an investigator-in-training can perform some tasks such as photographing the accident site if the case leader decides he or she can do this safely, has had prior instructions in the proper routine and the task is performed as part of his/her training to become an investigator. A third person who is a guest and not in training to become a DaCoTA investigator may not perform tasks.

At a vehicle inspection site

A third person must follow the instructions of the case leader or investigator in charge of a vehicle inspection on where it is safe to be and what to do. A third person can perform some tasks such as photographing the vehicle if the case leader decides he or she can do this safely, has had prior instructions in the proper routine and the task is performed as part of his/her training to become an investigator. A third person who is a guest and not in training to become a DaCoTA investigator may do so at the discretion of the case leader or investigator in charge of a vehicle inspection.

Personal Protective Gear

The rules regarding clothing, shoes and gloves apply to third persons as well as DaCoTA investigators.

Dealing with Distressing Accidents

Visitors may feel distressed by any of the sights, sounds or smells experienced whilst on scene or at any time afterwards and this is not always predictable. If any visitor feels uncomfortable about anything they are being exposed to from attending a crash scene, then they must make their feelings known to the case leader (and the case leader should inform the team leader). The visitor should return to the DaCoTA vehicle until departure from the scene can be arranged.

Some visitors may find attendance at collisions involving death and serious injury quite stressful. There should be invited to any de-briefing within the team and made aware of the availability of counselling where required.

Car - Parking and Equipment

The vehicle used for on scene investigations is driven by one of the two members of the investigations team. A third person should not drive the car unless in an emergency. The case leader should inform a third person who has the car keys and where the first aid kit is located in the investigation vehicle.

Legal Matters

All third persons accompanying a DaCoTA investigation team to an accident site must be insured by their employer. All third persons should also be given instructions in the relevant safety procedures by a person appointed by DaCoTA. Relevant safety procedures include this routine and other routines and instructions that may be applicable.

4.2.2.7. Retrospective Investigations

When working retrospectively, teams must be aware of the same hazards as for on-scene work. In addition, special consideration should be given to the health and safety aspects of retrospective site examination.

When returning to the site of an accident, teams may wish to collect data from a live carriageway (a road with traffic), without the benefit of an emergency services presence. In many ways this can be more hazardous than data collection within on-scene investigations.

If it is necessary to enter the road on foot, then consideration should be given to what safety precautions can be taken. As always, team members must wear high visibility clothing. It is important that investigators work in pairs, with one team member measuring / taking photographs etc. while the second team member is solely responsible for alerting the other to oncoming traffic at all times.

If local permissions allow you to cone out a safe working area then do so. Also consider parking a vehicle in a fend off position if it is safe, appropriate and legal to do so.

If it is unsafe to collect certain data retrospectively – then do not collect it. If the road is busy and unprotected then consider returning at a quieter time – but do not risk the safety of your team – and remember some roads may never be safe (or even legal) to enter as a pedestrian.

4.2.3. Equipment

Please refer to the main Equipment List for the Health and Safety equipment list.

4.2.4. Arrangements

Please refer to the Arrangement section of the Methodology Outline Health and Safety section.

4.3. Accident Notifications

4.3.1. Purpose / Aim

The purpose of the Accident Notifications section is to ensure that investigation teams are aware of the accidents as they are occurring. Furthermore, it is valuable to ensure that the teams are meeting their sampling criteria in a timely manner and are able to monitor and report sampling rates.

4.3.2. Methods

Retrospective & On-scene

It is important to ensure that the accident notification information adequately identifies all accidents that meet the sampling criteria. Also, the alarms must provide detailed information on the location of the accident.

Teams must record notifications about all accidents occurring in the sample region during the pilot study and note which accidents were accepted and rejected, and the reasons why. The accident notification data should be used to produce a brief report at the end of the pilot study.

Investigation teams should also consult the Sampling Plan to determine whether the accident notifications are meeting the sampling criteria.

Retrospective

Accident notification should be received within 24 hours of the accident occurrence to allow the team adequate time to collect as much of the remaining information from the scene of the accident as possible.

On-scene

For on-scene investigations, instant notification (e.g. by e-mail, two-way radio, SMS, etc.) from the police or other emergency services when an accident occurs are required to enable the team to reach the scene of the collision before it is cleared.

Experience has shown that real-time accident notification information can lack important details. Some teams may therefore need to go on-scene to determine if accidents are to be investigated without knowing beforehand whether they fit within the Sampling Plan requirements (i.e. if the accident on a public road, road user hospitalisation status, if vehicles or road users are on-scene, etc.).

4.3.3. Equipment

Please refer to the Accident Notification section of the Equipment List for the Accident Notifications equipment list.

4.3.4. Arrangements

Cooperation/agreements with the police or other emergency services to receive accident notification as soon as possible.

4.4. Photo Routine

4.4.1. Purpose / Aim

The purpose of the Photo Routine is to detail the methodology that should be adopted to sufficiently document and record scene and road and vehicular evidence that will allow accident investigators to complete a detailed accident reconstruction and investigation.

4.4.2. Methods

Photographic evidence should be recorded for both the scene and road as well as the accident vehicles. Therefore, the methodology detailed below is divided into Scene and Road as well as Vehicle Photos. Together, these two sections should comprise the required elements to sufficiently detail the accident scene and accident vehicles to allow investigators to conduct an investigation and reconstruction.

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

Generally speaking, for all cases when recording visual evidence, it is recommended that investigators use a flash in poor lighting conditions and a tripod where practical.

4.4.2.1. Scene and Road Photos

Generally many photos should be taken. Photos with lower quality and unnecessary duplicates can be erased afterwards.

The following steps are valid for taking photos of the accident site:

1. Overall accident site overview photos.
2. Photos of traces on and beside the road.
3. Photos of relevant measurements.
4. The approach towards the accident for each element.

1. Overview Photos

The overview photos should be taken in such a way to include all the major elements of the accident, including: the involved vehicles, the impact area, and the final position of the vehicles. This will hopefully provide investigators with a general description of the accident scene local road infrastructure and the environment.

When overview photos are taken, reference objects like posts, traffic islands and signs together with the placing of the vehicles should be included. These photos can advantageously be taken from a height beside the road to get a good overview of the accident site. Also, ensure to get a photo in the opposite approach direction of the vehicle from a point behind the end position of the vehicle.

The figures below show examples of Overview Photos.

Figure 4 Overall Accident Scene Example Photo

Figure 5 Overall Accident Scene Example Photo

Figure 6 Overall Accident Scene Example Photo

Figure 7 Overall Accident Scene Example Photo

2. Trace Evidence Photos

As stated above, it is important for investigators to prioritize photos of evidence that may disappear soon after the accident. This includes evidence such as: glass splinters, detached vehicle parts, vehicular fluid spillage, road user biological traces, debris, etc. These items should take priority over evidence that can be recorded after the trace evidence photos.

It is also noted that to have a better understanding of the size of the evidential objects, it is recommended to include a measure tape or reference object in the photo.

The figures below show examples of Trace Evidence.

Figure 8 Trace Evidence Example Photo

Figure 9 Trace Evidence Example Photo

Figure 10 Trace Evidence Example Photo

Figure 11 Trace Evidence Example Photo

3. Measurement Photos

Measurement photos can be made of barriers, road markings, trace depth, support strip and ditches. These photos are of special importance if it is judged that there are defects that might have influenced the cause of the accident or the course of events. To get a better understanding of the size of the objects it could be good to include a measure tape or reference object in the photo.

The figures below show examples of Measurement Photos.

Figure 12 Measurement Photo Example

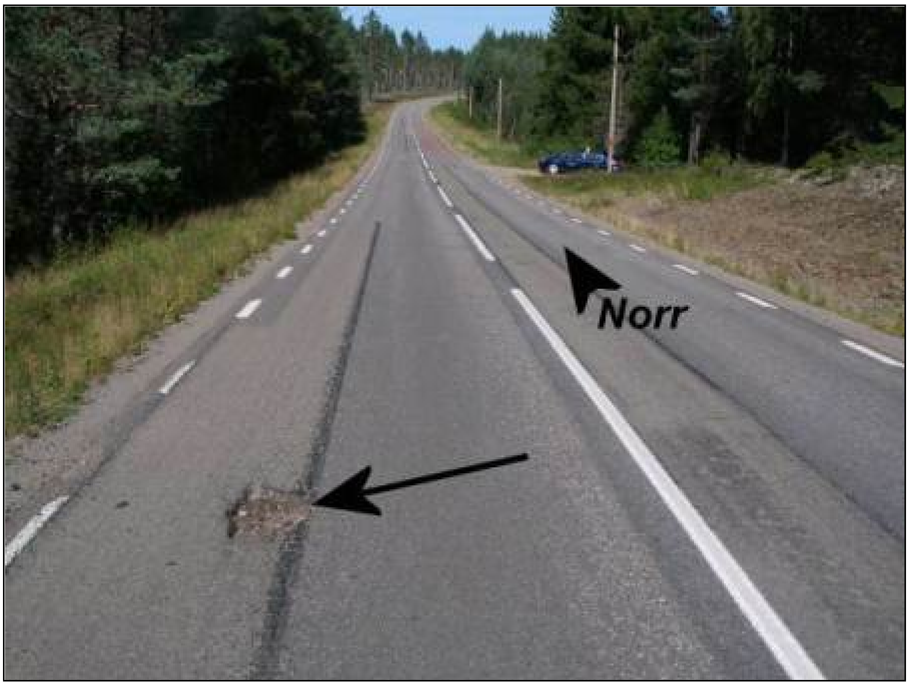

Figure 13 Measurement Photo Example

Figure 14 Measurement Photo Example

Figure 15 Measurement Photo Example

4. Accident Approach Photos

The purpose of documenting the approach of the vehicle towards the accident site is to determine if the road environment contributed the causation of the accident. In rural areas, the documentation should commence at least 300m before the accident site and in urban areas at least 50m. These photos are preferably taken from inside the investigation vehicle at the height of the eyes of the accident driver. If this is not possible, the photos can be taken from the road side. A complement to the photos can be made through a video recording of the approach.

Figure 16 Approach Photo Example

Figure 17 Approach Photo Example

Figure 18 Approach Photo Example

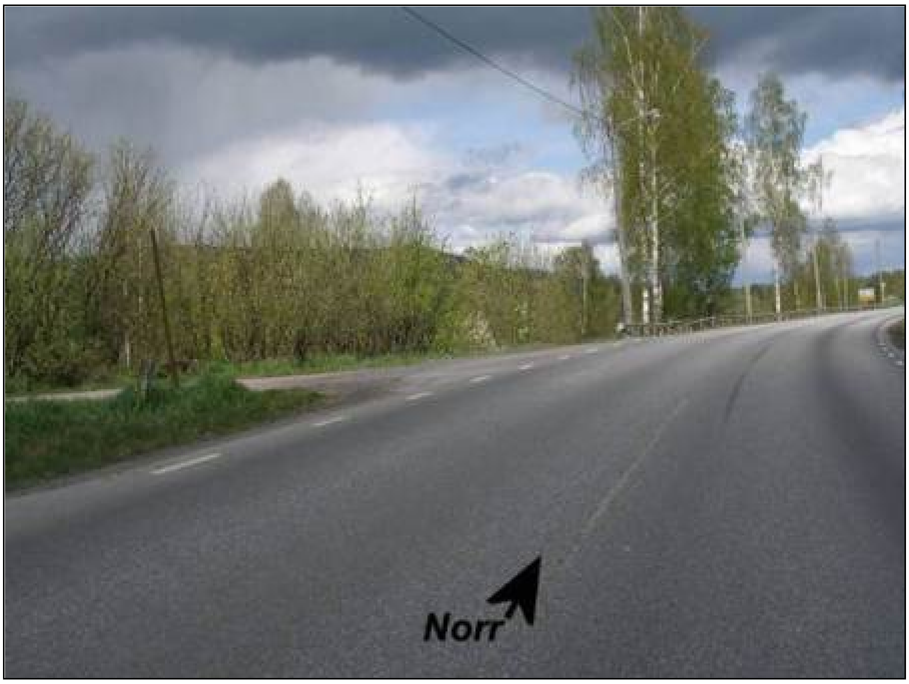

Figure 19 Approach Photo Example

Figure 20 Approach Photo Example

4.4.2.2. Vehicle Photos

Generally many photos should be taken. Photos with lower quality and unnecessary duplicates can be erased afterwards.

The following steps should be taken when recording car and heavy vehicle photos:

1. Exterior photos
2. Interior photos
3. Detail photos of exterior and interior

As there is no interior for Powered Two Wheelers (PTW), the photo routine will differ for inspections of this type. The methodology specific to the PTW photo routine is detailed later in the document.

Car

1. Car Exterior Photos

Exterior car photos should be recorded from eight angles around the car (as shown in the figures below). To ease the comprehension for later viewing of the photos it is best if the photos are taken in the same order for every car. If possible start with a photo of the front of the car and continue around the car in a counter clockwise manner. If this for some reason is not done properly the investigator can rearrange/rename the photos later.

An overall understanding of the car exterior should be determined by following this method of recording the car exterior. This can be of service when determining the placement of detailed photos.

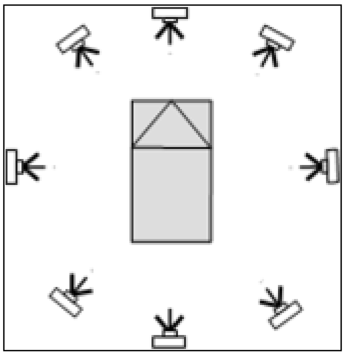

Figure 21 Exterior car photo angles

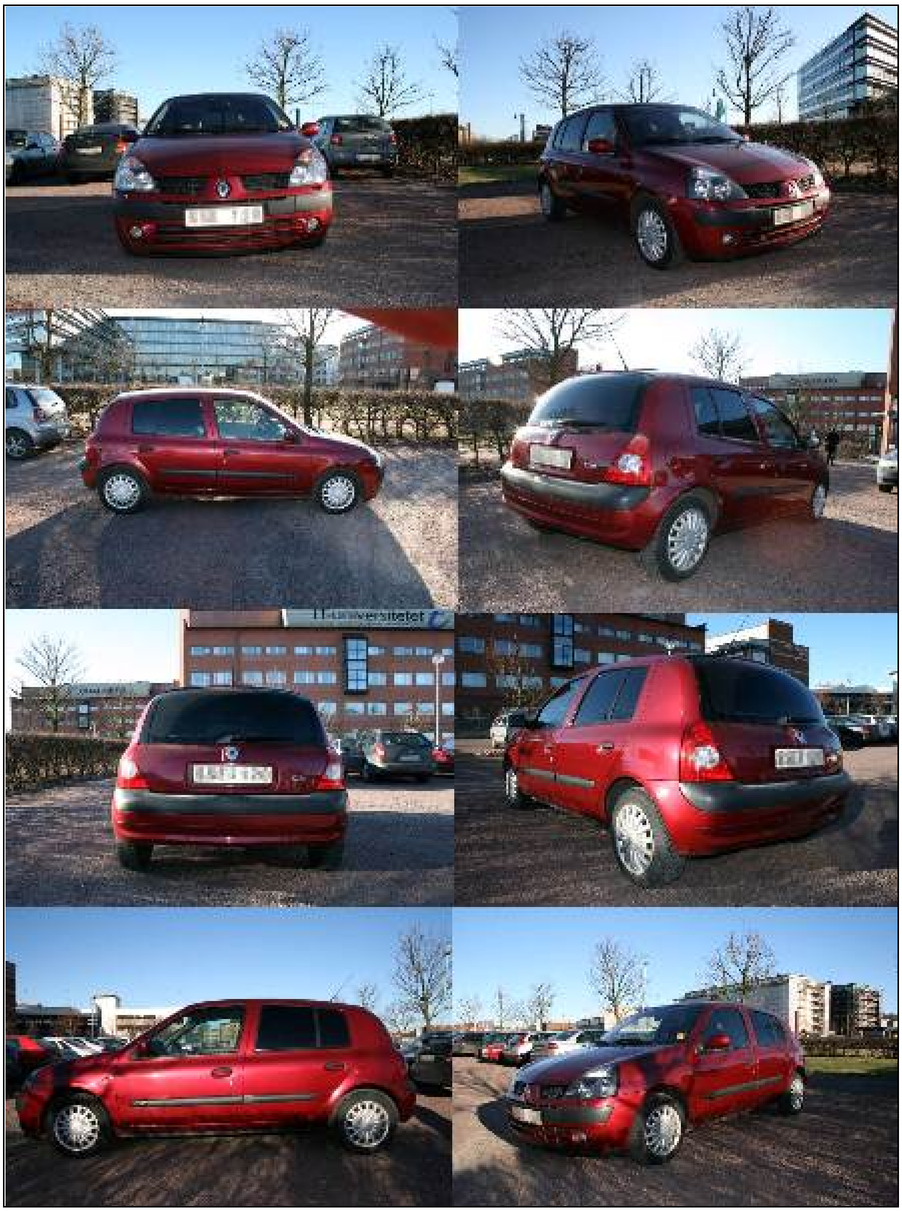

Figure 22 Exterior car photo angles

If possible, attempt to record a photo of the roof (as shown in the figure below).

Figure 23 Car roof photo

In some cases, the car roof may have been removed by accident rescuers when freeing trapped occupants. Photos should be taken without the roof (in the state found), followed by photos taken in the same manner (from the eight recommended angles - as above) with the roof replaced. Investigators should ask the wrecker to replace the roof and should not attempt to replace it themselves.

Please see the figure below for a sample of photos showing the removed and replaced roof.

Figure 24 Removed and replaced car roof photos

2. Car Interior Photos

Interior car photos should be recorded from two angles in the front seat and one in the rear seat (where applicable) for both driver and passenger sides of the car. It is important that the opposing door is closed when taking the photo and that the front and passenger seats, area around the door opening, a part of the ceiling and the door side can be seen (as shown in the figures below). The second front seat angle attempts to record the leg space and where applicable, the pedal placement.

