TOWARDS A GLOBAL AND HARMONIZED DATABASE FOR IN-DEPTH ACCIDENT INVESTIGATION IN EUROPE: THE DaCoTA PROJECT

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ABSTRACT

The aim with this paper is to describe the procedure for the development of a common methodology for research accident investigation and identifying and training new research teams across Europe. In-depth accident investigation has a great potential to provide researchers, car manufacturers and road administrations with valuable information on how and why accidents and injuries occur. The data can be used to determine the issues where efforts must be focused when research studies are conducted, crash protection countermeasures are designed and policy decisions are taken. Existing European databases are mainly focused on regional or specific stakeholder interests due to the lack of an international network, and there are significant differences in the information collected and how the database variables are coded. This lack of harmonisation precludes any detailed global analysis on the whole EU accident situation.

The EU co-funded the DaCoTA project - inspired by previous projects like SafetyNet and TRACE – intended to establish a Pan-European In-depth Accident Investigation Network and to create a European database that could include in-depth accident investigation cases from all the European countries.

Built on earlier pilot investigations conducted by previous projects, and following consultation with the range of stakeholders, an in-depth accident investigation system has been developed to standardise and harmonise the data to be collected during the investigations. Based on the new methodology, accident investigation teams from across Europe have been trained to systematically produce high quality research data. A comprehensive, secure, web-based database has been created to centralise the information collected and to analyse the results from the cases. To ensure the harmonisation of the data collected, a pilot study and subsequent data quality reviews were performed.

The DaCoTA project has developed a harmonised in-depth accident investigation methodology, openly available in an online manual. From 19 European countries, 22 organisations were trained in the DaCoTA accident investigation methodology. The web based database includes over 1,500 variables related to the road, vehicle, road-user, accident reconstruction and injury analysis. Over 450 of these variables are considered as essential “core variables”.

In total, 99 on-scene and retrospective cases have been collected by 18 accident investigation teams using the standard methodology and these have been uploaded to the database for further analysis.

Good relationships have been established between the network teams and their local authorities, including the police and hospitals. In some countries, efforts to obtain the necessary permissions to gain access to the accident scenes and to acquire sensitive medical or forensic data is continued.

The DaCoTA project has developed the Pan-European in-depth accident investigation methodology, including a network of investigating teams, providing a viable means for the systematic collection of harmonised in-depth accident data for use by researchers, road and vehicle safety related industries and policy makers.

INTRODUCTION

Background

More than 30,000 people died in 2011 in the roads of the European Union [1]. These losses have an estimated socio-economic cost of around 2% of EU countries’ gross domestic product, which means around 180 billion Euros [2].

In order to monitor trends, describe road safety problems and identify targets for interventions,
information on the state of road safety and factors influencing it is needed [3]. For this reason, improving the collection and analysis of data on accidents and injuries was one of the bullet points of the methodological network to identify and disseminate best practices pointed out by the European Commission [4].

Following this strategy, the DaCoTA project has built upon previous EU projects in in-depth accident investigation (as shown in Figure 1) with the intention of establishing the infrastructure for a future investigation system that will then be deployed beyond the completion of the project [5].

Furthermore, in-depth accident data based on the road environment, vehicle analysis and the road user evaluation with road-user interviews and injury information can provide a case analysis with the impact speed and the accident and injury mechanisms as shown in Figure 2.

![Figure 2. Example of information collected in the DaCoTA in-depth accident investigations.](image)

Therefore, in order to develop new policies based on real evidence, we see that there is a fundamental need for in-depth data. In fact, in-depth accident data has been and continues to be used in road safety monitoring, in consumer testing, for setting standards and for research and development. It provides information about the accident and injury outcome in different collision scenarios, allows determination of injury mechanisms and provides valuable information for the design and development of new products.

**Objective of the DaCoTA project**

The project aimed to enforce the strength and wealth of information in the Observatory (ERSO) by enhancing the existing data and adding new road safety information with the inclusion of new procedures and methods.

This paper is focused on Work Package 2, which was tasked with formulating a common methodology for research accident investigation and identifying and training new research teams across Europe.

The main goals for WP2 were:

- to identify research priorities requiring in-depth data
- to harmonise in-depth crash investigation methods at an EU level
- to identify and train crash investigation teams who will prepare to make investigations according to these harmonised methods.

