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**Enhancement and exploitation of the existing European road accident data**

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**Abstract**

The objective of this research is to provide a complete approach for the further enhancement and exploitation of the existing road accident data contained in the various international databases (CARE, IRTAD, Eurostat, UN-ECE, etc.), which takes place within the EC co-funded integrated project SafetyNet. On this purpose, a methodology of four distinct tasks was adopted. The first task concerns the enhancement of the EU CARE database by progressive incorporation of road accident data from the new Member States. At the same time, the improvement of road accident data compatibility throughout Europe is attempted, through the establishment of a recommendation for a common framework for road accident data collection, among all EU countries. Moreover, identification of the real number of road fatalities and injuries is attempted throughout a special uniform methodology for the identification of the underreporting level for each casualty severity in the national road accident databases. Additionally, the possibility to use a new common measurement unit: the "hospitalised person", is investigated. Finally, the exploitation of the various European databases is optimised through the development of a comprehensive set of statistical outputs with comparable statistics, useful for the support of decisions aiming to the improvement of road safety in the European Union. This integrated approach allows the European road safety Community to fully exploit the current important road safety data potential and subsequently produce reliable conclusions and backup important road safety decisions at EU, national and local level.

## 1. Introduction

Despite the important decrease in the number of road accident fatalities in Europe during the last decade, there are certainly many more actions to be taken, in order for a further decrease of road accident victims in Europe to be achieved. In 2005 more than 41.000 people were killed and approximately 1,7 million people were injured on the roads of the 25 Member States of the European Union ([http://ec.europa.eu/transport/roadsafety/road\\_safety\\_observatory/latest\\_statistics\\_en.htm](http://ec.europa.eu/transport/roadsafety/road_safety_observatory/latest_statistics_en.htm)) and the estimated cost of these casualties to the society is approximately 160 billion euros (*European Commission, 2003*). Road safety is considered as a high priority issue in all European countries and also at EC level. In 2001 the European Commission adopted a target of reducing fatalities by 50% (*European Commission, 2001*) within a decade and identified several areas where it could make a direct contribution within the constraints of resources. This EU target will only be achieved by the introduction of the most effective countermeasures. It relies on the existence of basic knowledge of crashes and their causation and the availability of road safety data to monitor and assess performance.

In the 2001 White Paper, the EC expressed the demand for a "Road Safety Observatory" and on that purpose, an Integrated Project titled "SafetyNet - Building the European Road Safety Observatory" has been initiated to meet this demand (*Thomas et al, 2005*). SafetyNet aims at addressing the specific need for co-ordinated accident and injury data resources and will supply the basic information to support safety policy decision making at EU and national level. More specifically, the Road Safety Observatory aims to enable the Commission to monitor progress towards targets, identify best practise, and ensure that new regulatory and other safety actions will result in the maximum casualty reduction. All data assembled or gathered within the project started already to be available over the web to the entire road safety community ([www.erso.eu](http://www.erso.eu)).

Within SafetyNet, a complete approach for the further enhancement and exploitation of the existing road accident data contained in the various international databases (CARE, IRTAD, Eurostat, UN-ECE, etc.) is developed. Under that perspective, SafetyNet will also contribute to the further development of the European road accident data bases as complete and powerful tools for road accident analysis, as well as it will attempt to produce a comprehensive set of end-products with compatible statistics, useful for the improvement of road safety in the European Union.

On this purpose, a methodology of four distinct tasks was adopted. Firstly, the compatibility improvement of data from the new Member States was carried out through transformation rules of existing data (bottom-up approach), followed by the overall improvement of accident data compatibility throughout Europe through the development of a recommendation for a common data collection framework (top-down approach). Additionally, identification of the under-reporting level and the estimation of the real number of road accident casualties are attempted as well as appropriate statistical outputs are developed for dissemination (*National Technical University of Athens, 2005a*).

## 2. Compatibility improvement of data from the new Member States

With the accession of the 10 new Member States in the European Union, there is a need to have the new countries accident data available in order to form a more complete picture on the road safety level in the EU. On that purpose, the European Commission intends to progressively incorporate the road accident data files from the new countries into the existing CARE system. Additionally, accident data from certain states of the European Economic Area (Norway, Switzerland) will also be progressively incorporated into CARE, which in this way will be enhanced and extended, allowing the establishment of a broad and compatible accident database, a more complete set of road safety analyses and comparisons among all countries at EU level.