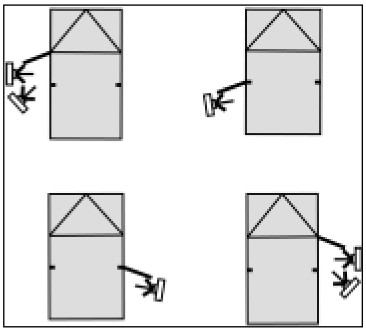

Figure 25 Car interior photos

Figure 26 Car interior photos

Figure 27 Car interior photo

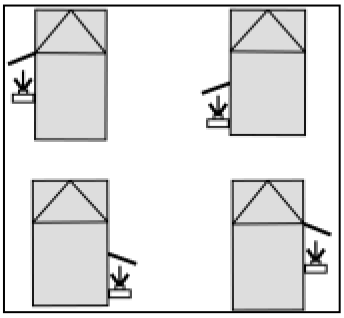

Figure 28 Car interior photos

3. Car Detail Photos

Car detail photos should show any relevant areas of the vehicle that are helpful during the overall investigation that may not have been adequately recorded in other exterior and interior photos.

These photos can contain detail of the engine compartment as well as any relevant deformations, impacts, airbags, child restraints, safety systems, etc.

The detail photos may also record any evidence of biological traces which may reveal information regarding the mechanism of injury (e.g. blood traces on the steering wheel resulting from injury caused through contact between the vehicle occupant and the steering wheel).

It is sometimes useful to include a ruler or coin within the detail photos to be able to determine the scale of the object being recorded.

As shown below, the car engine compartment detail photos should be recorded as they can be valuable in the overall investigation.

Figure 29 Car engine compartment

The figures below show details of relevant damages sustained during an accident.

Figure 30 Relevant car damage detail

Figure 31 Relevant car damage detail

Figure 32 Relevant car damage detail

Figure 33 Relevant car damage detail

Recording visual evidence regarding the car seatbelts is a key component of the interior photo routine and overall vehicle inspection. As shown below, damage such as friction marks on the seatbelt can indicate that the seatbelt was in use during the accident.

Furthermore, the seatbelt buckle may also reveal whether the seatbelt was worn during the accident, evident from abrasion marks left on the buckle due to the collision.

Figure 34 Seatbelt detail photo (note the damage to the belt)

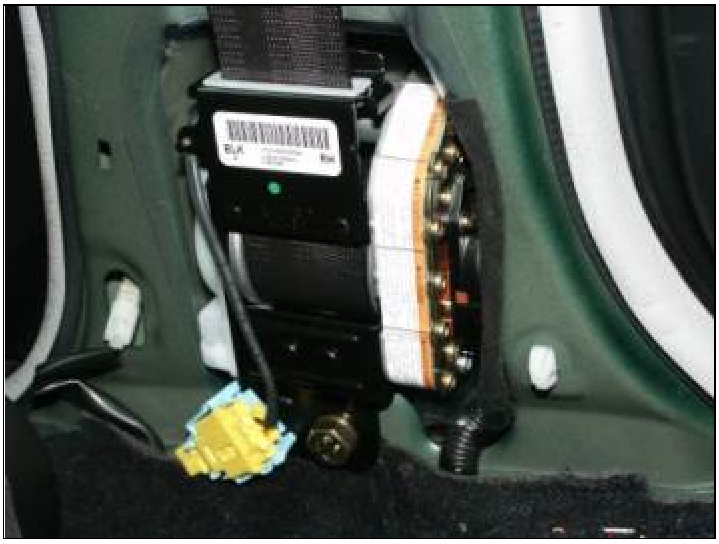

Figure 35 Seatbelt detail photo

Another indication of whether the road user was wearing their seatbelt at the time of the accident is through inspection of the load limiter. The load limiter is a part of the seatbelt that is intended to limit the restraint forces applied to the occupant's thorax during a collision.

The load limiter is often located at the base of the seatbelt where it coils. Examples of load limiters are shown in the figures below.

Figure 36 Load limiters

Figure 37 Load limiters

Figure 38 Load limiters

Airbag photos (as shown below) can be useful in revealing mechanisms of injury.

Figure 39 Airbag detail

Figure 40 Airbag detail

Child restraint systems should be examined and detailed in the photo routine (as shown in the figure below).

Figure 41 Child restraint detail

The vehicle load may also have contributed to the accident and/or the level of injury sustained by the occupants of the accident vehicle. Photographic evidence of the vehicle load should be recorded (as shown in the figure below).

Figure 42 Vehicle load

Truck

1. Truck Exterior Photos

Exterior truck photos should be recorded from eight angles around the truck (as shown in the figure below).

An overall understanding of the truck exterior should be determined by following this method of recording the truck exterior. This can be of service when determining the placement of detail photos.

In many cases, these photos can be difficult to record as there is often limited space available. Investigators should attempt to record these photos as accurately as possible. Also, the trailer is often removed and photos of the trailer may be required to be recorded separately.

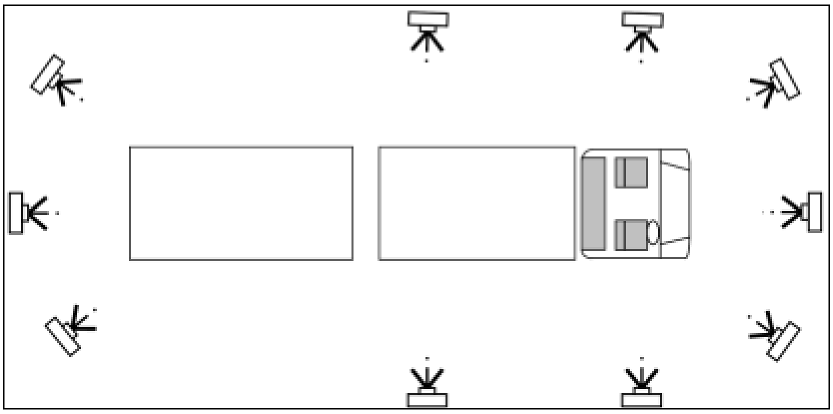

Figure 43 Truck exterior photo angles

Examples of exterior truck photos are shown in the figures below.

Figure 44 Truck exterior photo

Figure 45 Truck exterior photo

Figure 46 Truck exterior photo

Figure 47 Truck exterior photo

2. Truck Interior Photos

Truck interior photos should be recorded with at least two of each recorded from the driver and passenger side. It is important that the photos capture the driver or passenger seat, the area around the door opening and the foot well.

The photo from an angle behind the seat (looking towards the windscreen) is preferably taken from inside the cabin and is supposed to give an overview of the driver side seat, instruments and instrument panel.

Truck interior photos are also important if the protection systems of the driver will be analysed and also for the pre-crash analysis. The photos should give an overview of the driver seat, communication equipment, logistic systems, or any additional equipment used.

See the figures below for the recommended photo angles and example photos

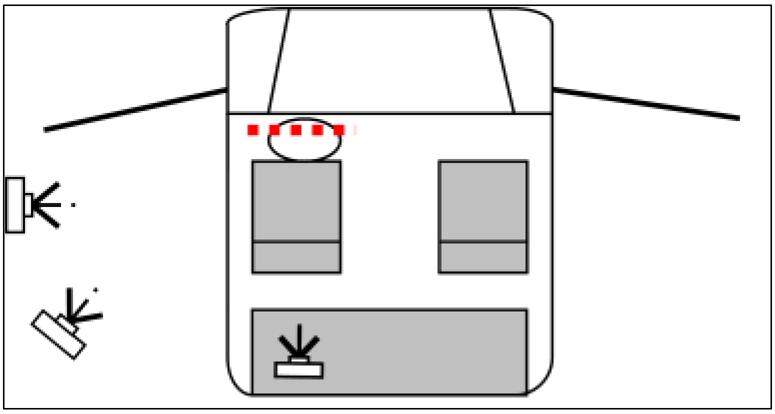

Figure 48 Truck interior photo angles

Figure 49 Truck interior photo

Figure 50 Truck interior photo

Figure 51 Truck interior photo

Photographs of the truck load should also be recorded. The type of load, arrangement, securement method and general estimate of the load weight can sometimes be determined from photos of the load. Furthermore, a loss of load should also be documented and can reveal accident causation methods. The truck load photos can be vital during the overall investigation.

Examples of truck load photos are shown below.

Figure 52 Truck load photos

3. Truck Detail Photos

Truck detail photos should show any relevant areas of the vehicle that are helpful during the overall investigation that may not have been adequately recorded in other exterior and interior photos.

These photos can contain detail of the engine compartment as well as any relevant deformations, impacts, airbags, safety systems, etc.

The detail photos may also record any evidence of biological traces which may reveal information regarding the mechanism of injury (e.g. blood traces on the steering wheel resulting from injury caused through contact between the road user and the steering wheel).

It is sometimes useful to include a ruler or coin within the detail photos to be able to determine the scale of the object being recorded.

The figure below shows some recommended (but not an exhaustive list) truck detail photo angles.

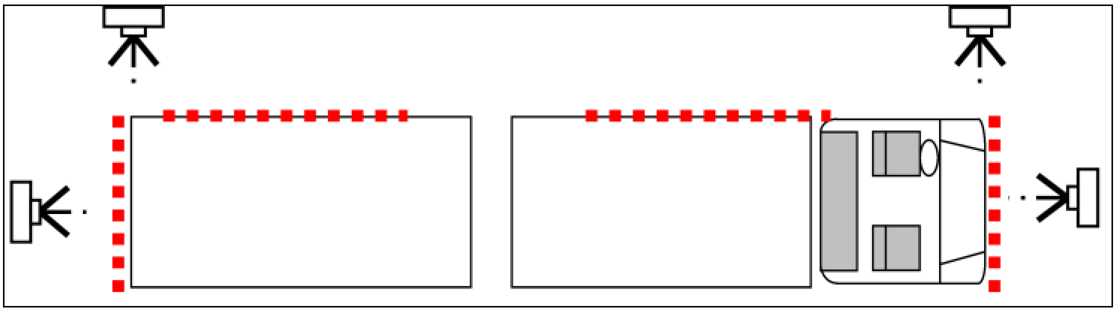

Figure 53 Some recommended truck detail photo angles

The figures below show examples of detail photos for a deformation on the Frontal Underrun Protection from a collision with a car, and also Side and Rear Underrun Protection deformation detail photos.

Figure 54 Frontal Underrun Protection deformation detail

Figure 55 Frontal Underrun Protection deformation detail

Figure 56 Rear and Side Underrun Protection deformation detail

Figure 57 Rear and Side Underrun Protection deformation detail

In the case of cabin displacement in relation to the chassis frame, this should be documented within the detail photos of the cabin attachment and photos from the front and side should also be recorded.

Examples of cabin displacement photos in a rear end accident at the rear of a trailer are shown in the figures below.

Figure 58 Cabin displacement detail

Figure 59 Cabin displacement detail

Exterior detail photos of all mirrors of the vehicle should be recorded. If possible, photos of the mirrors from the driver seat angle should also be recorded.

The figures below show some common truck mirror locations.

Figure 60 Common truck mirror locations

Figure 61 Common truck mirror locations

The figures below show examples of airbag and interior observation detail photos.

Figure 62 Truck airbag photo

Figure 63 Interior observations

Powered Two Wheeler

1. Powered Two Wheeler Exterior Photos

Exterior Powered Two Wheeler (PTW) photos should be recorded to give an overview of the PTW itself.

An overall understanding of the PTW exterior should be determinable from these photos. This can be of service when determining the placement of detail photos.

The figures below show examples of PTW exterior photos.

Figure 64 PTW exterior photo

Figure 65 PTW exterior photo

Figure 66 PTW exterior photo

2. Powered Two Wheeler Detail Photos

PTW detail photos should show any relevant areas of the vehicle that are helpful during the overall investigation that may not have been adequately recorded in other exterior photos.

These photos can contain detail of any relevant deformations, impacts, airbags, safety systems, etc.

The detail photos may also record any evidence of biological traces which may reveal information regarding the mechanism of injury (e.g. blood traces resulting from injury).

It is sometimes useful to include a ruler or coin within the detail photos to be able to determine the scale of the object being recorded.

Special consideration should be given to any deformations and/or marks as they can reveal much in regards to the kinematics and overall understanding of the accident event.

See the figures below for example deformation detail photos.

Figure 67 Typical PTW side body, gas tank and front forks damage

Figure 68 Typical PTW side body, gas tank and front forks damage

Figure 69 Typical PTW side body, gas tank and front forks damage

Figure 70 Typical PTW side body, gas tank and front forks damage

PTW braking systems differ significantly from car systems and require special consideration.

The brakes (both front and rear) should be recorded through photographic evidence.

See the figures below for example PTW braking systems.

Figure 71 Rear PTW brake system

Figure 72 Front PTW brake system

The PTW thread depth is relevant to the investigation and photographs should record the level of tread on the tyres.

See the figures below for example tread depth photos.

Figure 73 PTW Tread depth

Figure 74 PTW Tread depth

PTW road users usually wear Personal Protective Equipment (PPE) that differs from standard vehicle road users. This can include:

- Helmet
- Eyeglasses
- Jacket
- Gloves
- Pants

- Shin Guards
- Boots

All such equipment attempts to provide additional protection and visibility to the PTW road user and should be considered in the inspection.

The PTW protective equipment should be inspected for any damage and/or marks as this can reveal much in regards to the kinematics and overall understanding of the accident event.

Detailed photographs of the helmet (including the fastening mechanism) and all other protective equipment should be made.

See the below figures for example photos of PTW PPE.

Figure 75 PTW Jacket

Figure 76 PTW Gloves

Figure 77 PTW Helmet

Figure 78 PTW Helmet (note the fastener detail)

Figure 79 PTW Boots

Bus

1. Bus Exterior Photos

Exterior bus photos should be recorded from eight angles around the bus.

An overall understanding of the bus exterior should be determined by following this method of recording the bus exterior. This can be of service when determining the placement of detail photos.

In many cases, these photos can be difficult to record as there is often limited space available. Investigators should attempt to record these photos as accurately as possible.

2. Bus Interior Photos

Interior bus photos should show the overall layout of the passenger seats, the main aisles, location of doors and driver area.

3. Bus Detail Photos

Bus detail photos should show any relevant areas of the vehicle that are helpful during the overall investigation that may not have been adequately recorded in other exterior and interior photos.

These photos can contain detail of the engine compartment as well as any relevant deformations, impacts, airbags, safety systems, etc.

The detail photos may also record any evidence of biological traces which may reveal information regarding the mechanism of injury (e.g. blood traces on the steering wheel resulting from injury caused through contact between the road user and the steering wheel).

It is sometimes useful to include a ruler or coin within the detail photos to be able to determine the scale of the object being recorded.

4.4.2.3. Guidelines for Anonymisation

After returning to the office, all photos should be sorted and all redundant photos deleted. The remaining photos will be anonymised. The recommended method is to do so digitally, by editing the photos in a photo editing program (e.g. Adobe Photoshop, Paint Shop Pro, etc.) where selected parts can be pixelated in convenient fashion. What is important is that all identifiable elements such as faces, registration numbers and identifiable stickers are removed.

Adobe Photoshop Guidelines:

1. Open the photo to be edited in the program.
2. Choose the “Lasso Tool” in the Standard Toolbar.
3. Mark the element to be removed.

4. Mark “Filter” -> “Mosaic” in the menu field.
5. Choose appropriate “Cell size”.
6. Press “Ok”.
7. Save the photo.

Paint Shop Pro Guidelines:

1. Open the photo to be edited in the program.
2. Choose “Selection” in the toolbar.
3. Mark the element to be removed.
4. Mark “Flood Fill”.
5. Click inside the marked area.
6. Save the photo.

4.4.3. Equipment

Please refer to the Scene and Road Equipment List for the Photo Routine equipment list.

4.4.4. Arrangements

Review the above methodology to ensure that investigators have a good understanding of it before arriving on scene.

4.5. Scene and Road

4.5.1.1. Purpose / Aim

The purpose of the scene and road inspection is to collect information that describes the accident scene location, such as the roadway characteristics and traffic conditions. It is vital to have a thorough understanding of the accident event, the scenario leading to the accident and any causation factors in order to better conduct the overall investigation. A well conducted Scene and Road investigation can reveal much of this information.

The Scene and Road inspection attempts to collect accident scene related information which is required to subsequently fully code the accident case in the database. This information includes:

- Photographs of the accident scene, roadside, approach and accident traces (see: Photo Routine)
- Create a detailed sketch of the accident scene (see: Scene and Road Sketch)
- General road information (i.e. road type, historical and accident traffic conditions, speed limits, physical road characteristics, etc.)
- Description of Vulnerable Road User facilities (i.e. pedestrian and cycle crossings, bicycle lane, kerb height, etc.)
- Road area features (i.e. road components: barrier, lane, road side, etc.)
- Identification and description of any collision objects (i.e. animal, building, sign post, etc.)

4.5.1.2. Methods

Scene and Road inspections can be conducted on scene or retrospectively. Much of the on scene data to be collected may only be available for a finite period (due to accident site cleanup, etc.). Where possible, accident investigators should make efforts to collect any on scene data that may not remain indefinitely (i.e. pedestrian swipe marks, vehicular accident debris, etc.).

The Scene and Road methodology is divided into On Scene and Retrospective as the methodology used to conduct these two investigations differ. Despite these differences, it is important to understand that most data required for accident analysis can be collected on scene, depending on time constraints, obviating the requirement for a retrospective investigation.

AS MUCH ON SCENE EVIDENCE SHOULD BE COLLECTED AS POSSIBLE.

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

On Scene

The On Scene investigation is the collection of scene and road related evidence at the accident scene location, with a focus on the collection of evidence that may only be available for a finite period. Therefore, accident investigators should make efforts to arrive on-scene as soon as possible after receiving an accident alarm.

The methodology for On Scene investigation has been divided into the following steps:

1. Pre-Departure Preparations

After receiving an accident alarm, the investigation team should ensure they have all necessary investigation equipment (please refer to the Equipment List) and fulfilled all Health and Safety requirements.