The mainstay to reduce road casualties across Europe is to determine effective safety strategies by creating new knowledge based policies.
METHODOLOGY

During an in-depth accident investigation, two processes can be differentiated: data collection and analysis [5]. These two stages of an investigation must be separately carried out but always connected. When an investigator gathers data from an accident they have to be aware of how the analysis will subsequently be performed to ensure that they get the required information and not less, but this analysis must be done afterwards because of the usual constraints of field work, especially for on-scene investigations.

The developed methodology will therefore cover both stages as separate processes but with a global vision of the accident investigation. More specifically, the methodology establishes a wide range of areas such as investigation routines, necessary equipment, suitable arrangements, safety and more. This paper intends to give an overview of how these areas were approached.

Before the development of the methodology and the database system, the current and future data needs were consulted with key stakeholders to ensure that the focus would be centred on current and future concerns in road safety. In order to carry out this consultation, a matrix of research questions was generated which were rated, based on the complexity and the type of data required providing answers. At this point the identification of causes of accidents in the high fatality rate countries was one of the recurrent issues identified in the different key research areas considered.

After the research survey, all the priorities voiced by DaCoTA partners, EU countries and European organisations and institutions were considered when developing the new in-depth investigation methods. Based on the results of the consultations, the methods were focussed on: on-scene information, vehicle data, road user injury data, human data, accident causation analyses and accident reconstructions [7].

In order to validate the methodology and identify possible improvements concerning the operability, a pilot study was carried out (explained in detail in the Results section of this paper and in [5]).

The Network

The culmination of the project was to establish a network of accident investigation teams with standardised methods and data gathering procedures. The Pan-European In-depth Accident Investigation Network consists of the investigating teams which participated in the pilot study (see Figure 3). The Network was composed of a core group including the ten partners in WP2 of DaCoTA and more teams across Europe were invited to participate in the Network.

Figure 3: The participating teams

The different teams were divided into three different groups depending on the experience they had in in-depth accident investigation. This group division is considered in the methodology and the requirements for each team depend on this expertise classification.

However, all teams have a similar structure consisting of a team leader and multiple investigators. Other roles within the team are also defined, for example, case leader, on-scene investigator, interviewer, DREAM analyst, injury mechanism analyst. This role definition reflects the intention for the teams to be multi-disciplinary.

Another distinctive regard of the defined methodology is the differentiation between on-scene and retrospective investigations. 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 (ideally ≤ 30 minutes after the time when the collision occurred). Retrospective work includes any investigation activities carried out after the rescue of involved people is finished and the scene has been cleared from 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. All teams can perform both types of investigations but the more experienced teams are encouraged to carry out the scene inspection on-scene.

**Database**

The DaCoTA database was built upon a web application originally developed by the SAFER consortium and was made available for the DaCoTA project. Making adaptations based on the needs and expectations of the DaCoTA project, CTL designed the database that was used in the Pilot study (see Figure A.1 in the Appendix).

The purpose of the final design of the database is to store in a harmonised way in-depth accident data, and to allow the partners to analyse and filter the accidents collected, securely exchange the data collected and share the analysis results. The database is designed to work on-line with a central secure server at CTL but it is also possible to store the data locally. The different operational systems of the database are detailed in Figure 4.

**Figure 4:** Database configured on-line or for local operation

The system is divided into two parts, one data collection section with mostly objective variables and one case analysis section with information on the conclusions of the collected data. After the data gathering, the teams have to fill in up to 1,500 variables per accident. However this number will typically be less depending on the nature of the accident (depending on the number and type of vehicles for example). The database tools and structure (see Figure A.2 in the Appendix) helps to insert the data in an organised and methodological way. The case analysis section provides helpful tools concerning the analysis causation analysis with the DREAM methodology [8] and coding tools for reconstruction and injury analysis.

The data introduction is divided into different items of an investigation (see Figure A.2 in the Appendix). A navigation menu on the left shows the structure of the data gathering and the completion of the information entered. This provides a structured and organised way to fill in all the information. Moreover, this structure leads the investigator to introduce first the observational data available such as from examination of cars or the scene features, and then more analytic points such as DREAM analysis or injury coding and analysis.

Then, depending on the predisposition and the legal limitation of each team, the cases can be made available for further analysis by other Network team members.

It must also be pointed out that, due to the high number of possible variables to be filled, a variable classification has been made. There are approximately 450 core variables which need to be filled in with the corresponding information, and the rest of variables, are considered essential for the completion of a full case by the most experienced teams. Finally, several pictures can be uploaded and classified according to the accident item they relate to. Also reconstruction data can be uploaded as the final analysis part of the accident. More detailed information about the database can be found in [9].