On that purpose, a five step methodology based on the CAREPLUS structure has been developed, in order to appropriately transform the national accident data from the new Member States and make it compatible to the CARE system.

Initially, a list of the common national accident variables and values incorporated in the CARE system and the relevant definitions was established, exploiting the results of the CAREPLUS 1 and 2 projects (*Cete Sud-Ouest, 1997, Cete Sud-Ouest, 2000*). At a second stage, the national definitions of accident data were collected by all new Member States, as well as Norway and Switzerland using an appropriate template. Information collection process was coordinated by the European Commission and took place through the national representatives at the CARE Experts Group.

At the same time, a tabulated list of the national accident data definition elements is developed and filled-in for each examined country, in collaboration with the national Experts.

The elaboration of the appropriate transformation rules through the analysis of the national databases (description, content and definitions) is the next step of the methodology. During this process, interrelation between the CARE database and the national variables and values is examined, based on the variables and values definitions, as well as on the structure of the national database. On this purpose, specific templates, have been developed, allowing for a common format of the transformation rules between the countries.

The finalisation of the transformation rules is completed through an iterative process between the SafetyNet partners and the national Experts from each country, as additional information is required, clarifications on the variables and values definitions are necessary, as well as verification of the rules at several stages of the work. Setting-up the transformation rules for a country, allows the transition from the original national variables and values to the ones of the CARE system. Additionally, the list of common CARE accident variables and values and the respective Glossary of definitions are updated and enriched, incorporating new road accident elements when necessary.

The developed methodology was successfully tested through its application at the Estonian accident data. The relevant transformation rules have been drawn up and implemented on the Estonian accident data, which is now available at the CARE database. The compatibility improvement of data from the other countries is also under way and more accident data will be progressively incorporated into CARE.

### **3. Improvement of accident data compatibility throughout Europe**

Existing European road accident data are not always comparable among the various countries, mainly due to the different national accident data collection systems. Data variables and values are currently collected under different definitions in the EU countries, the various accident data collection forms have different structures and the relevant data fill-in systems cannot be compared (*Frantzeskakis et al., 1995*). Both accident data quality and availability are affected and consequently, data analyses and comparisons among the various EU countries are not always reliable, even for some of the common CARE variables and values (*Yannis, 2000*).

In view of improving the accident data compatibility throughout Europe, the establishment of a common framework for road accident data collection, among all EU countries is attempted. After the proposal of this common data collection set, every EU country wishing to update its accident data collection system can optionally and gradually use this recommendation for common data collection. In this way, progressively, comparable road accident data from more EU countries will be available within the CARE system.

Harmonisation of accident data at EU level is attempted through the development of a four step methodology, which takes into account both data availability (bottom-up approach) and usefulness (top-down approach) (*National Technical University of Athens, 2005b*). Initially, the current potential of the various existing national collection systems at EU-25 (plus Norway and Switzerland) was recorded, through the collection of several documents including the updated national collection forms, the relevant fill-in instructions, lists of national road accident variables and values and the respective definitions in both native and English language. On the other part, necessary data for accident analysis was identified through the development and distribution of a relevant questionnaire to road safety Experts from all EU-25 countries, as well as the development of a relevant tabulated list (Grid), which was filled-in by several road safety stakeholders in seven countries. Based on the analyses of the current national collection systems and the identified data needs, the recommendation of a basic common accident data collection set and methodology will be established and gradually adopted through an iterative process, with the participation of experts and Governmental representatives. New accident data variables, values and their definitions will also update the existing CARE accident Glossary, when necessary, allowing for a better and more complete description of the road accident phenomenon at national and EU level.