2. Arrival On Scene

Once arrived on scene, the investigation team should meet the requirements of the Arrival on Scene and Scene Safety section under the Health and Safety heading in this chapter to ensure a safe working environment.

After meeting the above stated health and safety requirements, the investigation team should identify all those involved in the accident (i.e. all road users and accident witnesses), those involved in the rescue process (i.e. ambulance and police services) and any other relevant parties (i.e. tow truck driver). These individuals can provide the accident team with relevant information and better enable the overall scene and road investigation process.

From speaking with the relevant authorities, the investigation team should determine the length of time the vehicles will be available on scene and a description of any changes made to the vehicles in the rescue and cleanup process.

3. Scene and Road Photographs

Photographic evidence of the accident scene and road should be recorded. The detailed methodology for this process is described in the Photo Routine section.

By following the Photo Routine methodology (as above), investigators should have photographic evidence that will enable the creation of a general description of the accident scene and allow for a detailed reconstruction and investigation. This includes: the accident vehicles, any temporary sight restrictions/visibility obstructions (i.e. parked vehicle(s), temporary signs, weather conditions, glare source(s), etc.), the infrastructure and environment, etc.

4. Transient Evidence

Some key scene and road evidence may only be available for a finite period and may not be available during subsequent retrospective investigations. Therefore, accident investigators should collect records of this evidence as soon as possible.

Examples of transient evidence to be collected include: vehicle positioning, traces (pedestrian traces, vehicular fluids, skid/brake marks), debris, collision objects, etc.

The majority of the transient evidence should be collected by following the above stated Photo Routine methodology.

5. Additional Evidence

All additional evidence (that which is not considered transient) can usually be collected retrospectively, therefore the detailed methodology for completing the vehicle inspection is detailed below in the Retrospective section. Although, it should be noted that ideally all evidence should be collected on scene, if time allows.

Retrospective

It is preferential for the scene and road evidence collection to be made on-scene, as much evidence is lost during the accident scene rescue, towing and cleaning processes. Depending on a variety of factors, it is possible to perform sections of the investigation retrospectively. Although it should be noted that the majority of evidence collected can and should be collected during the on-scene scene and road investigation, where possible. Therefore, the following methodology can be followed during an on-scene investigation if time allows.

Any retrospective accident scene site inspection should be conducted as soon as possible to retain as much evidence as possible, as much of the transient evidence may no longer be available over an elapsed time.

During a retrospective investigation, it is important to remain open-minded, even if the investigation team already has been provided a sequence of events (e.g. do not be limited by the police search as the retrospective investigation can reveal missed information).

1. Pre-Departure Preparations

Before departing for the retrospective scene and road accident site visit, the investigation team should ensure they have all necessary investigation equipment (see here: Equipment List) and fulfilled all Health and Safety requirements.

To enable an efficient retrospective investigation, it is important to collect as much relevant information as possible on the sequence of events before attending the accident scene site inspection as this may focus the investigation area and facilitate a better overall understanding of the accident event before arriving on scene.

It is also important to procure detailed information on the position of the accident. If the scene has been cleaned and the vehicle(s) towed, with little remaining evidence of an accident, it may be difficult to determine where to take road measurements if no exact position is given.

The following points are important to consider whenever undertaking a retrospective investigation:

- Communicate details of the planned inspection with police and road authorities in advance;
- Prepare the route to the crash scene in advance;
- Collect data about the crash scene and the direct environment: police data, maps, Google Earth and Streetview, internet and news sites. Take this data to the crash scene;
- Develop potential accident scenarios and determine the information required to evaluate these scenarios;
- Forecast potential issues beforehand and attempt to mitigate appropriately (e.g. doubts about the driving directions of the vehicles, the exact crash location, etc.).
- Based on the available information, determine the safety work zone at the crash scene.

To determine relevant accident information, use sources such as online media websites that publish news items within hours (or less) of the initial accident occurrence. The text of these articles often contain detailed information about the accident (e.g. driving direction, driver(s) and passengers (including statements of the driver(s) and/or witnesses), injuries, car damage, objects struck, etc.). The articles often have pictures with information about car (brand and type), damage, end position, objects struck, emergency services at the site, etc.

Please see the figures below for examples of accident information found on relevant websites.

HVZeeland.nl - Printvriendelijke pagina Page 1 of 1

www.hvzeeland.nl

Injured in accident at Hengstdijk

Added: April 3, 2010 - 15:32 pm - Updated: April 4, 2010 - 10:05 am

Hengstdijk - Saturday afternoon, two slightly injured at an accident on the Hengstdijksestraat in Hengstdijk.

The accident took place around 14.20 hours. A 20-year-old motorist from Terneuzen stated that he drove toward Kloosterzande when suddenly his cell phone fell to the ground. He wanted to pick it up and thus lost sight of the road.
He thus came with his car in the right shoulder and wanted to correct it but rolled over and then shot left in the ditch.

The two occupants were on their own out of the car. The driver had just a scratch but needed no further medical attention.
His passenger, a 16-year-old Terneuzenaar, went with the ambulance to the hospital. He was injured on his arm.
The car was heavily damaged and was towed.

http://www.hvzeeland.nl/Nieuws/PrinterFriendly/Item?nid=13242 17-12-2010

Figure 80 Example media website information (published within 1 hour of accident occurrence)

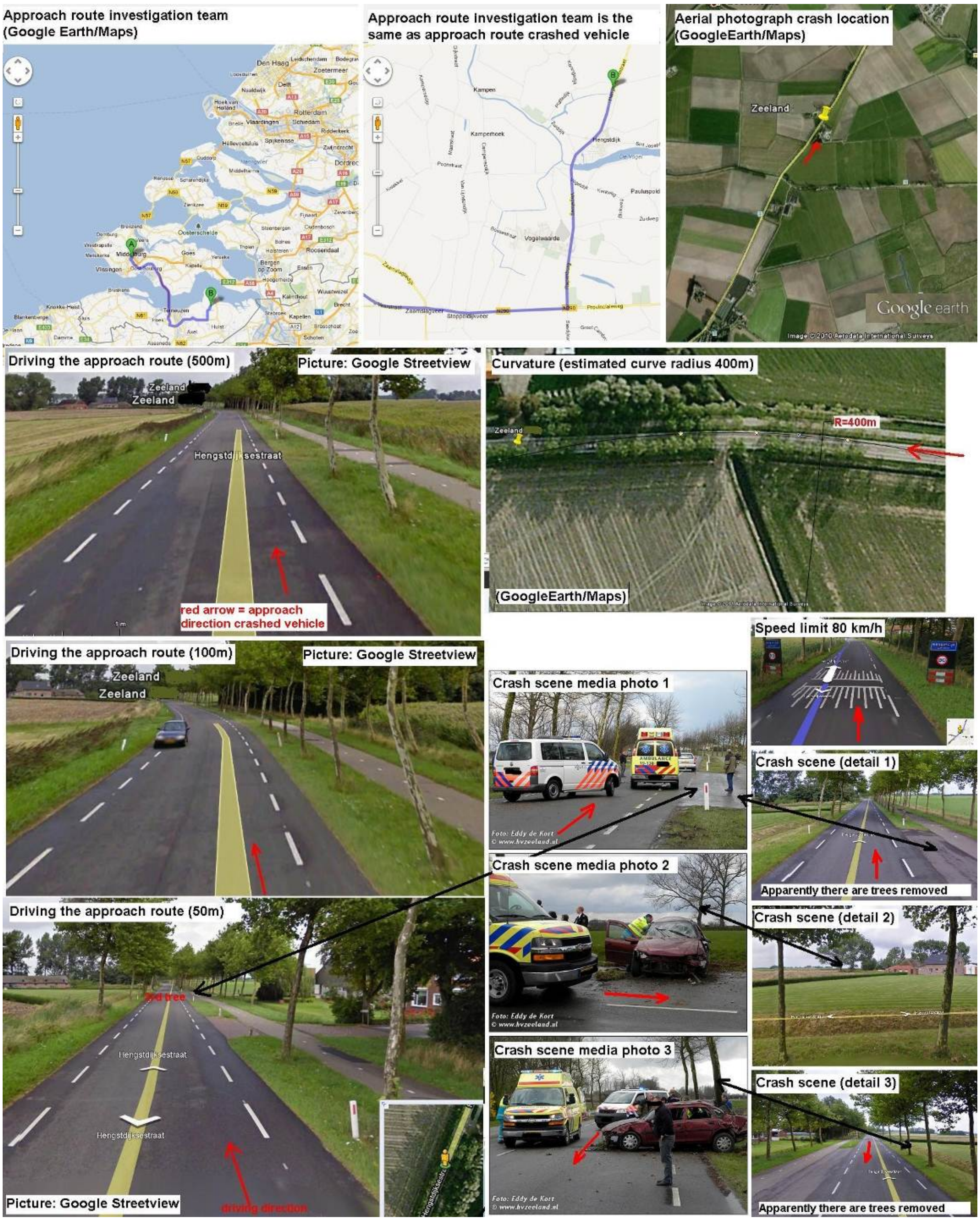

Figure 81 Example information from (GoogleEarth/Maps) maps, aerial photographs, digital pictures (GoogleStreetview) of situation before crash (including pictures of the accident scene from media website)

Furthermore, it is possible to use information from (local) police, emergency services, and scrapyards. This information is usually available within some days (or less) after the initial accident occurrence.

Additionally, Google Earth/Maps or other up to date maps can be used to get information about the approach route, surrounding land use, curvature, speed limits, etc. Google Streetview or other up to date pictures can be used to get detailed information about the carriageway and roadside (note: always confirm this information during the site visit), surrounding land use, sightlines (stop and sight distances), street furniture, etc.

See the figure below for an example of approach route information that can be found on Google Earth/Maps.

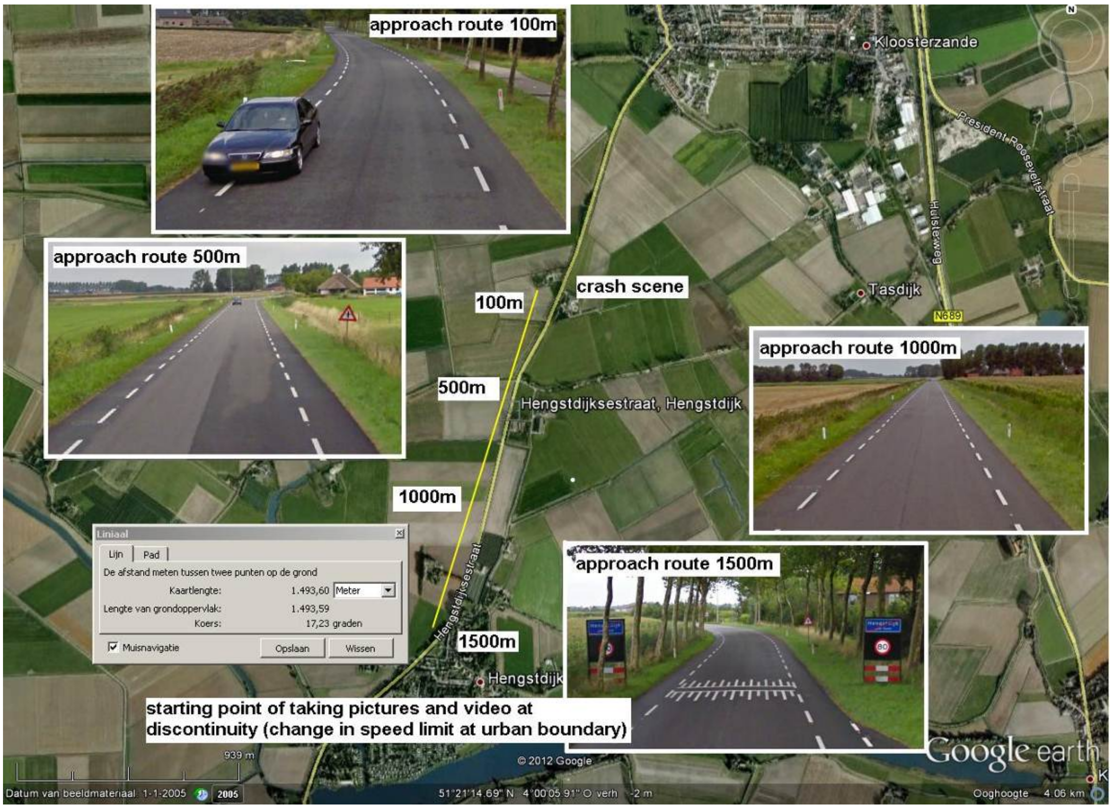

Figure 82 : Information about the approach route form Google Earth/Maps and marked points at which the site inspector should begin recording photographs and/or movies

Use Google Streetview or other up-to-date and digital pictures to get information about the available space for creating a work zone in which the crash site could be inspected in a safe way and according to the local guidelines or legislation. Contact the police or road authorities in advance, to notify them of the upcoming inspection.

See the figure below to see an example of marking a work zone at an accident site using Google Streetview photographs.

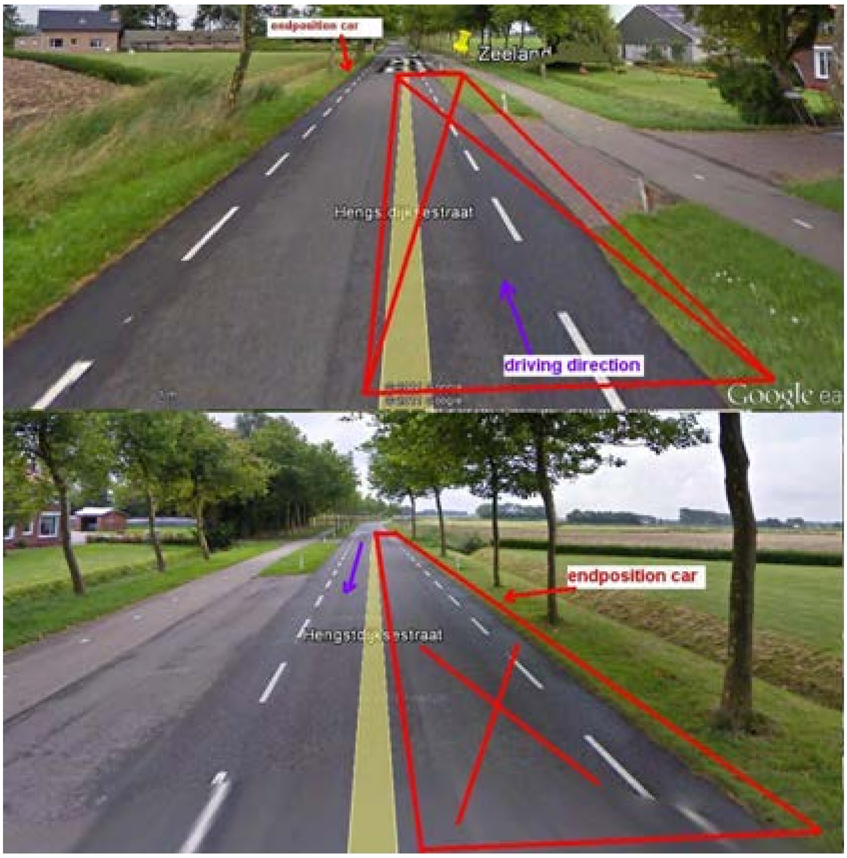

Figure 83 Information about the crash scene (pictures Google Streetview) and marked work zone in which the site inspector should inspect the crash scene in a safe way and according the local guidelines (two work zones for both driving directions of the carriageway and roadsides)

2. Retrospective Accident Scene Arrival

Once arriving on scene, the investigation team should meet the requirements of the Arrival on Scene and Scene Safety section of the Health and Safety sub-chapter mentioned earlier to ensure a safe working environment.

After meeting the above stated health and safety requirements, the investigation team can begin the retrospective investigation evidence collection process.

3. Retrospective Scene and Road Visual Evidence

The majority of evidence collected will be in the form of photographic records. Any evidence that was not collected during the on-scene (if any) investigation should be collected during the retrospective accident scene site visit.

Photographic evidence of the accident scene and road should be recorded. The detailed methodology for this process is described in the Photo Routine section.

By following the Photo Routine methodology (as above), investigators should have photographic evidence that will enable the creation of a general description of the accident scene. This includes: the roadway and approach, the infrastructure and environment, etc.

Furthermore, creating a video record of the last 1000 (or minimum 500 metres) of the vehicle route(s) should be made. This video evidence should give investigators the road user perspective shortly before the accident and the expectations during the approach to the crash site. To this end, the following characteristics should be recorded:

- Vertical and horizontal alignment;
- Consistency of the presence of curves and bends shields;
- Pavement type and quality of pavements;
- Type and condition of axis marking;
- Type of direction separation and / or median;
- Type and position of any parallel (moped and/or) bicycle facilities;
- Presence of sorting strips, parallel roads, slip lanes, hard shoulders and parking facilities;
- Any changes from a previous road section;
- Presence of pedestrian crossing facility;
- Presence and consistency of traffic inhibitors (speed humps, speed tables);
- Presence of light towers, reflector posts and hectometer poles;
- Description of the environment and the presence of trees and shrubs;
- Traffic signs along the route (including text-boards and any possible problems with the performance or visibility).

4. Cross Section Measurements

In performing cross section measurements, it is important that one investigator measures the cross section and take pictures, while the other investigator keeps an eye on the traffic.

Cross-sectional measurements should be taken (at minimum) at:

- Vehicle conflict point
- Any location where the vehicle(s) had a run of road
- Final resting points of the vehicle(s)

A laser distance meter with tilt sensor (digital inclinometer) can be used to measure road characteristics on the road surface or in the roadside from out of a work zone in the verge at a safe distance of moving traffic. If the inspection vehicle can be parked in the shoulder of the roadway or on a cycle lane, measurements can be carried out without having to block a traffic lane. The laser meter with tilt sensor can also be used to measure angles of cross fall (slope of road surface), slopes of embankments or cuts, etc.