**Figure 5:** Database structure

The application is characterised by being internet accessible, the code is open source, multiplatform, and accessible from any web browser (that supports Adobe Flash). The data is securely stored either on a central or local data server.
Even for the more experienced teams, the database will introduce a new way to gather the data and perform the analysis. To provide all the needed support during the data insertion, all the variables in the database are linked with an openly available online manual to explain what information needs to be introduced for each field of interest to the user.

**The Online manual**

The online manual is the other component of the DaCoTA Crash Investigation System and works alongside the database as explained before. The purpose of the online manual is firstly to provide information about the scope, characteristics and practical requirements of the investigation methodology and secondly to provide detailed information on how to interpret each data variable that should be collected and/or analysed [10].

The on-line manual consists of the following sections:

- Introduction and Acknowledgements.
- DaCoTA Teams.
- Variables.
- Methodology outline.
- Detailed methodology.
- Forms and documents.

The ‘DaCoTA teams’ section describes all the established teams’ features such as the structure and the roles of the investigators as stated before in this paper.

The ‘Variables’ section consists of a list of all the variables that should be collected within the DaCoTA methodology. These variables are also described in order to standardise the understanding and harmonise the methodology.

Then, the two following sections ‘Methodology Outline’ and ‘Detailed Methodology’ describe the methodology that all teams should follow.

Finally, the ‘Forms and Documents’ section provides all of the necessary material to gather the correct data and guides for use during the inspections and interviews (Figure 6).

**Figure 6**: Partial view of the road inspection form

The on-line manual provides the DaCoTA Network or any other accident investigation team with complete guidance to carry out accident investigations with an accessible tool. The full manual is publically available at http://dacota-investigation-manual.eu.

**Training**

As explained before, the Network consists of teams from several EU or neighbouring countries with different experience in accident investigation. In order to reduce disparity in experience and provide the new teams with a valuable foundation in DaCoTA accident investigation methodology and tools, a training week was carried out at the IDIADA facilities. In March 2012, 48 delegates attended this training including 26 theoretical and practical sessions performed over 5 days. The theoretical sessions were presented by the experienced DaCoTA core teams in seminar design.

The practical sessions were carried out at IDIADA’s proving ground where crashed cars and accident scene representations were examined. During these practical sessions, the delegates were given explanations of the guidelines of the DaCoTA methods and then were invited to collect the evidence that was made available for this purpose.

After the theoretical sessions and the data collection, the delegates were shown how to enter this data into the database. The mixture of theory and practice was greatly appreciated by the delegates. The training week aimed to explain and explore DaCoTA-specific methods to investigators of all experience levels, including the key investigation methods required for DaCoTA, DREAM causation analysis and DaCoTA database training [11].
The topics covered were:

- Preparing an investigation team, including safety at the accident scene.
- Scene examination, including recording visual evidence.
- Vehicle examination.
- Vulnerable road users.
- Collecting road user data.
- Medical/injury information.
- Interpreting the data.
- Using the DaCoTA database.

Based on the revision parameters established, each core team reviewed up to 5 cases from the other Network teams, performing a quality review which confirmed that the training was beneficial and yielded a high quality database.

The teams participating in this pilot study were able to investigate 99 accident cases (Figure 8) and introduced 77 cases into the DaCoTA database by the end of December 2012. Out of these 77 cases, 46 were investigated on-scene and 31 retrospectively.

The feedback received from all the participants was very positive and provided valuable information to refine the methodology and the DaCoTA database system.

Figure 7: Picture of the vehicle examination practical session

This training week established the baseline to carry out a pioneering in-depth accident investigation pilot study across 18 European countries.

RESULTS

Pilot study & Review
During the period from April to September 2012, the pilot study was carried out following the DaCoTA methodology.

The initial target for the pilot study was to collect 5 cases per partner, ideally collecting a range of collision and road user types at each centre. Although local needs were more specific in some cases - for instance, Italy and Spain focussed on vulnerable road user cases. After the collection, a review process was carried out by the core experienced teams. During this review, each core team revised one case from the other core Network teams and at least one from one of the new teams. After the revision, the conclusions on things that worked well, mistakes and difficulties during the study were pointed out and the possible solutions were determined. These possible improvements are described in the Final Report of the project [5].

Figure 8: Cases collected by all the teams in the pilot study

The main challenges reported during the pilot studies involved the accident reconstructions, DREAM coding and collecting injury information.

About two thirds of the teams could complete the reconstruction information but only one third were able to insert the accident causation coding. After receiving the feedback from the participants, this difficulty was attributed to the unfamiliarity of the teams with the coding system.