In order to record the existing national road accident data collection systems (bottom-up approach), several relevant documents were collected by all EU-25 member states (plus Norway and Switzerland), through the national representatives of the CARE Experts Group. The required documents concerned the updated national collection forms, the relevant fill-in instructions, lists of national road accident variables and values and the respective definitions. The various variables and values included into these national collection systems will be analysed, as well as the several data fill-in systems for each value. On that purpose, each partner involved in this Task will undertake the examination and analysis of a specific group of variables (Vehicle related variables, Person related variables, Accident type and manoeuvre related variables and Accident related variables) and will propose the most appropriate/necessary variables and values of the specific group. Other existing international data collection systems outside Europe will also be considered, allowing the identification of additional important variables and values that can be included in the common collection form (*National Highway Traffic Safety Administration et al., 2003*). At the same time, each partner will also consider and suggest how these proposed variables/values should be filled-in into the suggested common collection form. On that purpose, a document describing various data fill-in systems of the common collection form for different types of variables/values was also developed. Moreover, a relevant questionnaire on the existing national road accident data collection procedures and their quality was developed, enabling the development of a complete picture of the current data collection potential across the EU. The questionnaire was divided into four different sections: National road accident collection system, National road accident data validation, Underreporting and Road accident data analysis and was filled-in for all EU-25 Member States (plus Norway and Switzerland).

The needs of the main stakeholders in different EU countries for road accident data across the EU (top-down approach), at both national and local level were further recorded. An appropriate Grid was developed to establish a list of various potential data users by country and then identify their needs for accident data. By completing this Grid for several stakeholders, the maximum needs were defined for each country and these were further compared in order to identify the minimum/common needs for all countries. Exceptional needs recorded, such as those of cyclists in the Netherlands could also be considered, but not for all countries. Furthermore, identification of accident data needs was accomplished by exploiting the reviews of national collection systems or any accident publication and also by exploiting the existing experience of the partners' organisations from own consultant services to several national stakeholders. The needs of each stakeholder were not just identified, but also ranked according to a three level scale (low/high/ not used). Additionally, the frequency of accident data requirements in each country was also be taken into account when deciding on the list of the accident data needs.

On the basis of the outcomes of both the bottom-up and top-down approaches a recommendation on a common data collection set will be developed. The finalisation of this proposal to be gradually and

optionally adopted throughout Europe will derive after discussions initially among all project partners, the European Commission and national representatives from the EU member states, the CARE Experts Group and the High Level Group. The entire procedure will be coordinated by the Commission.

#### **4. Estimation of the real number of road accident casualties**

Currently, the only comparable measurement units among the EU countries, available in CARE but also in the various international databases are the numbers of fatal accidents and of people killed, where the degree of under-reporting is acceptably small in most EU Member States. However, the numbers of non-fatal accidents and of people seriously and slightly injured cannot be compared in different countries. In addition, the definition of injury severity differs among member states, so that an accident or casualty which would be recorded in one country might not be recorded in another, while an accident or casualty which might be recorded as 'serious' in one country might be recorded as 'slight' in another.

In order to overcome these inconsistencies, within the framework of SafetyNet, it is attempted to estimate the under-reporting level for each casualty severity (killed, seriously injured, slightly injured) by developing a uniform methodology and applying it in several EU countries, but also estimate in each country the number of casualties according to a new common measurement unit, the "hospitalised person". Thus, the scope of CARE-based road accident analyses will considerably expand and it will become possible to carry out meaningful analyses of non-fatal accidents and casualties. This will allow consideration of road safety to extend beyond the current focus on fatal accidents, which occurs in part because of inconsistencies between the national data relating to non-fatal accidents. Moreover, the increased size of the data sets for analysis will reduce the effects of chance, thereby permitting more detailed analyses to be carried out.

The adopted approach to address the accident data under-reporting issue in various EU countries, concerns primarily the development of a uniform methodology, which will allow for the identification of the underreporting level in the countries by comparing the road accident casualties in police accident records with those in medical records. Medical details can be summarised using the Abbreviated Injury Scale (AIS<sup>1</sup>) that is used throughout the world and this could provide the basis for a common EU-wide definition of casualty severity. The objective is to produce a set of factors, which could be applied to police accident statistics in any country to estimate the number that would have been recorded if the police had attended all accidents and compiled their reports using the common measurement units to be defined by this project.