The following road characteristics of the cross section should be collected:

- Road category (residential road (Zone30), rural access road (Zone60), distribution road (80 km/h) or flow road (A-level road), motorway 100/120 km/h));
- Lane configuration (e.g., 2x1 or 2x2);
- Speed limit on site;
- Road situation on the spot (intersection / road section; straight / bend);
- Radius if the crash occurred in or behind a curve;
- Width of the pavement, edging and lanes of driving strip;
- Width and type of axis marking, separation of driving directions and other marking and lines;
- Type and width of hard shoulder, semi-hardening, widths of obstacle-free zone, safety-/ breakdown zone, and roadside vegetation free zone, type of (rigid) obstacles, connection with the pavement;
- Type of cut or embankment, slope (degrees) and width to crown and toe line,

- Type and width of any devices in parallel and the width and material of the intermediate berms.

If a safe site inspection is not possible with the available safety equipment, for example on a 100km/h-road, only filming the road will be possible and additional measurements have to be carried out using estimations based on GoogleEarth and Streetview. The radii of curves can also be determined using GoogleEarth.

5. Back at Office

After returning to the office, it is important to properly compile the evidence collected during the investigation. This can be facilitated through:

- Inserting a minimum set of variables into the database without delay enabling other team members to continue working on the case
- Creating a scale plan using appropriate software (see: Scene and Road Sketch)
- Checking the quality of the data and entering the full data into the database
- Removing any vehicle identifiers (i.e. license plate numbers, etc.) and sorting/uploading the photos

4.5.1.3. Equipment

Please refer to the main Equipment List for the Scene and Road equipment list.

4.5.1.4. Arrangements

Please refer to the Arrangements section of the Methodology Outline Scene and Road section.

4.5.2. Scene Measurements

4.5.2.1. Purpose / Aim

The purpose of making scene measurements is to establish a better understanding of the positioning of relevant accident elements and to enable an accurate sketch to be created. The scene measurements provide valuable data to accident investigators that give a better overall understanding of the accident and aid in the reconstruction process.

4.5.2.2. Methods

There are numerous methods available to accident investigators for making scene measurements. Each method system has unique advantages and disadvantages that the investigators should consider when applying a particular measurement system.

The methodology below details the following measurement techniques:

- Orthogonal Coordinate Grid System
- Triangulation
- Path Coordinate System
- Photogrammetry

There are several alternate measurement techniques available using highly sophisticated equipment such as laser scanners, total stations, theodolites and differential GPS. These systems require an experienced user but can save time while collecting high quality data. However, due to the cost they are unlikely to be used for most accident scene investigations and therefore further details will not be described.

Orthogonal Coordinate Grid System

A simple method of measuring the accident scene is to record the measurements on an orthogonal coordinate grid by first finding a reference point and then defining a (straight) reference line which will represent the X-axis. The Y-axis measurements are then measured perpendicularly to the reference line.

Premises:

- One or two persons available
- Straight and simple road layout is present

Steps:

1. Establish Reference Point

Measurements of the accident scene can be facilitated by first establishing a fixed reference point. The point of reference must be fixed and can be street lamps, fixed posts, building wall corners, etc.

2. Define Reference Line (X-axis)

After selecting an initial reference point, an axis can be established from the reference point. This axis will form the reference base that all other points of interest will be measured against.

3. Accident Site Elements

After establishing the X-axis, all additional points of interest can be given as measured distances in the Y direction from the defined X-axis (note: for long distances (>3m), it is recommended to use a measurement wheel and for short distances (<=3m), a measurement tape (2 persons) can be used).

Pros

- Relatively fast and simple measurement method

Cons

- Requires a simple road layout

Triangulation

With this procedure, two points of reference are selected, where the distance between these points is known. The distance to each point of interest should then be measured from both the two reference points.

The angle between the reference base line and the line to the point of interest should not be obtuse or too acute. If the distance between reference point A and point B is too long and interest point C is too close to the connecting line AB, then there won’t be an intersection and point C cannot be found with this method. An acute angle and inaccurate measurement causes an offset of point C.

Premises

- Two persons available
- Complex measurement on straight road layout

Steps

1. Establish Reference Points

Measurements of the accident scene can be facilitated by first establishing a fixed reference points. These points of reference must be fixed and can be street lamps, fixed posts, building wall corners, etc. At least two points of reference are required to make accurate measurements. These two reference points will act as base points to which all additional points of interest are related to.

2. Determine Distance between Reference Points

After defining the reference points, the distance between the two should be measured.

3. Accident Site Elements

After establishing the reference points and determining the separating distance, the location of various evidential elements of interest can be determined. All relevant accident elements (i.e. accident vehicles, collision objects, transient evidence, traces, debris, etc.) should be measured in relation to the original reference points.

The angles between the reference points and the point of interest are used to determine the position of the point of interest in relation to the reference points (see the figure below).

Each point of interest should also be numbered to enable accurate record keeping and identification of each element.

An example of measurements created through triangulation is shown in the figure below.

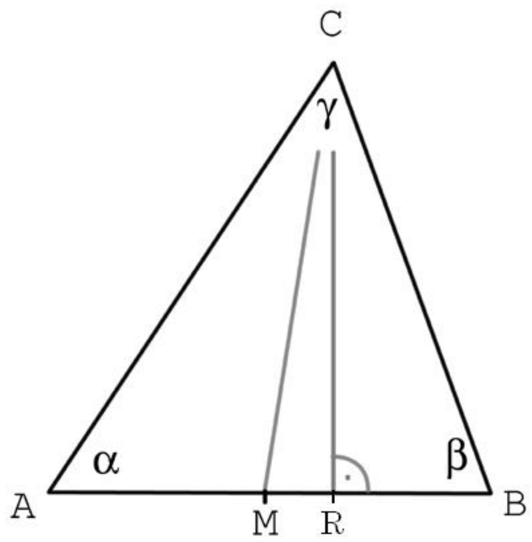

Figure 84 Triangulation measurements

Pros

- Very accurate method for measuring as long as the point of interest is within a suitable area

Cons

- Takes more time than other methods

- Two persons required for measuring
- Low level of accuracy for obtuse and acute angles

Triangulation with Moving Reference Points

If the accident site is relatively large or complex, it can be divided into a network of triangles. These triangles can be measured according to the same principles as stated in the above triangulation method. The measured points are then used as reference points to measure the next unknown point until all unknowns have been accounted for.

Premises

- Two persons available
- Complex road layout is present with a relatively large area.

Steps

Same as above triangulation, but with multiple triangles.

Pros

- Very accurate measurement method

Cons

- Time consuming
- Two persons required for measurements

Path Coordinate System

A path coordinate system is a measurement method where the x-axis is set to follow a path (e.g. the road edge) and the y-axis values are measured perpendicular to the x-axis. This, however, requires that the path itself is well defined.

Premises

- One or two persons available
- Path can easily described

Steps

1. Establish Reference Point

Measurements of the accident scene can be facilitated by first establishing a fixed reference point. The point of reference must be fixed and can be street lamps, fixed posts, building wall corners, etc.

2. Define Reference Line (X-axis)

After selecting an initial reference point, an axis can be established from the reference point. This axis will form the reference base that all other points of interest will be measured against. As stated above, the X-axis is usually chosen to follow the road path.

3. Accident Site Elements

After establishing the X-axis, all additional points of interest can be given as the perpendicularly measured distances in the Y direction from the defined X-axis (note: for long distances (>3m), it is recommended to use a measurement wheel and for short distances (<=3m), a measurement tape (2 persons) can be used).

Pros

- Very simple method for measuring of complex road path

Cons

- Long chords required for accurate measurements
- Perpendicular measurements may be difficult

Photogrammetry

Photogrammetry is the practise of producing real world measurements from photographs. There are several photogrammetric techniques available. 2-D photogrammetry methods require only one photograph and can provide adequate accuracy for nominally flat surfaces. Even when no measurements have been taken at the time of an accident, it is possible to obtain adequate dimensional data to rectify photographs by going to the scene and taking measurements of painted lines or other long-lasting roadway features that appear in the original photographs.

Premises

- One or two persons available
- Measurement of the reference distances only

Steps

1. Define reference points

Measurements of the accident scene can be facilitated by first establishing a fixed reference points. These points of reference must be fixed and can be street lamps, fixed posts, building wall corners, etc. At least two points of reference are required to make accurate measurements. These two reference points will act as base points to which all additional points of interest are related to.

2. Determine Distance between Reference Points

After defining the reference points, the distance between the two should be measured.

3. Accident Site Elements

Based on the scale of the photograph and the known distance between the reference points, the remaining accident site element points can be established by measuring the distances on the photograph itself and scaling the result.

Pros

- Very simple method for measuring of complex road path
- No on-site measurements beyond the reference distances

Cons

- Measurement points must be clearly visible

4.5.2.3. Equipment

Please refer to the main Scene and Road section for the Scene Measurements equipment list.

4.5.2.4. Arrangements

Please refer to the Arrangements section of the Methodology Outline Scene and Road section.

4.5.3. Scene and Road Sketch

4.5.3.1. Purpose / Aim

The purpose of completing a scene and road sketch is to show all the relevant elements necessary for an accident reconstruction in one place. The sketch should include all relevant elements to enable a detailed accident reconstruction.

The sketch should be based on photos and measurements of the scene itself. It is recommended to take initial pictures of the accident scene, before creating chalk measurement markings. A second set of pictures can then be taken after the markings have been made. The markings should include a numbering of the evidence so that accurate correlations can be made between the pictures and the measurements.

A detailed scene and road sketch should include the following:

- The road and its surroundings, including infrastructure type (e.g. intersection, straight section, etc.)
- Relevant measurements (e.g. road width, shoulder width, distances to roadside furniture, etc.)
- Road pavement markings (double line, turning arrows, etc.)
- Point of collision and final accident vehicle positioning
- Highlighted areas where accident evidence traces were found
- Accident vehicle brake and skid marks
- Road furniture, both fixed and mobile (traffic lights, signs, barriers, etc.)
- The initial driving direction of the accident vehicles
- Accident vehicle path(s)
- Position of collision objects before and after impact
- Pictures may also be included directly within the sketch

An example scene and road sketch is shown in the figure below.

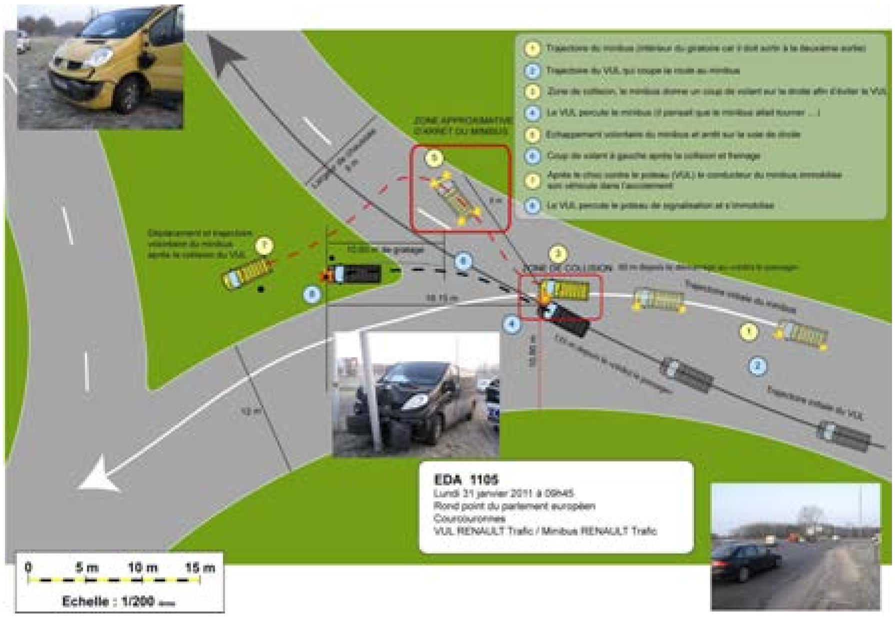

Figure 85 Scene and road sketch

4.5.3.2. Methods

The methodology for creating a scene and road sketch is divided into the following three steps:

1. Perform the accident scene measurements.
2. Create the initial draft sketch.
3. Digitalise the initial sketch to a digital scaled sketch.

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

1. Accident Scene Measurements

The Accident Scene Measurements methodology is detailed in the Scene Measurements section.

2. Initial Sketch

By following the Scene Measurements methodology, accident investigators should be able to create an initial hand drawn sketch of the accident scene, including all relevant points of interest.

An example initial sketch is shown in the figure below.

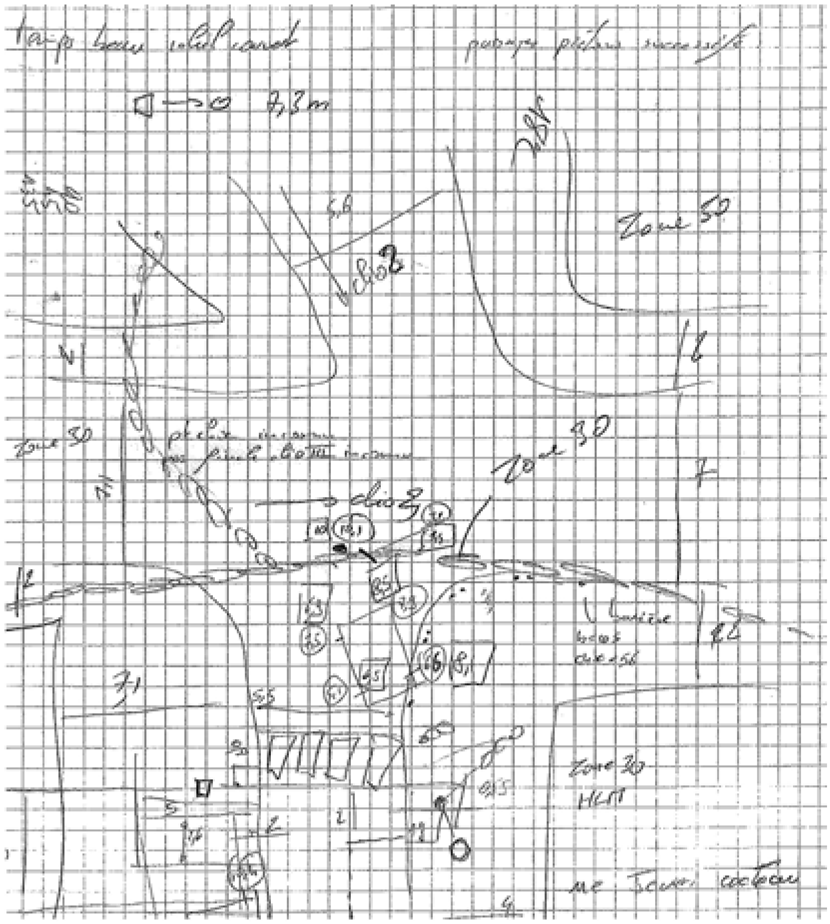

Figure 86 Initial hand drawn sketch

3. Digital Scaled Sketch

As the initial sketch may be difficult for others to understand, it is important digitalise the initial draft. Furthermore, a digital sketch can also be properly scaled. The final scaled sketch can better enable the accident reconstruction process.

An example scaled sketch (based on the above example initial sketch) is shown in the figure below.

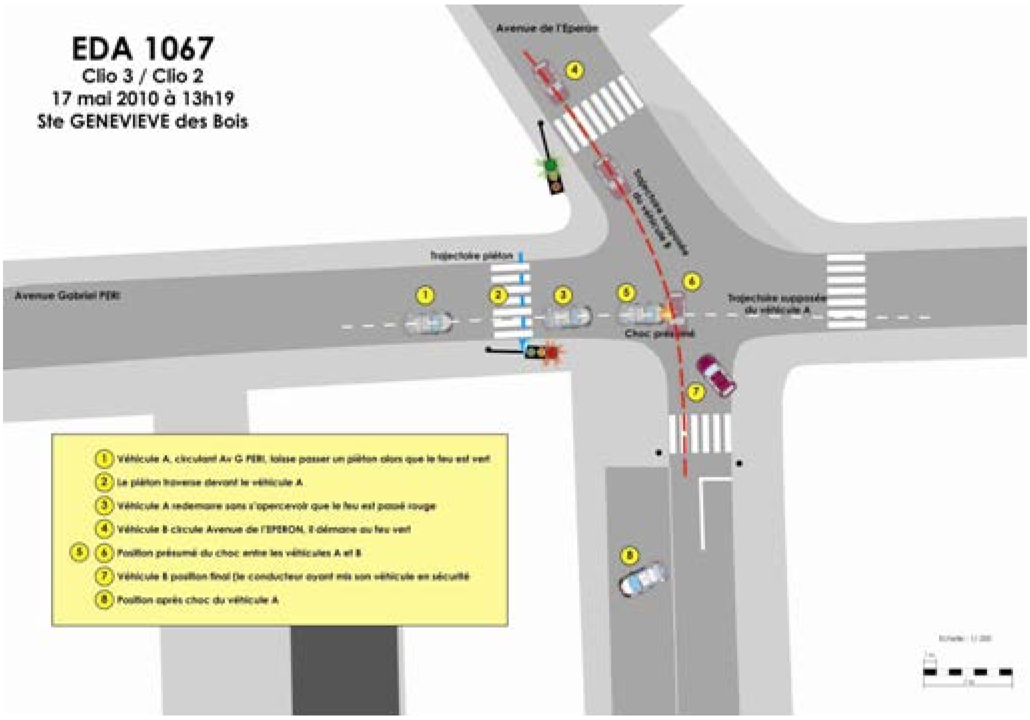

Figure 87 Scaled digital sketch

There are a number of different software packages available to facilitate the creation of a digital scaled sketch (i.e. Adobe Illustrator, PC Crash, PC Rect, etc.). A suitable software program should be selected to allow for a clear and accurate plan to be made.

For further information on PC Crash and PC Rect, please visit the following website:

http://www.pc-crash.com

4.5.3.3. Equipment

Please refer to the Equipment List for the Scene and Road Plan equipment list.

4.5.3.4. Arrangements

Please refer to the Arrangements section of the Methodology Outline Scene and Road section.

