

## Development of the European Road Safety Knowledge System

George Yannis<sup>a</sup>, Pete Thomas<sup>b</sup>, Nicole Muhrad<sup>c</sup>, Heike Martensen<sup>d</sup>, Letty Aarts<sup>e</sup>,  
Petros Evgenikos<sup>a</sup>, Eleonora Papadimitriou<sup>a</sup>

<sup>a</sup>National Technical University of Athens, Greece

<sup>b</sup>Transport Safety Research Centre, Loughborough University, United Kingdom

<sup>c</sup>Institut français des sciences et technologies des transports, de l'aménagement et des réseaux, France

<sup>d</sup>Belgian Road Safety Institute, Belgium

<sup>e</sup>Institute for Road Safety Research, The Netherlands

---

### Abstract

The objective of this paper is the presentation of the European Road Safety Knowledge System, which was developed within the DaCoTA research project of the 7th Framework Programme of the European Commission. This knowledge system includes a number of components, concerning data and tools, road safety issues and countries. A wealth of data was gathered, on road fatalities, exposure, safety performance indicators, socioeconomic indicators, health and causation indicators, road user attitudes & behaviours, traffic laws and regulations, road safety management etc., for 30 European countries. This data was used in road safety analyses leading to the Basic Fact Sheets, and the Annual Statistical report. Comprehensive syntheses of the literature on important road safety issues and methodologies were carried out, in the form of web-texts. Country analyses were also carried out, including road safety management “profiles”, “country overviews” and country forecasts. These were integrated through a web-based Road Safety Knowledge System. This System can be a very useful support for road safety research in Europe, and ideal to link research and policy making.

*Keywords:* European Road Safety Knowledge System; data; knowledge; analyses; syntheses.

---

### Résumé

L'objectif de cet article est la présentation du système de connaissances sur la sécurité routière européenne, qui a été développé au sein du projet de recherche DACOTA du 7<sup>e</sup> programme-cadre de la Commission européenne. Ce système comprend plusieurs composants, concernant les données et les outils, les questions de sécurité routière et les pays. De données ont été recueillies, sur les accidents mortels, les indicateurs d'exposition au risque, les indicateurs de performance de sécurité, les indicateurs socio-économiques, la santé et la causalité, les attitudes de l'utilisateur et les comportements, les lois de la circulation et des règlements, de la gestion de la sécurité routière, etc, pour 30 pays européens. Ces données ont été utilisées dans les analyses menant à des fiches de renseignements de base, et le rapport statistique annuel. Des synthèses exhaustives de la littérature sur les questions importantes et les méthodes ont été réalisées, sous la forme de web-textes. Des analyses par pays ont également été menées : «profils» de gestion de sécurité routière, aperçus de pays et prévisions. Ceux-ci ont été intégrés grâce à un système de connaissances de la sécurité routière basée sur le Web. Ce système peut être très utile pour la recherche de sécurité routière en Europe, et idéal pour lier la recherche et la politique.

*Mots-clé:* Système européen de la sécurité routière de la connaissance; données; connaissances sur la sécurité routière; analyses de la sécurité routière; synthèses de sécurité routière.



## 1. Introduction

Even though some European countries present a remarkable road safety level, being among the countries with the best road safety performance globally, there are several constraints that do not allow for accurate road safety analyses at a European level. The lack of specific data and of related details (accidents, injuries, exposure, performance indicators, etc.), the data compatibility and comparability issues among the European countries and the low reliability of data in several cases are the most common problems that need to be confronted. Additionally, the absence of standard methodologies for data/information collection and analysis is observed. Through existing analyses, the correlations between various parameters are identified, but not the causation of the accidents, thus analyses are not solution oriented. On that purpose, the necessity for systematic collection of road safety data and knowledge through a comprehensive tool is now more urgent than ever, allowing to consolidate and organise existing data and information and making data and information easily available as an one-stop service. Moreover, such a system should provide a complete tool-kit (analyses, methodologies, benchmarking tools) and support road safety decision making at all levels.