The injury information is usually one of the most difficult types of information to collect due to the data protection, ethics or other legislation in many countries. Also the lack of experts able to code the injuries is one of the reasons.
The success of this pilot study is encouraging for a continuation and possible expansion of the Network in the future, especially considering the positive feedback received from the participating teams.

CONCLUSIONS AND DISCUSSION

Previous EU projects focussed on accident investigation have already pointed out the importance of in-depth data in policy making but DaCoTA has proved that a programme of standardised data gathering across Europe is possible and has great potential.

An accident investigation Network team was created to carry out a pioneering pilot study to compile high quality data in several European countries. This proved that the creation and operation of a Pan-European in-depth accident investigation network and database is feasible and can provide valuable information for researchers and stakeholders.

The pilot study was performed during approximately five months gathering information on 99 new cases.

Continuing with this network and supporting the establishment of the tools developed is a priority for achieving the goal of enhanced road casualty reductions.

It is also encouraging for further developments remarking how 19 different countries worked in a coordinated way, overcoming the different natures of transport mobility and accidents to provide harmonised data across Europe.

A great effort must be focussed in overcoming the limitations in getting certain data like occupant injuries that represents key information for developing new policies and safety systems to prevent road injuries.

The project has achieved its aim to develop a common methodology, establish an investigating team network and overcome the key operational requirements. Beyond the project, a business model must be put in place to enable the continued data collection. It was encouraging to find out that when the partners were asked, only 3 out of 15 acknowledge having difficulties in finding funding to perform the pilot study. In conclusion, there was not just a need and an interest, but also now the willingness supported by a new system and network to carry out in-depth data collection activities across Europe.

RECOMMENDATIONS

The pilot study yielded very encouraging feedback on the newly developed system and gave excellent ideas for further improvements.

It showed the need for on-going networking and team development activity to ensure the harmonisation of the data and improve the teams’ knowledge, learning from each other and sharing the experiences when investigating the accidents.

Several participants have also pointed out the need for improvements in getting medical information based on the guarantee that all the data is anonymised before being added to the database. Personal information is of no interest in an accident investigation of these characteristics. However, during the pilot study it has been noticed that some information could be avoided (like geographical or accident time data) to reinforce the anonymisation of the data collected.

A lot of effort was focused on the creation of the database and the on-line manual, which are high essential, quality tools for carrying out accident investigations following the DaCoTA methods. However, these tools need maintenance and the future business model has to take this into account.

ACKNOWLEDGMENTS

The DaCoTA project was co-funded by the European Commission within the Seventh Framework Programme. Special thanks go to the many individuals in addition to those named as authors who have contributed to this work from the following countries and institutions. Belgium: Belgian Road Safety Institute (IBSR). Germany: Medical University of Hannover (MUH). Greece: National Technical University of Athens (NTUA) and Hellenic Institute of Transport (HIT). Spain: Jefatura Central de Tráfico (DGT), Institute f. automobile Research (INSIA), Applus IDIADA, and Foundation for Transport and Energy Research and Development (CIDAUT). France: French Institute of science and technology for transport, development and networks (IFSTTAR) and Laboratoire d’Accidentologie (GIE RE PR). The

We are very grateful to all organizations who contributed to the pilot study during 2012. The project partners were joined by other organizations to form the Pan-European In-Depth Accident Investigation Network. The partnership would like to extend our sincere thanks to colleagues from the following organizations for all their help and hard work: Austrian Road Safety Board; Austrian Institute of Technology; Technical University of Graz, Austria; IDIADA Czech Republic; Danish Road Traffic Accident Investigation Board; Estonian Investigation Team; Estonian Road Administration; Finnish Motor Insurers’ Centre; Icelandic Road Accident Investigation Team; Transport Malta; Motor Transport Institute, Poland; Norwegian Accident Investigation Board; Norwegian Public Roads Administration; Slovenian Traffic Safety Agency and Volvo Car Corporation.

The DaCoTA partnership would like to acknowledge the contribution of SAFER at Chalmers University of Technology who developed the predecessor to the database and online manual which were given to DaCoTA for subsequent modification and use.

Mostafa Aldah and Rachel Talbot (TSRC, Loughborough University) are acknowledged for their considerable efforts in helping with the coordination of the final project reports and the contents that are reflected in this paper.

REFERENCES


APPENDIX

Figure A.1. View of the DaCoTA database tool.

Figure A.2. Welcome page of the On-line manual website