4.6. Road Area Coding

4.6.1. Introduction

The following content discusses the topic of Road Area Coding. This information provides a model and a method with reference to variables concerning the Road Area. Real-world examples are illustrating the method by showing pictures from the accident scene and how these cases are coded. Please read the section “Definitions” for specific vocabularies providing better understanding of the content.

A different way of coding the road geometry

This is one option to standardize the data/information about the Road Area collected from the accident scene. This standardized method simplifies the way of inserting the data and the interpretations of the road geometry coded. In particular, this method simplifies the interpretations of the coded information for persons not involved in collecting accident data.

4.6.2. Definitions

DB (Database) Road Direction:

Is marked in the sketch where the vehicles were situated at the start point of the accident scenario and defines the coded road section. Should be defined for all roads added to the database (A, B etc.) where vehicles involved in the accident have been travelling (see example 2). If two or more vehicles were travelling on the same road, the DB road direction should be defined by Vehicle 1 travelled direction.

Design Order:

The order of the added road component types at the road area section. In the database this number is automatically generated but can be changed by drag and drop.

Road Area:

Is the total area containing both the road way (paved area, including lanes and shoulders) and the road-sides (both the side of the road and the median area if any).

Median with Barrier:

A roadway where the traffic is physically divided with a median and a road restraint system (barrier).

4.6.3. Method

This section provides the method concerning Road Area coding. Please see the following steps below:

- The road area should be coded at the first point of impact if it is a collision on a single road. For run off road accidents the road area should be coded at the point where the first wheel leaves the road area. For accidents in intersections/crossroads each road should be coded before the intersection starts.
- Select a photograph in which you can draw a line which corresponds to where the road area should be coded (i.e. where the road measurements are taken).

- Define and trace the “DB road direction” on the Road Area picture and on the road sketch for all vehicles directions involved in the crash. If two or more vehicles travelling on the same road, the DB road direction should be defined by Vehicle 1 travelled direction.
- The design order should start at the leftmost component type of the Road Area. This component will be denoted design order 1.
- All components of the paved road area (road way) should be coded including hard shoulders, lanes and markings etc. Inactive lanes on the other side of a centre line might not have been measured and will be coded inactive. If the road area includes a median an exception can be made (see section “Exceptions” below). If the roadside(s) have been inactive (no vehicles have left the roadway i.e. paved area) it does not have to be coded.

Example 1

An accident occurred on a road area with four lanes (two in each direction) and the driving direction is separated with a single solid line (see the figure below). No vehicle was entering the roadside therefore it is inactive and not coded.

Table 1 shows the coded information from the road area.

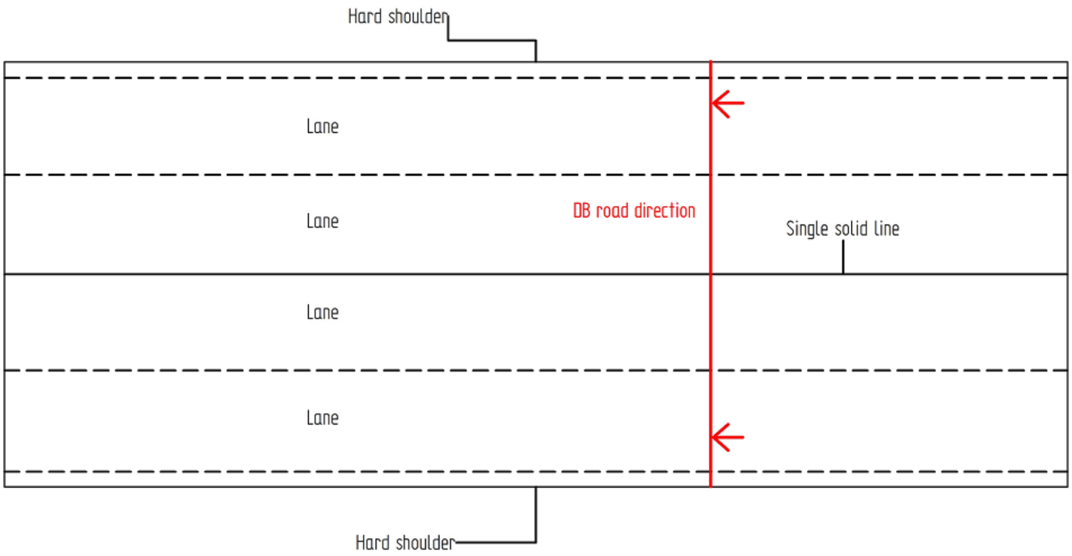

Figure 88 Road with 4 lanes

Design order	Road type	Road component sub type
1	hard shoulder	N/A
2	marking	single dashed line
3	lane inactive	N/A
4	marking	single dashed line
5	lane inactive	N/A
6	marking	single solid line

7	lane inactive	N/A
8	marking	single dashed line
9	lane active	ahead
10	marking	single dashed line
11	hard shoulder	N/A

Table 1 Design order of the coded road area

Exception

Adding information about a motorway could imply a big amount of road components. Therefore an exception should be used to simplify the implementation. If the motorway contains a “median with barrier” the opportunity arises to set this component type to design order 1. By using this operation the total amount of elements at the road section will be reduced while the correct amount of data to understand the important information of the road area still prevails.

This coding exception should be used if the road area acquires these criteria:

- The road is a motorway.
- The motorway contains a median with barrier.
- The other side of the median is totally inactive, inactive = did not contribute to or effect the start or outcome of the accident.

Accident Examples - Road Area Coding

Example 2

In the figure below an accident on a rural road with single carriageways (one lane in each direction) is shown, see Table 2 for the coding of the road area.

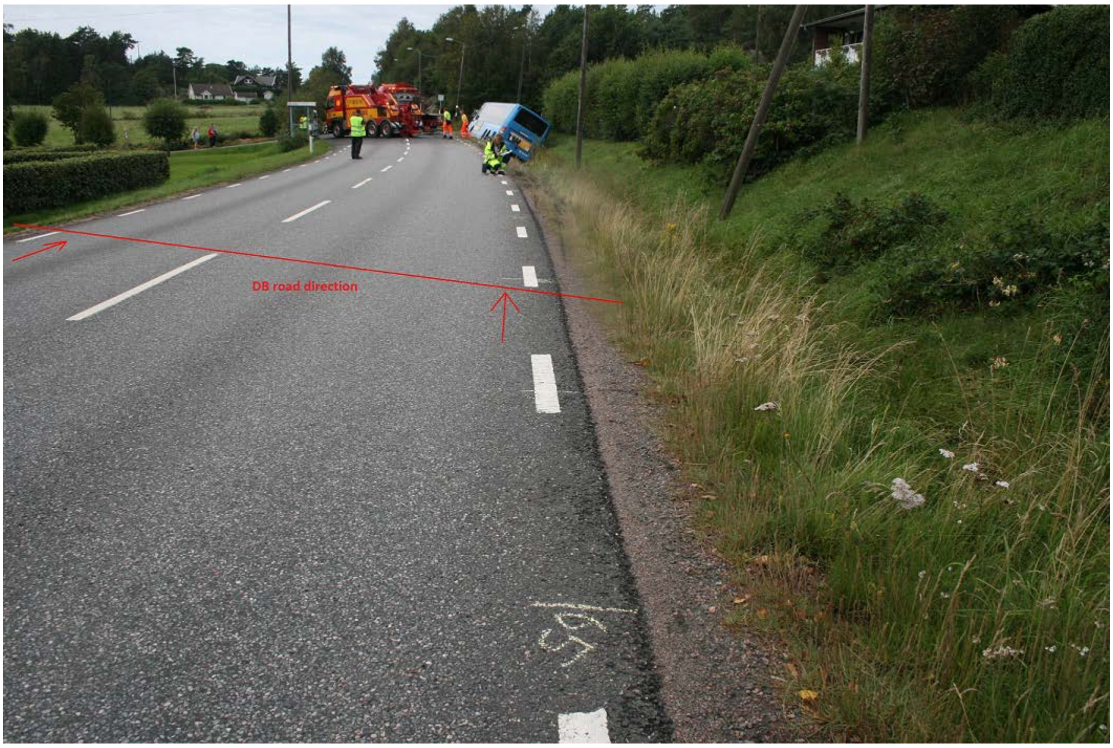

Figure 89 Defined DB road direction

Road number	Design order	Road type	Road component sub type
1	road a	hard shoulder	N/A
2	road a	marking	single dashed line
3	road a	lane inactive	N/A
4	road a	marking	single dashed line
5	road a	lane active	ahead
6	road a	marking	single dashed line
7	road a	hard shoulder	N/A
8	road a	road side active	N/A

Table 2 Design order of the coded road area

If an analyst or investigator not familiar with the road interprets the information in Table 2 the outcome is illustrated in the figure below.

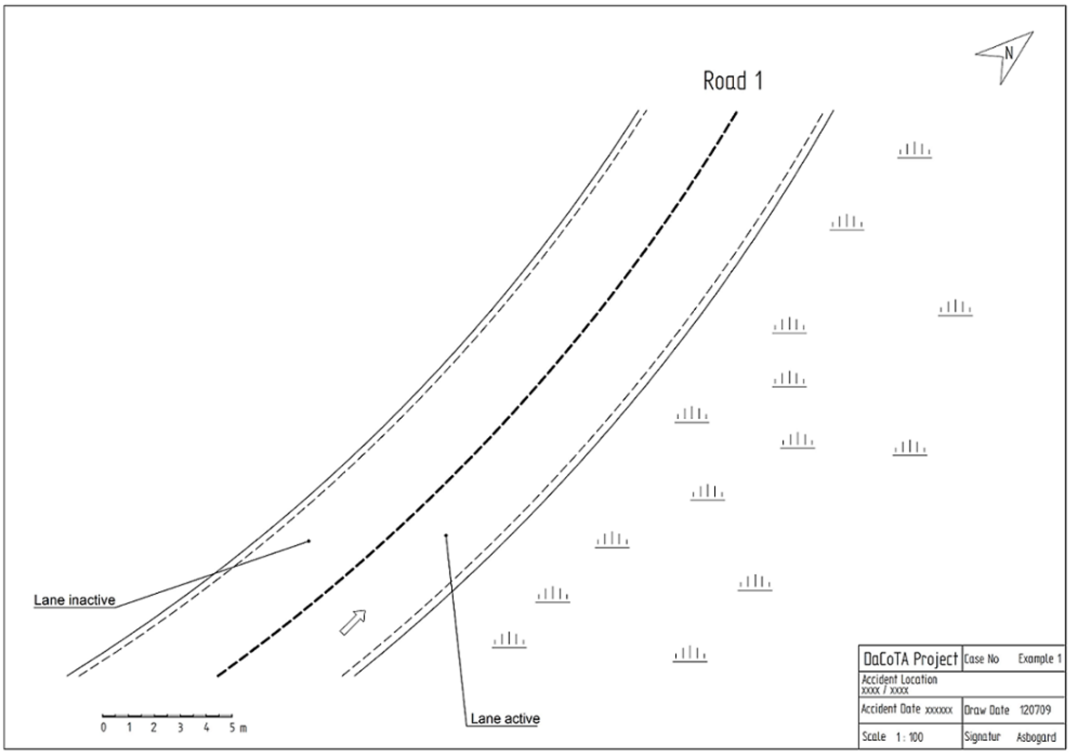

Figure 90 Interpretation of the road area

Example 3

In the figure below an accident on a city street with single carriageways (one lane in each direction) is shown, see Table 3 for the coding of the road area.

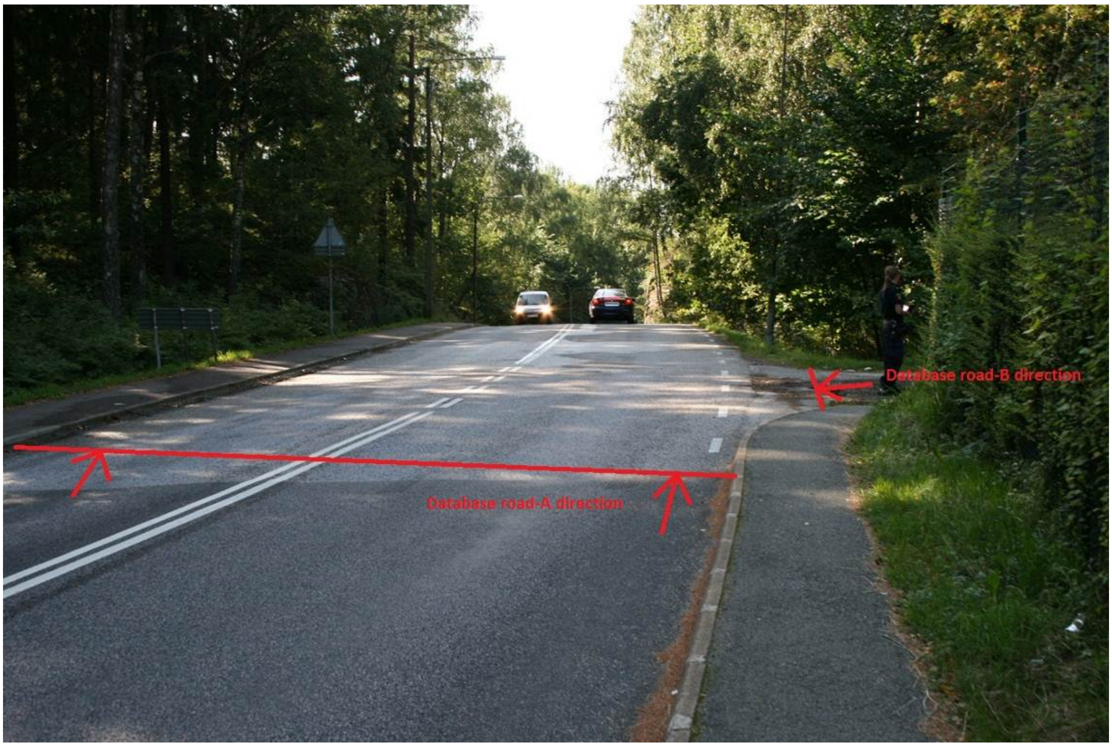

Figure 91 Defined DB road directions

Road number	Design order	Road type	Road component sub type
1	road a	hard shoulder	N/A
2	road a	lane inactive	N/A
3	road a	marking	double dashed line
4	road a	lane active	ahead + right turn
5	road a	marking	single dashed line
6	road a	hard shoulder	N/A
7	road a	hard shoulder	N/A
1	road b	lane active	all directions

Table 3 Design order of the coded road area

If an analyst or investigator not familiar with the road interprets the information in Table 3 the outcome is illustrated in the figure below.

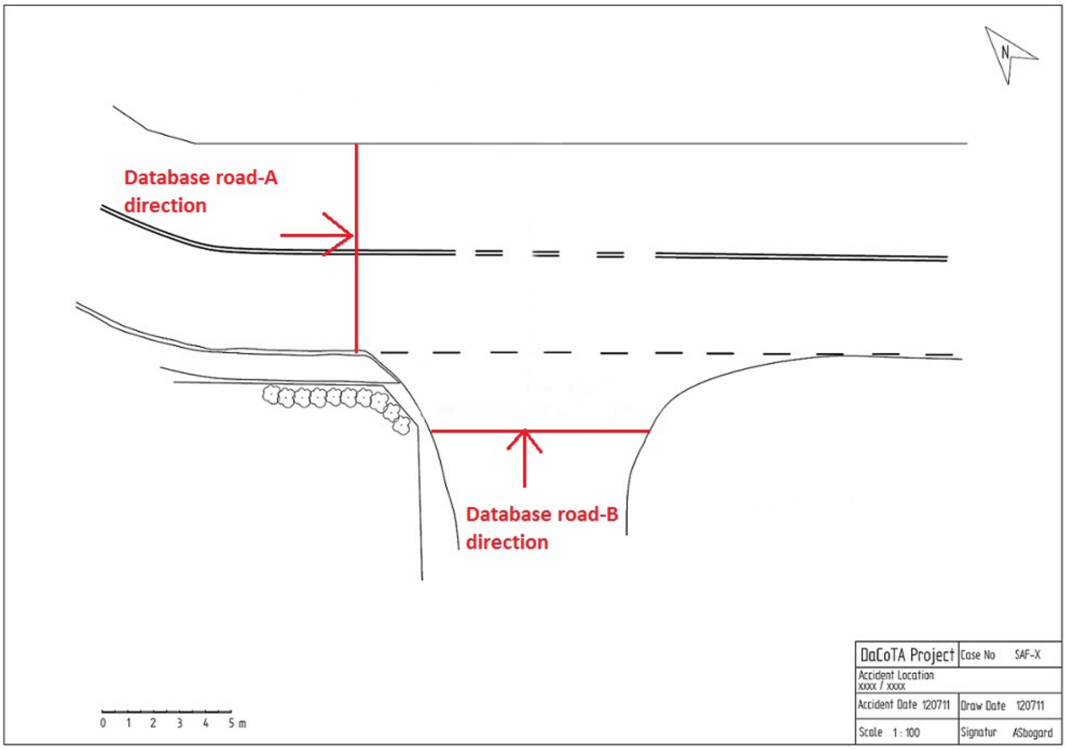

Figure 92 Interpretation of the road area

4.7. Vehicle Inspection

4.7.1. Purpose / Aim

The purpose of the vehicle inspection is to collect data that describes the vehicles involved in an accident, including general vehicle information, its condition, damage, safety equipment and occupant information, to a level that will enable a detailed case analysis and accident reconstruction. The Vehicle Inspection also includes the collection of data relevant to any child occupants such as the use of child restraint systems (please also refer to the Vulnerable Road User section). Parked vehicles without occupants are excepted and should only be considered as a collision object if they have been hit by a case vehicle.

The vehicle inspection attempts to collect vehicle related information which is needed to subsequently fully code the accident case in the database. This information includes:

- Photographs of the vehicle exterior, interior and accident traces (see: Photo Routine)
- General information about the vehicle (e.g. make, model, engine, gearbox type, cargo, etc.)
- Deformations of the vehicle due to the accident (e.g. CDC, deformation measurements, etc.)
- Exterior observations (e.g. functionality of doors, deformation of door hatches, damage to windows, etc.)
- Interior observations (e.g. intrusions, information on airbags and seat belts, seat positions, marks from passengers due to a collision)
- Vehicular Event Data Recorder information (if applicable)
- Identification of vehicular safety systems from inside and outside the vehicle (e.g. ABS, electronic stability program, lane departure warning, Alcolock system, cruise control, etc.)