On that purpose, several research studies on underreporting (*Aptel et al., 1999, Elvik, Mysen, 1999, James, 1991, IRTAD, 1994*) but also on databases linkage (*Simpson, 1996, Rosman, 2001*) in eight EU countries (Austria, Czech Republic, France, Greece, Hungary, Spain, The Netherlands and United Kingdom) were examined and additionally, availability of medical records and methods to link police and medical data in these countries was considered (*Transport Research Laboratory, 2005*).

Medical data on road accidents from hospitals which will be compared with accident data recorded by the local police, can be available either by exploiting relevant data records maintained in regional or national medical authorities, or collecting medical data specifically for a study. In this second case, a representative sample of hospitals that receive accident victims can be selected, and the necessary approvals for the data collection will be obtained from the medical authorities. During the period of data collection, project staff should regularly visit the hospital departments that receive accident victims. They will sift the records held in these departments to identify those people whose presenting history indicates that they had been injured in a road accident. A range of details can be recorded for each of these people, and subsequently entered in the project database. The number of hospitals and the length of the data collection period depend upon the funding available.

<sup>1</sup>Abbreviated Injury Scale, ranging from 1 for minor injuries to 6 for injuries that are currently untreatable

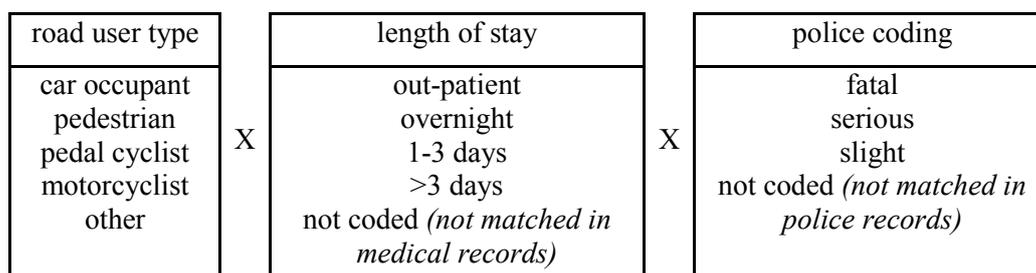
Either way, the medical records will be cross-checked regularly with the police accident records. The checking will take account of the catchment<sup>1</sup> area of each hospital, comparing the hospital records with police accident records only for that area. The aim is to identify all cases where the same person is present in both sets of records. Personal names are unlikely to be available in both data sets, in which case this process must be based on factors common to both data sets such as the casualty's age, gender and mode of transport, together with accident circumstances such as time and location. The outcome will be a combined set of police and medical data in which these matched cases are marked. The matching process should make allowance for minor errors in the recording of personal details, for example small discrepancies in age between the two sources. The process used may need to vary in detail from country to country to allow for local data and facilities.

Once the cross-checking of medical and police records has been completed, the proportion of accident casualties that has been reported by the police can be calculated. This will provide the level of under-reporting of casualties in the police data and is likely to vary with type of accident (e.g. in relation to the number and type of vehicles involved), which should also be examined. The medical data to be collected must include those details, needed to cross-check with police records. The principal extra item of data is whether or not the casualty was admitted to hospital, and if so for how long. Additionally, medical details such as the AIS score for each body region should also be recorded.

The combined police and medical data sets will be used to compile two 3-dimensional matrices of casualty counts. Road user type will be identified from police data, as it is often poorly recorded in medical records.

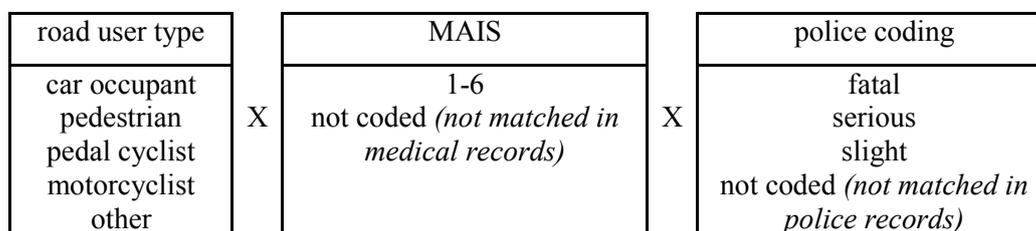
The first matrix in Figure 4 will incorporate the length of stay information:

Figure 4: Matrix based on the length of stay



The second matrix in Figure 5 will incorporate the MAIS (maximum of the AIS scores per body region) information:

Figure 5: Matrix based on the MAIS



More detailed matrices can also be developed if more information is available, for example including age and gender of casualty.