The objective of this study is the presentation of the European Road Safety Knowledge System, which was developed within the DaCoTA research project of the 7<sup>th</sup> Framework Programme of the European Commission and includes a number of components, concerning data and tools, road safety issues and countries. A three-step methodology was adopted for the development of this European Road Safety Knowledge System. Initially, a wealth of data and information was gathered and stored in an organised way, on road fatalities, exposure, safety performance indicators, socioeconomic indicators, health and causation indicators, road user attitudes & behaviours, traffic laws and regulations, road safety management structure and processes etc., for 30 European countries.

These data were subsequently used in road safety analyses leading to specific outputs on important road safety issues, namely the Basic Fact Sheets (on e.g. motorcycles, older drivers, rural areas etc.) and the Annual Statistical report. At the same time, comprehensive syntheses of the literature on important road safety issues and methodologies were carried out, in the form of web-texts (e.g. on motorcycles, cost-benefit analysis etc.). Country analyses were also carried out, including a number of outputs: Road safety management “profiles” were developed for each country, including the related structures and processes, the “good practice” elements, as well as the elements needing improvement. Moreover, “country overviews” were created, with country-specific data and information. Finally, country forecasts were developed, on the basis of a robust and specially developed methodology, in which the developments in road fatalities and exposure over the period 1970-2010 are used to forecast road fatalities on 2020, according to different mobility scenarios.

Finally, the structure of a web-based Integrated Road Safety Knowledge System was designed and developed as a comprehensive and integrated road safety information system containing in a structured way all above mentioned outputs (statistics, interactive data, knowledge and tools). In this system different types of road safety data and knowledge were included and respective structures were tested, allowing their future exploitation into the EC European Road Safety Observatory system by giving easy access to data, information and tools, and thus supporting the road safety policy making in Europe.

## 2. Data/knowledge collecting and processing

### 2.1. Assembly of road safety data

As a first step various types of existing road safety data and information was gathered from various national and international sources, initially directly from the sources and at a second phase through national Experts of the CARE/RSPI Experts Groups of the European Commission. On that purpose appropriate comprehensive Master Tables, as in Table 1 below, with all types of national data were developed and were gradually filled-in for 30 European countries.



Table 1: Snapshot of Master Table

Time Series Road Safety Data (1975 -2010)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Number of persons killed</b>																				
12 Total figures	2172	2150	2156	2253	2411	2157	2195	2182	2110	2037	1880	1634	1635	1630	1686	1657	1614	1553	1450	1281
13 drivers killed	1114	1186	1242	1286	1361	1207	1199	1251	1229	1155	1131	974	1010	1017	1053	1074	1018	1020	954	836
3 passengers killed	525	509	450	518	568	528	497	504	489	469	411	378	338	363	371	315	344	285	250	241
4 pedestrians killed	473	464	464	475	481	422	409	417	399	375	338	279	257	293	234	267	255	248	203	179
51 age group 0-14 (children)	30	21	30	38	24	23	25	25	18	14	19	16	9	15	11	11	13	12	10	4
61 age group 15-17	11	11	9	4	11	5	5	8	5	4	5	4	5	3	3	2	3	1	1	1
71 age group 18-24	28	15	27	30	19	20	15	18	13	16	9	12	9	11	8	14	8	3	7	4
81 age group 25-49	89	78	70	77	69	62	73	66	69	61	61	39	41	60	39	56	47	40	40	32
91 age group 50-64	105	90	103	83	80	83	75	68	67	58	59	48	38	46	38	33	36	36	31	28
101 age group 65+	242	238	256	248	243	237	204	223	209	210	173	152	148	143	126	141	140	142	98	100
111 unknown	0	1	4	1	6	12	12	16	19	11	13	8	8	15	12	10	8	14	15	10
121 Total vehicle occupants killed	1638	1694	1661	1774	1929	1735	1696	1765	1717	1662	1542	1355	1348	1377	1424	1390	1357	1305	1254	1079
131 vehicle age < 1 year	110	144	94	101	97	80	76	88	63	104	168	82	73	87	105	104	92	83	46	7
141 vehicle age 1-2 years	248	251	294	269	271	257	245	275	319	310	345	269	291	242	244	242	248	207	179	1
151 vehicle age 3-5 years	212	430	510	512	558	303	298	271	280	270	230	267	268	305	254	248	245	238	231	1
161 vehicle age 6-10 years	473	452	407	454	512	320	323	358	335	318	292	239	233	222	272	313	262	276	265	1
171 vehicle age 11-15 years	399	419	366	455	542	208	242	215	205	202	163	143	187	202	237	187	176	158	167	1
181 vehicle age >15 years	-	-	-	-	-	1817	1777	2300	2171	1771	1688	1634	1592	1177	1311	1162	1511	1551	1592	1
191 unknown	-	-	-	9	-	380	335	330	291	281	236	189	219	269	176	182	163	180	174	1079