4.7.2. Methods

Vehicle inspections can be conducted on scene or retrospectively. Much of the on scene data to be collected may only be available for a finite period (due to accident vehicle towing, etc.). Where possible, accident investigators should make efforts to collect any on scene data that cannot be collected retrospectively.

The Vehicle Inspection methodology is divided into On Scene and Retrospective as the methodology used to conduct these two investigations differs. Despite these differences, it is important to understand that most data required for an accident analysis can be collected on scene, depending on time constraints, obviating the requirement for a retrospective investigation.

AS MUCH ON SCENE EVIDENCE SHOULD BE COLLECTED AS POSSIBLE.

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

On Scene

The On Scene investigation is the collection of accident vehicle related evidence at the accident scene location, with a focus on the collection of evidence that is only available for a finite period.

The methodology for the On Scene investigation has been divided into the following steps:

1. Pre-Departure Preparations

After receiving an accident alarm, the investigation team should ensure they have all necessary investigation equipment (please see the Equipment List) and fulfilled all Health and Safety requirements.

2. Arrival On Scene

Once arrived on scene, the investigation team should meet the requirements of the Arrival on Scene and Scene Safety section of the Health and Safety section to ensure a safe working environment.

After meeting the above stated health and safety requirements, the investigation team should identify all those involved in the accident (i.e. all road users and accident witnesses), those involved in the rescue process (i.e. ambulance and police services) and any other relevant parties (i.e. tow truck driver). These individuals can provide the accident team with relevant information and better enable the overall accident investigation process. Furthermore, it is usually necessary to receive permission from the accident vehicle owner (and in some cases, the police) to access the interior of their vehicle.

From speaking with the relevant authorities, the investigation team should determine if and where the accident vehicle(s) will be available for a retrospective investigation, an estimate of the length of time the vehicles will be available on scene and a description of any changes made to the vehicles in the rescue and cleanup process.

3. Vehicular Photographs

Photographic evidence of the accident vehicle(s) should be recorded. The detailed methodology for this process is described in the Photo Routine section.

4. Transient Evidence

Some key vehicular evidence may only be available for a finite period and may not be available during subsequent retrospective investigations. Therefore, accident investigators should collect this data as soon as possible.

Transient evidence includes: pedestrian swipes, biological traces, vehicular fluid traces, debris, interior cargo and broken glass found within and on the vehicle.

5. Additional Evidence

All additional evidence (that which is not considered transient) can usually be collected retrospectively, therefore the detailed methodology for completing the vehicle inspection is detailed below in the Retrospective section. Although, it should be noted that ideally all evidence should be collected on scene, if time allows.

Retrospective

The retrospective investigation is the collection of accident vehicle related evidence at the accident vehicle storage location (e.g. scrap yard, garage, home of the owner, etc.), with a focus on evidence that was not collected during the on scene investigation. The vehicle investigation should preferably be completed on scene as transient evidence may still be visible, however, due to the time consuming nature of the inspection itself and the sometimes limited available time frame at the accident scene, it may be necessary to complete the vehicle inspection retrospectively. In this case, the inspection should be completed as soon as possible at the accident vehicle storage location.

The methodology for the retrospective investigation has been divided into the following steps:

1. Pre-Departure Preparations

After determining the accident vehicle storage location, the investigation team should ensure they have all necessary investigation equipment (please refer to the Equipment List) and fulfilled all Health and Safety requirements.

If not already done so, the investigation team should procure permission to enter the accident vehicle from the owner and any other relevant authority.

2. Arrival at Accident Vehicle Storage Location

Once arriving at the accident vehicle storage location, the investigation team should identify the vehicle to be inspected. This may seem trivial, but depending on the extent of damage and number of similar vehicles at the storage location, care should be taken to ensure the correct vehicle is inspected. This can be facilitated through comparison of the VIN number plate and/or chassis number on the vehicle to the vehicle registration.

After the accident vehicle to be inspected has been identified, it may be necessary for the investigation team to receive assistance (from the wrecker or tow truck operator) to move the vehicle to a place that will allow adequate area around the vehicle to facilitate the inspection.

For safety reasons, the investigators should also ensure that the vehicles battery is unplugged and any airbag systems are deactivated.

3. Vehicular Photographs

If not collected during the on scene investigation, photographic evidence of the accident vehicle(s) should be recorded. The detailed methodology for this process is described in the Photo Routine section.

4. General Vehicle Information

General information about the accident vehicle should be collected by the investigation team during the vehicle inspection. This includes information regarding the vehicles:

- Make / Model
- Fuel and Powertrain
- Geometry and Weight
- Cargo
- Modifications

The majority of this information should be determinable from the vehicle’s registration certificate, visual inspection of the vehicle and through interview with the vehicle owner.

5. Deformations

Vehicular deformations resulting from the accident are measured and recorded by the investigation team during the vehicle inspection in order to determine the extent of damages and to categorize the deformations. A systematic approach is applied to record the deformations, which should allow investigators a more accurate correlation between impacts and road user injuries in their analysis.

6. Exterior Observations

Exterior observations should be recorded by the investigation team during the vehicle inspection. These observations include:

- Evidence of fire damage
- Fuel system and battery damage
- Observed fluid leakage
- Condition of doors, windows and glazing
- Description and condition of wheels and tyres
- Trailer information (if applicable)

The majority of this information should be determinable from visual inspection of the vehicle and through interview with the vehicle owner.

7. Interior Observations

Interior observations should be recorded by the investigation team during the vehicle inspection. These observations include:

- Condition of interior vehicular components (e.g. steering wheel, dash panel, footwell, etc.)
- Belt and seat description
- Airbag system description
- General interior observations (e.g. impact marks)

The majority of this information should be determinable from visual inspection of the vehicle, vehicle manufacturer information and through interview with the vehicle owner.

8. Event Data Recorder

Vehicles equipped with Event Data Recorders may offer investigators additional information about the accident that may aid in the overall analysis.

9. Safety Systems

A description of the accident vehicles safety system should be recorded by the investigation team during the vehicle inspection. Aspects of the system that should be noted include:

- Support and warning systems (e.g. cruise control, lane departure warning, GPS, etc.)
- Brake and handling system description
- Visibility system (e.g. xenon lights, night vision, etc.)

The majority of this information should be determinable from visual inspection of the vehicle, vehicle manufacturer information and through interview with the vehicle owner.

Powered Two Wheelers

Special consideration is required when investigating accidents involving Powered Two Wheelers (PTW) as there are differences between a PTW and a standard vehicle (i.e. car) inspection. For this reason, this section is devoted specifically to the particularities of PTW inspections.

A PTW inspection should be carried out in the same format and methodology as described above for a standard vehicle inspection with the following particularities:

Photo Routine

The photo routine will differ from the standard vehicle inspection in that there will be no interior photos in the case of PTW investigation. Particulars of the PTW photo routine can be found in the Powered Two Wheeler section of the Photo Routine.

Deformations

Special consideration should be given to any deformations and/or marks as they can reveal much in regards to the kinematics and overall understanding of the accident event.

Braking System

PTW braking systems differ significantly from car systems and require special consideration. Some PTW are equipped with ABS brakes and should be verified by the owner or by consulting manufacturer specifications. Visual inspection of the brakes (both front and rear) should be performed, followed by capturing relevant photographic evidence.

Inspection of the brake controls should also be made. Most PTW have separate left and right handlebar brake controls, controlling the front and rear brakes. In some PTW's, the rear brake is controlled by the right foot.

Tyre Thread Depth

PTW tyres require significant thread depth and curvature to maximise road area contact while leaning through a curve. The depth of the tread should be well noted during the inspection.

Trucks

Special consideration is required when investigating accidents involving trucks (Heavy Vehicles) as there are differences between a truck and a standard vehicle (i.e. car) inspection. For this reason, this section is devoted specifically to the particularities of truck inspections.

A truck inspection should be carried out in the same format and methodology as described above for a standard vehicle inspection with the following particularities:

Truck Type

There are various types of truck trailers and body types in use. It is useful for the investigator to determine the type in use.

Please see the below figure for some common truck types.

Figure 93 Common Heavy Vehicle trailer types

Figure 94 Common Heavy Vehicle cab types

Load Type

Trucks that contain loads that may be considered hazardous (e.g. flammable, explosive, etc.) should display their load type on the exterior of the vehicle.

Signs displaying the hazardous material type should state the type of hazard that the truck contains. The hazardous material type should be recorded for each truck investigated.

Sample load hazard types are shown in the figure below.

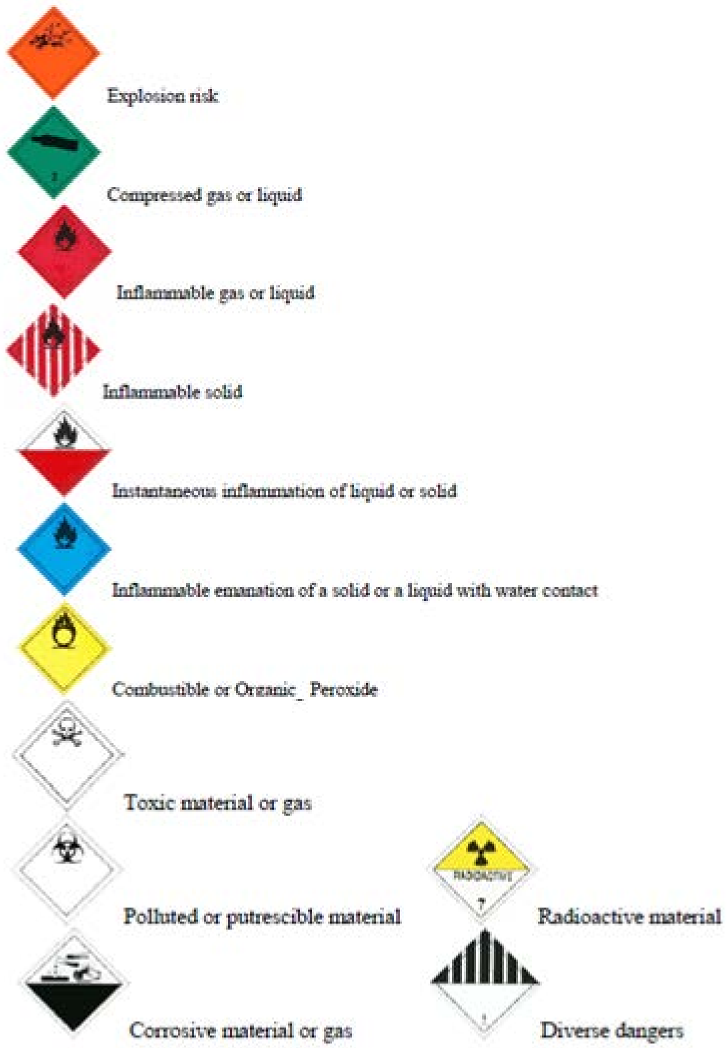

Figure 95 Heavy Vehicle hazardous load signs

Vehicle Specifications

Certain truck specifications are usually stated on a plate on the side of the vehicle. This plate can contain information regarding the empty weight, length, width and surface area of the vehicle. This evidence is useful to the investigator and should be recorded. Furthermore, if the load is still present, it may be determinable if the vehicle was overloaded in the accident.

A sample specifications plate is shown in the figure below.

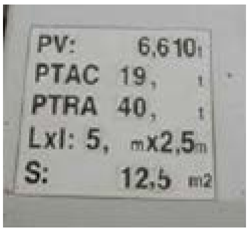

Figure 96 Specifications plate (values from top to bottom: vehicle weight with no load, gross vehicle weight rating, authorised gross vehicle weight, length and width measurements (respectively), surface area)

Tachograph System

Some trucks are equipped with a tachograph system. A tachograph system states the number of working and resting hours for the truck. Tachograph systems are predominantly either digital or analogue. In the case of an analogue system, a photograph of the display reading should suffice as an adequate record. In the case of a digital system, card access may be required.

Sample tachograph system output is shown below.

06.01.2006 15:05 (UTC)
24h
F /30000000011800 0 0
25.11.2009
Mr Conducteur 2574 TES
Prénom
F /10000000025740 0 0
12.05.2010
VF15497845FBJN197
F / 258 BCF 75
SiemensVDO Automotive
AG
1381.1070100007
Atelier 2207 TEST
F /20000000022070 0 0
21.10.2005
F /30000000011800 0 0
05.01.2006 09:45
05.01.2006 3
F / 258 BCF 75
1 075 km
00:00 07:12 07h12
07:12 09:45 02h33
09:45 09:53 00h08
09:53 12:57 03h04
12:57 15:00 02h03
15:00 15:30 00h30
15:30 16:16 00h46
16:16 23:11 06h55
23:11 00:00 00h49
1 946 km; 871 km
13h02 871 km
00h54 00h00
10h04 ? 00h00
00h00
>> 4 03.01.2006 15:18
(3) 00h00
F /10000000025740 0 0
>> 4 03.01.2006 10:08
(2) 00h00
F /10000000025740 0 0
>> 4 03.01.2006 09:41
(1) 00h21
F /10000000025740 0 0
1 03.01.2006 09:22
(1) 00h00
1 03.01.2006 09:20
(1) 00h00

Figure 97 Tachograph readings

Buses

Special consideration is required when investigating accidents involving buses as there are differences between a bus and a standard vehicle (i.e. car) inspection. For this reason, this section is devoted specifically to the particularities of bus inspections.

A bus inspection should be carried out in the same format and methodology as described above for a standard vehicle inspection with the following particularities:

Bus Type

There are various types of buses in use and the type of bus involved in the accident should be determined and recorded.

Occupant Allowance

Buses are somewhat unique to other vehicle types in that they allow for standing occupants. In addition to the number of seat placements within the bus, the number of permitted standing occupants should be determined and recorded.

4.7.3. Equipment

Please refer to the Equipment List for the Vehicle Inspection equipment list.

4.7.4. Arrangements

Please refer to the Arrangements section of the Methodology Outline Vehicle Inspection section.

4.8. Vulnerable Road User

4.8.1. Purpose/Aim

The purpose of the Vulnerable Road User section is to collect data that describes all Vulnerable Road Users (VRU) (pedestrians, motorcyclists, pedal-cyclists) involved in the accident, including their role in the accident causation, sources of injury, whether they were equipped with protective clothing, a record of any contact marks and other related scene evidence.

4.8.2. Methods

- General vehicle examination for motorcycles (Powered Two Wheelers) and pedal-cycles.
- Identification of vehicle safety features (ABS, Traction Control, Adaptive lights).
- Examine if tyres or rims (and other vehicle parts) were damaged due to the accident, checking for scrape marks and cracks.
- Check if the upper protective system integrates an airbag or neck protection

Experienced Teams may do the following in addition:

- Examination of the PTW for motor power enhancement
- Inspect the fuel management system for enhancement
- Evaluation of the effectiveness of systems such as brakes and suspension.

On-scene

- In addition to scene/road examinations (item 5), examine and record approach paths for PTWs, pedestrians and bicyclists, and take measurement, such as throw distances and skid marks at scene.
- Look for evidence of locked wheels on tyres
- Exterior contact marks from VRU's on opponent vehicle.
- Look for helmet damage caused in the accident.
- Examination of helmets, body armour and protective clothing.
- Examine if helmets and visors were certified for PTW use.

Developing Teams and Experienced Teams may do the following also:

- In addition to injury coding described in medical data, identify the body regions that contacted the other vehicle or object on the road.

Experienced Teams may also do the following:

- Examine the protective equipment (helmets and clothing) to assess impact performance
- Examine if the Personal Protective equipment was fitted correctly and worn in the correct place

4.8.3. Equipment

Please refer to the Vulnerable Road User section of the Equipment List for the Vulnerable Road User equipment list.

4.8.4. Arrangements

At least one team member trained in collecting VRU specific variables.

Experienced Teams may also have a PTW specialist on the team.

4.9. Behavioural Data

4.9.1. Purpose/Aim

To collect data (mainly from interviews/questionnaires) to understand and describes road user behaviour and relevant background information in support of the overall accident analysis.

4.9.2. Methods

Interviews are the main method for collecting road user behavioural data but all data collection can give information valuable for evaluating road user behaviour. Interview material should be stored locally and as complete as possible for later re-analysis by the team, if local laws and guidelines allow. Database entries to be made fully anonymous, without any personal names, addresses or vehicle registration numbers included.

On-scene

- On-scene contact and if possible ask questions concerning the course of events and possible causes of the accident.
- Full interview according to a semi structured form to be conducted as soon as possible, on-scene, at hospital, or retrospectively by phone/face to face.

On-scene and retrospective

Interviews should be conducted as soon as possible after the accident and if possible face to face. As it is not always possible to conduct an interview on-scene, the methods recommended here are to be tried in following order:

1. On-scene interview
2. Interview at hospital
3. Retrospective interview face to face or by phone
4. Postal questionnaire

4.9.3. Equipment

Please refer to the Behavioural Data section of the Equipment List for the Behavioural Data equipment list.

4.9.4. Arrangements

- Check national legislation and guidelines for possibility to process potentially sensitive personal findings as anonymised data.
- Ethical approval if necessary.
- Consent forms to perform interview if needed.
- Investigators trained in conducting interviews.

4.9.5. Interview Guidelines

4.9.5.1. Purpose / Aim

The act of interviewing road users regarding a road traffic accident is an involved task due to the emotional significance, legal context and the practical conditions. There is therefore a requirement to adapt the interview method accordingly. The purpose of the Interview Guidelines section is to describe the difficulties likely to be encountered in the application of the semi-directive interview method as well as some of the techniques which are advisable to implement to mitigate these difficulties.