The above described methodology will be applied within the framework of SafetyNet, to eight EU countries and national studies on the identification of the under-reporting level will be carried out. Once

the relevant matrices are completed, data will be entered into a database and will be further analysed to provide under-reporting coefficients for each of these countries, relating to alternative bases: hospitalised casualties (or perhaps with a minimum length of stay) and MAIS. The strengths and weakness of the alternative approaches will be investigated at a later stage.

Based on the analytical experience attained from the processing of the national studies and the development of the underreporting coefficients, the establishment of a common definition, such as the "hospitalised person", to be used when estimating the actual number of accidents and casualties will be attempted.

## **5. Development of statistical outputs**

The exploitation of the various European databases is also optimised through the development of a comprehensive set of statistical outputs with comparable statistics, useful for the support of decisions aiming to the improvement of road safety in the European Union. These statistical outputs concern Annual Statistical Reports and Basic Fact Sheets, as well as Aggregate Data Files derived from the EU CARE road accident database. Various types of road accident data users, ranging from road safety analysts to the wider public, will form the target audience to which these statistical outputs will be addressed and thus, their content and format will be accordingly defined.

The development and dissemination of the various outputs takes place in three distinct steps (*Kuratorium für Schutz und Sicherheit, 2005a*). Initially, the exact set of statistical reports and analysis notes is defined. Then, the identified Annual Statistical Reports, Basic Fact Sheets and Aggregate Data Files are prepared and finally, based on the experience attained through the preparation of these statistical outputs, establishment and promotion of a complete set of analysis techniques can take place. This methodology allows maximum flexibility and potential with regard to analysis of the information available in the system and thus, opens up a whole set of new possibilities in the field of accident analysis.

In order to define the set of statistical reports and analysis notes, several existing international databases were evaluated (*Yannis et al., 1998*). Relevant information for each of these databases (Fatality Analysis Reporting System - FARS, Community database on Accidents on the Roads in Europe - CARE, United Nations Economic Commission for Europe - UN/ECE, World Health Organisation - WHO, EUROSTAT, International Road Traffic and Accident Database - IRTAD, European Conference of Ministers of Transport - ECMT) were collected and assessed. FARS (Fatality Analysis Reporting System of NHTSA) in particular is highly comparable with the CARE database as FARS also uses disaggregate road accident data. Additionally, in order to define the content of the outputs in terms of road accident variables and values used, the needs of the several road accident data stakeholders in seven EU countries (AT, CZ, DK, EL, HU, NL, UK), as recorded in a relevant Grid developed in SafetyNet WP1, as well as the respective information collected by the CARE Experts Group through a questionnaire on the road accident data collection, were also considered. Following this review, it was decided that Annual Statistical Reports and several Annual Basic Fact Sheets will be produced both in electronic and paper form, based on disaggregated accident data retrieved from CARE. Additionally, a set of Aggregate Accident Data Files will also be produced, allowing the CARE user to have direct access to useful sub-sets of CARE data.

The Annual Statistical Report is a document consisting of approximately 55 Tables and 20 Figures with the most interesting combination of road accident data derived from the CARE database. No comments are included in the form of text and only data/information comparable among EU countries is used. Basic characteristics of fatal road accidents in the 14 member states of the European Union (except Germany) for the period 1994-2003 are included in the last version of the Annual Statistical Report 2005 (*Kuratorium für Schutz und Sicherheit, 2005b*). Every year, the new version will be prepared using the last available data from the CARE database and can be slightly amended to incorporate improvements either related to the document's format, or to its content, in order to get a more comprehensive picture of the road safety level

in Europe. Additionally, data for more years and more countries will be progressively incorporated, as soon as accident data from the new Member States will be uploaded into the CARE system.