Regarding road accident data, as they are already harmonised at the European level through CARE, the Community database with road accident data at disaggregated level, a list of 73 road accident elements (variables and values) collected from all EU countries using a uniform protocol was established. The main criteria for the selection of these basic figures were that the combined variables and values must be useful for macroscopic road accident analysis at EU level, but also that they are available and reliable in all EU countries. This set comprises of basic figures regarding number of persons killed as total figures, but also at a disaggregated form i.e. total vehicle occupants killed by vehicle age group, passenger car occupants killed by vehicle age group, motorcyclists killed by vehicle age group, moped riders killed, etc.

With reference to risk exposure data, a first assembly through EUROSTAT and IRTAD took place and a list of 97 risk-exposure elements was developed and included in the Master Tables: Population by age group, vehicle fleet by vehicle type and vehicle age, person-kilometres by vehicle type, vehicle-kilometres by vehicle type, vehicle-kilometres by road class, ton-kilometres, road length by road type, traffic per road type, economic and social indicators such as GDP, unemployment rate, fuel and alcohol consumption, etc.

Furthermore, data on selected Safety performance indicators (SPI), reflecting the operational conditions of the road traffic system, which influence the system's safety performance, have been gathered through the outputs of the SafetyNet project ([http://ec.europa.eu/transport/wcm/road\\_safety/erso/safetynet/content/safetynet.htm](http://ec.europa.eu/transport/wcm/road_safety/erso/safetynet/content/safetynet.htm)) but also through the National Experts using the Master Tables. The SPIs for which data were collected concerned alcohol and drug use, such as % of fatalities resulting from crashes involving at least one driver impaired by alcohol, % of drivers above legal limit for alcohol in roadside checks, amount of roadside checks by the police, etc. Similarly, regarding speeding the SPIs for which the related data were collected concerned average speed, % of speed limit offenders, % of vehicles over speed limit by road type, etc. Regarding protection systems for seat belt wearing the SPIs concern: Passenger cars - front seat (separated by driver and front seat passenger if available), Passenger cars - rear seats, Passenger cars - correct protection of children < 12 years, etc. For helmet use the SPIs concern: Cyclist helmets, Moped helmets and Motorcycle helmets. Regarding daytime running lights (DRL) the SPIs are: total usage of DRL, usage rate of DRL per road type, usage rate of DRL per vehicle type, DRL usage by road type and total DRL usage. Regarding vehicles the SPIs are: Vehicle fleet distribution by age, % of vehicle fleet tested by EuroNCAP, average EuroNCAP score for the vehicle fleet, vehicle fleet composition by vehicle type, crash worthiness, etc. Regarding enforcement the collected data concerned the following SPIs: number of speeding tickets by the Police, amount of alcohol tickets by the police, amount of seatbelt wearing tickers by the police and amount of helmet use tickets by the police. In total, 39 elements related to Safety Performance Indicators are available through the Master Tables.

Moreover, harmonised data and information regarding accident causation, across a number of European countries, was used, exploiting the in-depth SafetyNet Accident Causation Database collected from 6 countries following a common methodology and, importantly, a detailed process for recording causation called the SafetyNet Accident Causation System (SNACS). This resource includes 1.006 cases split between Germany, Italy, The Netherlands, Finland, Sweden and the UK and was used to produce some basic causation factors.