4.9.5.2. Methods

In-depth accident studies rely upon a detailed approach designed at gaining as much information about the event as possible (clinical type approach). The collection of data is inevitably interdisciplinary and thus a number of investigators are active concurrently. These investigators are specialist in (among others) the dynamics of vehicles, kinematics, mechanics, biomechanics, infrastructure and psychology.

The consideration of the "human factor" (road users) in its interaction with the other components of the Vehicle-Human-Environment system implies a psychological dimension. The ideal is to rely on the expertise of specialists in the study of human operator behaviour when engaged in the driving task (ergonomics, cognitive psychology) for the collection of human data and the analysis of their influence in the accident mechanisms. In any case, the interviewer having an understanding of the human processes at play in driving and in accidents is highly desirable.

The following sections summarise the difficulties likely to be met in the course of the interview in the particular context of the accident, and provides some techniques which can be implemented to mitigate these difficulties: which attitude to adopt with the interviewees, how to establish a good interview relationship, how to engage the person in the interview, which questioning techniques to use, which adaptive procedures are effective, how to manage interventions from other people (in the case where others are present e.g. at the accident scene).

The Interview Guideline Methodology also attempts to detail how to utilise information gained through exchanges with the investigator and the importance of relating with the people involved (i.e. rescue services, police, etc.).

1. Timing

In regards to the determining when to conduct the interview, the ideal situation would be to conduct the interview as soon as possible, in consideration of the availability of the people involved. This is done so that the interviewee delivers the most spontaneous information, before mental reconstruction or mediation takes place as a result of discussion with others.

An efficient way of proceeding relies upon a data collection procedure divided into two stages:

1. An initial interview: a relatively brief (considering the circumstances) on-scene interview at the accident scene (or in the emergency rooms of the hospital).

2. A follow-up interview: a complementary data collection interview within 48 hours of the accident. The investigators should direct their questions based on their initial understanding of the accident, resulting from the initial interview and an examination of the first data collected by the interdisciplinary team.

The collection of immediate recollections improves the chances of receiving genuine and more accurate statements from interviewees, without interference resulting from the interviewee talking with others about the accident or mental reconstruction self-reflection regarding the events. In the absence of these conditions, it is necessary to be aware of the biases which can affect the testimony.

2. Preparation

The interviewer has to approach the interviewees without any preconceptions to avoid the risk of biasing the interview by questioning directed subjectively. But not having preconceptions does not mean being ignorant of any available information. It is necessary to prepare for the interview by becoming familiar with the material circumstances of the accident.

It is useful to know beforehand: the number of vehicles involved, the overall configuration of the crash, available evidence, etc. In this respect, to have observed beforehand the site of the accident constitutes a main requirement for an effective interview and an understanding of the facts described by the road users. This preparation can develop from dialogue with other investigators involved in the case analysis. This preliminary information does not have to result in conclusions, but to assist investigators in determining appropriate questions to ask.

More generally speaking, investigators must have an understanding of the different topics they are required to cover during the interview. The use of an interview guide is useful during the interview to verify the points which have not been developed yet. But this guide should not be followed too rigidly: a good interview occurs when the different questions come about naturally, as would happen in normal conversation.

Indeed, the reactions of the interviewee in these particular conditions can be very diverse and the interviewers should account for these differences and adapt accordingly, in respect for those involved, the ethical rules, and in the objective to collect the best information necessary for the understanding of the accident. The technique of the "semi-directive" interview must, according to the particular situation, be revised either:

- "Downward": to reduce the rigidity of the interview and allow the interviewee to express themselves freely on a subject which affects them, even if it does not interest directly the analysis of the accident (e.g. when the person is manifesting a very strong emotion)

or

- "Upward": encouraging the interviewee to clarify any discrepancies or suspected misappropriated statements to ensure their claims are reliable and accurate, even if it means pushing the person in a more directive way (e.g. when this person is obviously insincere or resistant).

3. Interview Commencement

To achieve an efficient interview, the investigator needs not only the agreement of the interviewee, but even more so the investigator needs to instil a sense of support in the interviewee for the project and its aim to investigate all the facts of the accident. The interviewer should emphasize the importance of the results of the overall project in improving road safety. The quality of the introduction influences the quality of the following interview, so it is advisable to take the necessary time to do the following:

- Introduce oneself by name and role, do not hesitate to give your name
- Briefly introduce the DaCoTA project and its purpose
- Present the frame and the purpose of the work. Keep explanations concise and factually based (i.e. "We analyse vehicular accidents to understand how and why they happen, to hopefully determine how to reduce the number and severity of future accidents. Your witness account of the accident event is vital to our research").

- Reassure the interviewee by stating the ethical guarantees of discretion and non-disclosure of the contents of the interview (independence with regard to investigations of police or justice, anonymity in the use of the results).
- If necessary, involve the interviewee in this work, by assigning them the role of an irreplaceable witness (i.e. "How did this accident occur? I need you to explain to me what happened to understand the events that led to the accident. Your witness account is one of the most vital components to our understanding of the accident". Remind him/her that this study can allow the prevention of other accidents.
- Outline the protocol for the interview. "I would like to begin by listening to your account of the accident in as much detail as possible". Then proceed with the interview: "Is that OK? Do you understand? We will start now... ".

4. Questioning

The investigation should cover the follow topics:

a. The preliminary driving situation, momentarily prior to the accident event (speed of approach, intentions, expectations).
b. The nature and the conditions of the problem encountered (manoeuvres made by themselves and of others).
c. The emergency situation (protective manoeuvres).
d. The collision event itself.

For each of these phases, the interviewer must gather information on the nature of the perceived elements, the interpretations, the decisions and the operations made. In order of importance, the first key question is "How?", the second is "Why?" (i.e. "What did you do?", and "Why that way?").

As a general rule, a novice investigator may be satisfied with general answers, and believes to have understood everything at the very moment when numerous details or answers remain ambiguous or unanswered (i.e. a person who says " I did not see him arriving" can really mean, "I did not see that he arrived so fast").

We recommend three distinct phases in the interview: a first phase (Open Phase) of listening centred on the progress of the accident, a second phase (Deepening Phase) of gaining a deeper understanding and questioning on this progress and a third phase (Filling-in Phase) centred on the contents of the information check list.

1. Open Phase

It is better to begin with the progress of the accident as it may be what the interviewee expects. In the first stage, the principle is to let the interviewee speak as freely as possible, for as long as they choose to speak (as long as they remain on subject).

The Open Phase is initialized by an open question, such as "Can you tell me how that took place?". The purpose of the Open Phase is to collect an overall view of the accident, while retaining as much detail as possible.

It is the interviewee who knows what took place and it is the task of the investigator to listen to them. If the interview begins with closed questions, the interviewer risks disengaging the interviewee, putting him in a situation of unpleasant interrogation, into a passive position of waiting for the following question, thereby running the risk of discouraging the information source.

Also, the investigator will avoid premature interruptions as the risk is too great of preventing the interviewee from delivering relevant information that may not have been revealed otherwise. In this stage, it is recommended to allow freedom of expression on behalf of the interviewee. This allows the interviewee to become comfortable with the interviewer and to feel confident in giving their response.

Deepening Phase

The second stage consists of an exploration of the information gathered during the Open Phase, hopefully leading to a deeper understanding of the accident. The Deepening Phase should concentrate on specific details, to investigate the "blanks", the ambiguities and the contradictions. This stage is more directive, the questioning is therefore more methodical. The investigator uses what he knows already to gain further knowledge. Once again, a good knowledge of the accident facts will help at this stage.

Filling-in Phase

The final stage, the Filling-in Phase constitutes a change in the content of the interview which may reveal new information. It is good to make a transition. It is suggested that this transition is introduced, i.e., "I would now like to ask questions which concern you more personally, as we try to understand if there are other background factors that alter the risk of having an accident. For example, I would like you to tell me about your experience of driving, how long have you driven, on which roads, your annual mileage...", etc. With such an introduction, the interviewee finds it normal to answer questions of this nature.

It is recommended that the investigator continues to conduct the interview in the manner of conversation which it had until then. The use of a check list as a questionnaire at this stage may detract from the interview by asking questions mechanically, one after the other. As mentioned earlier, the check list is only a list of themes to be investigated. It is best for the investigator to have them in mind and possibly consult it as a reminder, to verify that nothing was forgotten.

Throughout the interview, it is important to be reminded that the information collected will eventually be coded into the DaCoTA database: the investigator must have studied carefully this coding, to verify that the answers will allow it to be easily entered into the database.

5. Additional Considerations

Speech

It is sensible for the investigator to adopt a level of language similar to that of the interviewee for a better understanding and to adapt his speech to the capacity and the personality observed. This process has the advantage of motivating the verbal productions of the interviewee by relating to them.

Giving to the interview the feeling of a conversation allows it to pass from one theme to another naturally by the association of ideas. Although the order of the themes may not reflect that of a formalised check list, being well linked in the conversation may foster a more natural environment to encapsulate the details from an interviewee as long as all the themes are covered.

Professionalism

The investigator may be regularly confronted with uncomfortable feelings depending on the nature of the accident. Meeting with interviewees who are in distress after recently being involved in a traffic accident, it is sometimes difficult to assume a professional investigation approach. Therefore, investigators must conduct themselves professionally, in such a way that they can overcome any anxiety or nervousness. It is essential to remember that the primary motive of the investigation and the investigator is to collect relevant data to better understand the accident.

Testimony Reliability

The verbal testimony of the road user involved in the accident is essential for the reconstruction of events and analysis of the accident. It is therefore advisable to be aware of the various biases which can be found in the statements of involved road users. The analysis of these statements thus requires a certain caution, as inaccuracies and distortions (deliberate or not) can occur at various levels. Some sources and examples of bias to be considered are detailed as follows:

- The Forgery: the road user deliberately gives a version of the facts which releases him from the responsibility. It is here that the ability of the investigator to acquire the trust of the interviewee about the confidentiality of the data which is collected is important.
- The Justification: the road user tries to prove, to others and themselves, that their behaviour obeyed a certain logic, coherent with the capacities of a "good driver", protecting implicitly their actions. They can sometimes persuade themselves that what was envisaged beforehand as a hypothesis is fact.
- The Rational Reconstruction: the user reconstructs the chain of his actions from the elements which he memorized, but he involuntarily fills in the gaps by resorting to his mental representation of his task and his usual ways of functioning.
- The Bias of Analysis: the gap between the declarations and the facts can also be revealing mechanisms of errors with which were confronted by the persons. Such inaccuracies are of interest from the point of view of the understanding the difficulties really met by the interviewee in situations, in regards to their perception and interpretation of the process.

Certain inaccuracies are thus voluntary and many others unconscious. The experience of the investigators is paramount in the ability to disentangle these various biases in the speech and to allow them to grant more or less credit to the narrative of the road users.

4.9.5.3. Equipment

Please refer to the main Equipment List for the Interview Guidelines equipment list.

4.9.5.4. Arrangements

Please refer to the Arrangement section of the Methodology Outline Behavioural Data section.

4.9.6. Draft Telephone Interview Script

A first draft Telephone Interview Script was developed and this can be found in the Forms and Documents section of the on-line manual. Telephone interviews were outside the scope of the pilot study and it was not therefore possible to fully validate the script which is however included in the on-line manual in draft form for reference. Future testing and any future developments are recommended to be carried out in any on-going work.

4.10. Medical Data

4.10.1.1. Purpose/Aim

To collect and code injury data (according to the Abbreviated Injury Scale) and perform injury mechanism analysis – to classify accidents by medical injury severity and allow analysis on the potential for injury reduction.

4.10.1.2. Methods

Database entries to be made fully anonymous, without any personal names, addresses or vehicle registration numbers included.

- Note Police recorded injury severity for each person involved.
- Attempt, with permission, to collect medical records from hospitals or other appropriate sources (e.g. pathologist or doctors) and describe the injuries.
- To follow all necessary ethical and data protection procedures both in the acquisition, processing and storage of any information on both paper and electronic media.

Developing and Experienced Teams should in addition to the above:

- Code injuries according to AIS 2005 (update 2008) manual by trained medical personal.
- Carry out a case by case analysis of the possible mechanisms or causes of injuries.

4.10.1.3. Equipment

Please refer to the Medical Data section of the Equipment List for the Medical Data equipment list.

4.10.1.4. Arrangements

- Ethical approval if necessary.
- Consent forms to obtain medical records including routines on how to send and receive these forms.
- Agreement with local hospitals to access medical records.
- Please note: the DaCoTA training programme will cover the collection and basic description of injuries, but will not be able to provide authorised AIS training. Additionally, it is recommended that at least one investigator from each team should receive official AIS training and acquire the necessary manual.
- A list of authorized training organisations can be provided upon request.

Experienced Teams should have in addition to the above:

- Fully trained and experienced medical personnel for AIS coding and analysis of the causes of injuries.

4.10.2. Coding Injuries

4.10.2.1. Purpose/Aim

The purpose of Coding Injuries is to collect and code injury data (according to the Abbreviated Injury Scale) and perform injury mechanism analysis – to classify accidents by medical injury severity and allow analysis on the potential for injury reduction.

4.10.2.2. Methods

When coding injuries, it is important to note Police recorded injury severity for each road user involved. Each investigation team should be familiar with the methodology used by the Police to assign the severity to the victims (i.e. if the report is limited to a statement that the road user taken to hospital or if the reporting is more detailed).

Furthermore, accident investigators should attempt, with permission, to collect medical records from hospitals or other appropriate sources (e.g. pathologist or doctors) and describe the injuries. Investigators should follow all necessary ethical and data protection procedures in the acquisition, processing and storage of any information on paper and electronic data.

The injuries should be coded according to the Abbreviated Injury Scale (AIS) 2005 (update 2008) manual by trained personnel. It should be noted that certified training can be provided only by the Association for the Advancement of Automotive Medicine (AAAM) directly. Once coded, investigators should complete a case by case analysis of the possible mechanisms or causes of injuries. Database entries are to be made fully anonymous, without any personal names, addresses or vehicle registration numbers included.

4.10.2.3. Equipment

Please refer to the Medical Data section of the main Equipment List for the Coding Injuries equipment list.

4.10.2.4. Arrangements

Ethical approval may be required in some circumstances.

Consent forms to obtain medical records including routines on how to send and receive these forms should be prepared.

Agreement with local hospitals to access medical records should also be obtained.

Please note: the DaCoTA training programme will cover the collection and basic description of injuries, but will not be able to provide authorised AIS training. Additionally, it is recommended that at least one investigator from each team receive official AIS training. The only authorized training organisation is the AAAM, although there are outside AAAM consultants that offer AIS training.

4.10.3. Injury Causation

4.10.3.1. Purpose/Aim

The purpose of the Injury Causation section is to determine the injury-causing part and external injury mechanism that might have caused the injuries sustained by occupants and pedestrians involved in a crash. This includes:

- To collect data about physical evidence originated by occupants and pedestrians impacts (e.g. impact marks, deformation, residual blood). Also refer to the vehicle inspection section.
- To collect data about injuries and determine the internal injury mechanism (e.g. acceleration, compression, torsion). Also refer to the injury coding section.
- To analyse and link the information about physical evidence and injuries.

4.10.3.2. Methods

The determination of injury causation essentially builds around the information collected during the stages of vehicle inspection and injury coding. It is therefore important for teams to act according to a global view. Some points that might be important during the inspection of vehicles for determining injury causation are the following:

- In crashes involving vulnerable road users, marks and deformations on the exterior of vehicles (e.g. pedestrian impact marks on the hood).
- Evidence for determining the trajectory of occupants during ejection.
- Evidence of intrusion.
- Evidence about the deployment of restraint systems.
- Marks and deformations on interior parts, such as dash panel, seats.

Finding key information can sometimes be difficult and require a considerable degree of expertise (for example, evidence behind seat covers). All of the relevant data should be recorded and collected according to the protocols defined in the vehicle inspection section (photographs, markings, measurements). Refer to the corresponding section.

The final result of the analysis should be the connection of the injuries identified during the phase of injury coding and analysis with the corresponding causation parts.

4.10.3.3. Equipment

Please refer to the Medical Data section of the main Equipment List for the Injury Causation equipment list.

4.10.3.4. Arrangements

Please refer to the Medical Data section Arrangements for the Injury Causation arrangements.

4.11. Accident Causation

4.11.1. Purpose/Aim

The purpose of the Accident Causation is to use the DREAM methodology to analyse and code the cause of each accident in a uniform and comparable way.

4.11.2. Methods

When all relevant pre-crash information is collected the DREAM method is used for categorising contributing factors.

- Reconstructions can validate the result.
- One DREAM analysis is completed for each road user such as driver, powered two wheeler rider (driver), pedal-cyclist and/or pedestrian (not passengers) regardless of blame.
- Enter the DREAM codes in the database system.

DREAM

The Driving Reliability and Error Analysis Method (DREAM) was first developed by Ljung and later developed in the EC SafetyNet project to make it possible to systematically classify and store accident causation information which has been gathered through in-depth investigations by providing a structured way of sorting the causes behind the accident into a set of formally defined categories of contributing factors. The methodology has since been further developed, including updates for use in the DaCoTA project.

For further information on DREAM please visit the website:

http://www.dreamwiki.eu

4.11.3. Equipment

Please refer to the Accident Causation section of the Equipment List for the Accident Causation equipment list.

4.11.4. Arrangements

Training and support from the DaCoTA partnership.

4.12. Accident Reconstruction

4.12.1. Purpose / Aim

The purpose of the accident reconstruction is to allow investigators a better overall understanding of the accident event. An accident reconstruction involves investigation and analysis of an accident and the eventual drawing of conclusions that may provide investigators insight into contributory accident causation factors and resulting collision analysis.

The resulting data and analysis from an accident reconstruction can be used to improve the overall safety for vehicles, road infrastructure and road users.