The Basic Fact Sheets are documents dealing with more detailed road accident data/information on specific road safety topics in a clear, comprehensive to the wide public way. Basic Fact Sheets consist of Tables and Figures relevant to each topic, but contrary to the Annual Statistical Reports they also include principal analysis of the data and related comments in the form of text. Road accident data derives from the CARE database but also exposure data are used from other international databases (i.e. population, length of network etc.), enabling the development of appropriate rates and thus, allowing comparisons between different EU countries. Some basic characteristics of these Fact Sheets are that only data on fatalities and fatal accident are used allowing comparability among the various EU countries. They are annually updated and their size does not exceed 12-13 pages, they are easy-to-read and do not include extensive in-depth analyses, as their scope is to provide basic road accident statistics to the wide general public and not only to people specialised on road safety. Another important element is that the most worth-noticing comments are outlined in the "highlight boxes", as they attract the attention of the readers to focus at these issues and notice the relevant data included in the Tables and Figures. A comparative overview of the EU countries throughout the years and also the relevant trends for the same period are examined by looking at the time series of the specific issue within the last decade.

The road safety topics treated in the last version of the Basic Fact Sheets - 2005 are: Car occupants, Motorcycle and moped occupants, Motorways, Pedestrians, Children, Young people aged 16-24 years old, Elderly people (*Kuratorium für Schutz und Sicherheit, 2005c*). Four new Basic Fact Sheets will be prepared for the 2006 version, on Pedal cycles, Heavy goods vehicles, Junctions and one with Overall road accident figures.

Complementary to the above described documents, a set of Aggregate Data Files is planned to be developed, consisting of multi-dimensional data Tables based on accident data derived from the CARE database, which will allow users outside of the CARE structure to have access to aggregate accident data at European level. Thus, road accident data stakeholders will be able to access selected data variables and values of CARE in order to perform appropriate analyses and compare accident data among different EU countries.

Aggregate Data Files should have specific characteristics, in order to be easy to use by any potential user. Firstly, due to compatibility reasons among the various EU countries, these data files will be based on the number of fatalities or the number of fatal accidents. The use of any other casualty type (seriously and slightly injured) can also be used but the results cannot be comparable among the countries and might not be reliable, due to the increased underreporting level at these casualty types. Moreover, the size of the files should be limited and each file should contain at least the variables "Country" and "Year" and a maximum of three or four additional variables.

## **6. Conclusions**

Currently available road accident data, existing in various international databases (CARE, IRTAD, Eurostat, UN-ECE) provide a useful basis for road safety monitoring and analysis at national and European level. However, further enhancement and exploitation of these data is necessary, making the databases a complete and powerful tool for road accident analysis, useful for the improvement of road safety in the European Union.

The EC co-funded integrated project SafetyNet intends to deal with a number of challenges that the various databases face at present, through the application of a four-task methodology. Progressive incorporation of road accident data from the new Member States will allow for a complete road safety monitoring at EU

level and also enable comparisons between countries. At the same time, the improvement of road accident data compatibility throughout Europe can be achieved, through the establishment of a common framework for road accident data collection, among all EU countries. In this way, harmonisation of accident data at both national and EU level could be achieved and progressively, additional comparable road accident data from all EU countries will be available, allowing for more detailed, complete and reliable analyses. Identification of the real number of road accident casualties is possible by addressing the underreporting issue, through the establishment of appropriate underreporting coefficients for serious and slight injuries. Moreover, the possibility to use a new common measurement unit, the "hospitalised person", can be proposed, enabling the collection of comparable road accident data among the various countries.

The exploitation of the various European databases is also optimised through the development of a comprehensive set of statistical outputs with comparable statistics, useful for the support of decision makers, aiming to the improvement of road safety in the European Union. These statistical outputs concern Annual Statistical Reports and Basic Fact Sheets, as well as Aggregate Data Files derived from the EU CARE road accident database.

The adopted integrated approach described in this study, will allow the European road safety Community not only to fully exploit the current important road accident data potential but also develop the basis for further enhanced road accident databases and subsequently produce reliable conclusions and backup important road safety decisions at EU, national and local level.

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