4.12.2. Methods

Accident reconstructions are instrumental in conducting an accident analysis. Furthermore, they also require specialist knowledge which all teams may not have access to. Therefore, to ensure that all accidents can be reconstructed (possibly by another team or an analyst using the data) it is important that all teams collect the required data to perform reconstructions accurately. Much of the data collected is merely useful when performing reconstructions, whereas other data is crucial and must be collected whenever possible, with high quality. Such vital information includes:

- A scaled sketch containing all relevant data
- Pictures of road layout, road user paths, traces, collision objects and vehicle deformations
- Information from the road users of their account of the accident
- A sequence of events according to the investigators
- Deformation measurements of the vehicles

Developing and Experienced Teams

As the investigation teams gain more experience, they will be able to find and interpret information useful for the reconstruction more efficiently. Examples of data that the teams should try to collect in addition to what is mentioned for all teams are:

- Roll over direction and number of rolls based on impact marks
- Braking or no braking based on deformations
- Basic speed assessment by the use of simple equations
- Delta V based on energy based reconstructions

Experienced teams

The experienced teams should not only be able to collect and interpret all the information but use it for full reconstructions using specialized software. In cases were not all data could be collected the investigator will have to determine if the missing data can be replaced with estimates or if it is not possible to do a reconstruction. Based on the result of the reconstruction other collected data should be reviewed and discussed if not in line with the reconstruction.

Theory of reconstructions

An accident reconstruction is based on three laws of physics, which have to be used by the investigator in order to define parameters, such as initial speeds and post crash speeds. These laws can be used separately (if only one variable is unknown) or combined (if more variables are unknown).

Newton's First Law of Motion

Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.

Newton's Second Law of Motion

The relationship between an object's mass 'm', its acceleration 'a', and the applied force 'F' is 'F = m x a'. Acceleration and force are vectors in this law and the direction of the force vector is the same as the direction of the acceleration vector. 'F' is the acting force, 'm' the mass of the body and 'a' is the acceleration of the body due to the acting force.

Newton's Third Law of Motion

Action and reaction are equal and opposite, i.e. when two bodies interact, the force exerted by the first body to the second body is equal and opposite to the force exerted by the second body on the first.

Newton defined the collision into two phases: the compression and the restitution phase. In case of a full impact, at the end of the compression phase, the velocities of both vehicles at the impulse point are identical. Due to elasticity of the vehicle structures, the two vehicles will separate again.

Conservation of Energy

The conservation of energy states that the amount of energy in a closed system is constant, regardless of the changes in form of that energy. Energy can neither be created nor destroyed. Therefore the kinetic energy before the impact equals the kinetic energy after the impact, in addition to the energy loss.

$$\sum_{i=1}^{n} \frac{1}{2} \cdot m_i \cdot v_i^2 = \sum_{j=1}^{n} \frac{1}{2} \cdot m_j \cdot v_j^{'2} + EnergyLoss$$

Where:

m = the total mass of the bodies

v = the body velocities

i and j = the bodies involved in the crash

Energy can be lost during the impact due to:

- Deformation of vehicles
- Rotation of vehicle
- Friction between tires and pavement
- Sound due to impact

The energy loss due to deformation is more significant than the other values, as its magnitude is much greater than the other losses. The other losses are difficult to define, because of unknown parameters (e.g. duration of impact, moments of inertia of vehicle, centre of gravity of vehicle). Since they are typically one order of magnitude smaller, they are most often neglected. A parameter, which is commonly used to define the deformation energy loss, is the Energy Equivalent Speed (EES). The reconstruction parameter EES will be described later on. There are crash test databases (the NCAP database for example) from which the EES can be obtained.

Principle of Linear Momentum

Momentum is the product of inertia and velocity. During any collision, momentum is conserved as a consequence of Newton's 3rd Law - the Law of Action-Reaction. Momentum is the tendency of an object in motion to stay in motion. Thus, the total momentum before a collision is always equal to the total momentum after a collision.

$$\overrightarrow{S_{1,2}} = \int_{v_1}^{v_2} d(m \cdot \vec{v}) = \int_{t_1}^{t_2} \overrightarrow{F} \cdot dt = m \cdot \overrightarrow{v_2} - m \cdot \overrightarrow{v_1}$$

A useful way of increasing the applicability of the above mentioned equation is by using the concept of elasticity. Elasticity is a measure of the ratio between the separation and final velocity. It can vary between 0 (fully elastic impact) and 1 (plastic impact, no separation).

Principle of Conservation of Angular Momentum

Angular momentum is the tendency of a rotating object to keep rotating at the same speed about the same axis of rotation.

$$\int_{t_1}^{t_2} \overrightarrow{M_{\mathrm{Res}}} \cdot dt = \int_{t_1}^{t_2} d(\vec{r} \times m\vec{v}) = \int_{t_1}^{t_2} d\vec{L}$$

4.12.3. Equipment

Please refer to the Equipment List for the Accident Reconstruction equipment list.

4.12.4. Arrangements

Please refer to the Arrangement section of the Methodology Outline Accident Reconstruction section.

4.13. Case Delivery

4.13.1. Purpose

The purpose of the Case Delivery section is to detail how the investigation findings should be organised and recorded in the DaCoTA database system. The Case Delivery section attempts to ensure that investigation teams enter sufficient case related data into the database after their investigation, so as to provide the necessary data to perform an analysis and reconstruction for the accident in question.

The DaCoTA system is an internet based open source cross-platform web application that allows users to enter variously formatted data (i.e. text, pictures, sketches, files, etc.).

The DaCoTA database system attempts to:

- Store and organise in-depth accident data in a harmonised fashion
- Provide an environment to filter and analyse the collected accident data
- Enable a secure method for DaCoTA partners to share data and analysis

The recommended methodology to ensure a comprehensive data set is detailed below.

4.13.2. Methods

The methods outlined within this section should be applied in conjunction with relevant Detailed Methodology sections.

1. Appoint a Case Leader

Determine the most suitable team member to be responsible for controlling the quality and completeness of the dataset entered. The case leader will ideally be the most experienced team member on the investigation team. A more experienced Case Leader should better understand what is required from an investigation and familiar with the core variables to be entered into the database.

2. New Case

The case leader should then open a new case in the DaCoTA database. The Case Leader should then liaise with the investigation team to allocate specific responsibilities to each member.

Entering in collected data into the DaCoTA database can now begin. The Case Leader should ensure that the core variables have been entered. Furthermore, the data should be reviewed by the Case Leader to check the quality thereof.

3. Additional Considerations

Once the collected data has been entered into the database and it has been reviewed by the Case Leader for quality and completeness, the Case Leader must decide whether an additional retrospective investigation is required. A subsequent investigation may be required to procure additional evidence in order to create a more complete dataset.

Furthermore, the Case Leader is responsible to ensure that all data is made anonymous. All identifiers should be removed from data (licence plate numbers, road user names, addresses, Vehicle Identification Numbers, etc.).

4.13.3. Equipment

Please refer to the main Equipment List for the Case Delivery equipment list.

4.13.4. Arrangements

Please refer to the Arrangement section of the Methodology Outline Case Delivery section.

4.14. Equipment List

4.14.1. Purpose / Aim

The purpose of the Equipment List is to compile all individual equipment lists into one comprehensive list for reference purposes.

This list is subdivided into the various Detailed Methodology tasks. Before accident investigators begin any one of these tasks, it is recommended to consult the relevant Equipment List section to ensure they are properly equipped and able to perform the requirements of the task.

4.14.2. Equipment List

Sampling Plan

Please refer to the Accident Notifications equipment list.

Health and Safety

- Personal Protective Equipment (according to Directive 89/686/EEC):
  - Steel toe capped footwear
  - Reflective jacket
  - Gloves – heavy duty (anti-tear) and disposable
  - Safety glasses
  - Safety helmet
  - Face shield
  - First aid kit
- High visibility reflective items and lights for investigation vehicle

Accident Notifications

- Sampling plan and local maps (GoogleEarth/Maps and GoogleStreetview) – to check notified accidents are within the agreed geographical boundary
- Mobile phone, smartphone, tablet PC or similar for receiving notification when the team is away from the office

Scene and Road

The Scene and Road equipment list also applies for the Photo Routine, Scene Measurements and Scene and Road Sketch tasks.

- Checklist (based on the database)
- Permit or memorandum of agreement for in-depth research of road authority or police, driver license, vehicle registration document
- All Health & Safety equipment
- Investigation vehicle (appropriately marked for visibility and equipped with flashing lights)
- Measuring tapes
- Folding staff
- Spray chalk
- Thermometer
- Digital camera (with video capabilities)
- Spare camera batteries
- Spare memory card for camera

- Camera tripod
- Toolset
- Flashlight
- Inclinometer
- Measuring wheel
- Digital laser distance meter (incl. digital inclinometer)
- Tripod for laser distance meter
- Torch
- Level
- Levelling rod
- Grade rod
- Note taking items (pen, pencil, paper, etc.)
- Marking cones
- Safety gate
- Traffic signs: road works, speed limit, right of way by narrowing road
- GPS
- Scaled paper for making hand sketches

Vehicle Inspection

- PPE
- Tyre pressure gauge
- Tread depth gauge
- Stands and rulers for measuring deformations
- Digital camera
- Magnetic arrows to indicate small marks/deformations
- Investigation vehicle

Vulnerable Road User

Please refer to the Vehicle Inspection equipment list.

Behavioural Data

- Phone with headset
- Interview guide
- Recording equipment (where legal, appropriate and consented)
- Questionnaires (to send in the post, when required)

Medical Data

- Abbreviated Injury Scale (AIS) 2005 (update 2008) Manual
- Anatomical references
- Secure storage (for all medical related data)

Accident Causation

- Coding database system
- DREAM manual (DaCoTA update)

Accident Reconstruction

- Appropriate software (i.e. AI Damage, PC-Crash, etc.)

Case Delivery

- A computer system and internet connection (capable of running the DaCoTA database system)

5. FORMS AND DOCUMENTS

This section provides a selection of accident investigation tools (forms, lists and diagrams) that can be effective tools to help the investigator collect data in a structured an organized manner. Please visit the website to download them in full.

- Bicycle Inspection Form
- Bus Inspection Form
- Car Inspection Form
- Draft Telephone Interview Script
- Interview Form
- On Scene Accident Form
- On Scene Interview Prompts
- On Scene Road Form
- On Scene Extra Road Form
- PTW Inspection Form
- Reconstruction Form
- Road User Child Form
- Truck Inspection Form

6. RECOMMENDATIONS

DaCoTA Work Package 2's final product was to harmonize in-depth crash investigation protocols and develop tools to support the identified Pan-European Network of crash investigation teams who would prepare for investigations according to these harmonized protocols.

To achieve this within the Work Package a number of steps were taken. Research priorities and investigation teams cross Europe were identified in Deliverable 2.1 available online[2]. The protocols were harmonised into draft protocols and presented as a methodology in an on-line manual [http://dacota-investigation-manual.eu/]. A computer web application for input, storage and export of data was developed[3] [link to deliverable]. The on-line manual containing the methodology and the web application were linked and integrated into the "DaCoTA Crash Investigation System". A training package was developed and the Pan European Network met for a week of training in order to harmonize procedures. The procedures were tested during a pilot data collection where each team investigated five accidents. The final part of the work was to review the results from the pilot study in order to find topics which needed further improvements.

The review was divided into two major parts; a case review made by the Core teams and a questionnaire concerning the experience all teams had during the pilot study. In the review of cases both core teams and new teams were reviewed and the aim was to find common mistakes to identify training needs and team capability. In the questionnaire all teams had the chance to give their own opinion about the system as a whole and the methodology, the on-line manual and the web application separately.

The results from the review and the questionnaire were analysed and many issues were resolved within the project. Some issues are still open though and are presented below.

6.1. General Recommendations

During the development of the Pan-European network, training week and pilot study important issues were noted.

- The support organisation around the methodology and the web application was very much appreciated and is essential to enhance data quality, receive case feed-back and to improve the methodology further.
- The evaluation of the training package got very good responses especially that it included a mixture of theory and practice during the days.
- New/inexperienced teams would benefit from training sessions provided by experienced teams.
- More emphasis should be directed to the education in drawing a scaled sketch of the crash. The information from the sketch is one of the most important information when analysing the crash during the investigation and analysis datasets afterwards.

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[2] Available from the project website: http://www.dacota-project.eu/ (Deliverable 2.1)

[3] Available from the project website: http://www.dacota-project.eu/ (Deliverable 2.2)

- More focus should be directed to the importance of collecting human behavioural data.
- The link between the web-application and the on-line manual (where each variable has a direct link to the manual) is speeding up the coding process a lot.
- Not many teams have the ability to retrieve information on long term injury consequences but it will stay as an optional part in the methodology.
- Data protection is a delicate issue and it should be highlighted in the planning of any new activity. How data can be provided and distributed from all teams/countries should be clear. One solution could be to also remove all indirectly identifiable information (directly identifiable information such as names and registration numbers is already removed) which would secure the integrity of involved people.
  - Date: only code year and season (e.g. Dec-Feb, Mar-May, Jun-Aug, Sep-Nov)
  - Time: only code intervals (e.g. 06-09, 09-12, 12-15, 15-18, etc.)
  - Geographical area: not use any city/area names or GPS coordinates.
  - Road environment: Never use any road names or numbers
- A thorough identification of priorities from research, policy and industry is important before any data collection activity starts. In the beginning of DaCoTA WP2 this was undertaken and formed the base for the investigation methodology. Some of the new teams found the methodology too excessive and would like to limit the data collection to the core variables. Before any new activity starts a specific aim with the collected data needs to be specified and the new priorities and data collection should be adjusted accordingly.
- Even if a joint data collection activity in Europe is not running it has proven important to continue the collaboration between the investigation teams. All teams learn from each other and the data in the internal data collection activities are improved.

6.2. Essential Improvements

Essential improvements include issues that need to be resolved before any new data collection activity based on this methodology starts. These issues were identified during the development and/or during the review but have not been resolved within the timeframe and/or resources of the project.

6.2.1. Methodology and On-line Manual

- The on-line manual needs to be more oriented to data codification to ensure data quality.
- Road area: how to interpret and code the road area needs further development. It is not always clear what to code and when it should be coded. Special attention should be drawn to the methodology concerning where on the road the measures should be taken and a more thorough description concerning the road side features should be presented. It also needs to be decided how the road area should be coded from a left-hand-drive perspective to ensure correct comparison of aggregated data.
- Event type: the explanation in the manual needs to be extended to include which event should be coded and in which order.
- Core variables: the core variables need to be reviewed and fitted to the purpose of any new study. The core variables are the information that each crash investigation should contain from all teams even though that more experienced team should use the full data scheme.

- DREAM: The web application need to be updated to DREAM 3.2. The method for coding contributing factors to the crash was updated to version DREAM 3.2 during the project. The updated version was not implemented into the web application therefore DREAM 3.0 was used during the pilot.
- AIS injury coding: It is important for all teams to use the same version of the AIS codebook (here AIS 2005). Only special trained AIS coders should code the injury outcome and it should only be based on medical records.

6.2.2. Variables

- There are number of variables that are missing the option “unknown”, “not applicable” and/or “other”; these are not listed here explicitly. A thorough review of variables and updates is necessary.
- Accident summary: it needs to be mentioned specifically to all teams to follow the instruction for how to write informative summaries. The summary together with the sketch is two of the most important variables to quickly get an understanding of the crash.
- Traffic Regulation: values available in the web application and the definition in the manual are not the same (“entrance” is item n°2 and n°8 in wiki)
- Injury Causing Part: values available in the web application and the definition in the manual are not the same.
- DaCoTA accident type: add instructions that left-hand-driving countries should mirror the pictograms.

6.2.3. Web Application

- Generally there were some issues in the application concerning the response from the server and the system was slow. During the pilot some parts of the application were still under construction and therefore slower than expected. When starting a data collection activity it is recommended that the storage system is well tested for best results.
- Guidance in the web-application: the web-application either need its own instructions on how to fill in specific variables e.g. “right click to add element” or a section in the on-line manual.
- Powered Two Wheelers: add option to input impacts
- Graphical User Interface (GUI): The “grids” (tables) that are built up in the web application when adding impacts, road components etc. should either be in top of the page or the first row must always be automatically selected for viewing.
- Photos and files: need to improve the speed to view files, view and download separate photos/files.

6.3. Desirable Improvements

Desirable improvements are issues that would improve the DaCoTA Crash Investigation System but are not essential to use the tools developed.

6.3.1. Methodology and On-line Manual

- Exterior photos of the vehicle: It must be clearer which photos of the vehicle that are essential for a case and in which order these should be uploaded to simplify for analysts (not involved in case collection) to analyse aggregated cases.
- Reconstruction: add guidance to use kinematic reconstruction and option in the coding of the crash.

- Vehicle crash profile measurements for calculating crash energy and speed change at impact ("C1-C6 measures"): add more detailed guidance how to measure different deformation patterns.
- A draft telephone interview script was developed as part of the project, but this can be further developed and trialled for optimisation.

6.3.2. Variables

- To explain how to code certain variables examples needs to be added in the manual.
- It should be examined if more variables could be automatically filled in due to another response of a previous variable to increase the automatic consistency checks for data quality.
- Date and time: due to data protection the exact date and time should be changed to seasons during the year instead and intervals during the day. Hours and minutes should be separated in the system to allow "unknown" to be coded.
- Traffic flow at accident time: Need to change the input from a numerical field to a list of choices that can be estimated at the scene (such as no traffic, moderate, heavy, saturated, unknown)
- Child Restraint Systems: should be automatically disabled in case of an adult person.
- Vehicle type, other vehicle: add more values if needed (such as novel vehicles)

6.3.3. Web Application

- Percentage of progress: the percentage of progress is now based on all variables. It would be good to have an optional progress report on core variables.
- Drop down lists: Should consider if the whole row of the short description needs to be available when viewing a published case.
- Adding a spell checking facility in the accident summary field could improve readability
- Adding a text search option would allow analysts to search for specific words in the text.
- Sketching tool: an improved application can be sought and implemented (as long as it is open source software in keeping with the rest of the program).
- Text clarity: once a case is published, greyed-out text in some fields becomes hard to read. The colour scheme can be revised to improve readability.
- Length of text entries: some selected options are very long and cannot be viewed without referring to the online manual. An option to expand the text fields to show all the text when required can be considered (for instance when the mouse hovers over the selection, or by having a button that switches between short and full descriptions).