As combining road accident data with data on road accidents derived from the health sector can provide a better insight on the severity of the road accidents, an assembly of health data took place. Information on medical



environment from EUROSTAT was exploited and the following health indicators were defined: Health personnel by the type of personnel, hospital facilities and main causes of deaths.

Additionally, several other data useful for road safety analyses were gathered through the Master Tables. More specifically, data on underreporting of casualties and data on basic country characteristics (Area - km<sup>2</sup>, amount of unused land - % of total area, average winter temperature of the capital city, average summer temperature of the capital city, annual precipitation level for the capital city (mm), population density and population living in urban areas). In total, 263 data elements are available through the Master Tables, including 37 elements related to traffic laws and road safety measures, 27 elements related to road safety management and 14 elements related to under-reporting, social costs and country characteristics. These elements were selected as the most interesting among many others gathered, as described in the following section 2.2.

## *2.2. Assembly of road safety knowledge*

For the selection of the information, the Basic Principles for the DaCoTA Data Warehouse were applied, namely:

- Quality: Data and information are made public only after thorough quality control (availability, reliability, comparability, etc.),
- Transparency: All data and information available to everybody, accompanied with the related meta-data (sources, definitions, etc.),
- Independence: Data, information and especially analysis results should be checked for their consistency and any bias should be properly highlighted,
- Usability and Accessibility: An advanced user interface should guarantee easy access to all data and information.

Appropriate templates were developed as checklists for every type of information to be collected and the data collection was carried out in three levels. Firstly, all international and National sources, research projects and any other available sources and links identified were explored and exploited. Secondly, the CARE/RSPI Experts Groups were consulted to validate and add any further information. Finally, in some cases missing information was collected through direct contact with national contacts.

Data on basic road safety programmes in 30 European countries were gathered and examined, and several elements such as the existence of a broad national road safety strategy with measurable targets, a specific national road safety plan with quantitative goals, the progress achieved, the responsible organization for implementing the safety strategy plans, etc. are considered. Additionally, information on Road Safety Management for the various countries was gathered through the Master Tables. More specifically, 27 relevant elements were gathered regarding key functions in road safety policy making, road safety strategy or vision of the country, national plans and targets, availability of road safety management components, enforcement and remarkable road safety policy issues.

Moreover, data on road safety measures in European and other countries were gathered and organised in respective categories, covering different road safety areas and geographical levels. Various data sources were used concerning mainly results from research projects (PROMISING, ROSEBUD, SUPREME, RIPCORDEREST) and final reports/studies of CEDR, COWI and IRTAD. These measures were categorised into 4 main categories concerning Road User Behaviour, Road Environment, Vehicle and Road Safety Management consisting of more detailed sub-categories. In total, 655 safety measures were identified for the 34 different sub-categories and for each of them an exhaustive description and related information were recorded.

Information about traffic rules in the EU Member States was also gathered. Several rules were examined and a list of the most appropriate in terms of importance and EU availability was selected. In accordance with those arrangements, the data was divided into 4 groups: drivers, pedestrians, vehicles, emergency phone number. The scope of data collection was defined for each group and overall for the 4 categories 54 variables were defined and gathered for 27 Member States and Switzerland in an appropriate Table. Several websites were reviewed (95) to find out the necessary information, such as the European Commission (DG MOVE), World Health Organization, International organizations (e.g. ETSC - European Transport Safety Council, International



Transport Forum), Research Institutes, National sources as Ministry or road safety organizations. Each source and its data were evaluated and from each one the most reliable data were selected.

As information on how road users perceive rules, measures and behaviour in traffic can give additional insight in the public support for certain measures taken or to be taken and the self-reported behaviour also gives some additional insight in road user behaviour, related data on road user attitude and behaviour were selected and gathered. The SARTRE studies provided an appropriate source for this information. The studies span a number of years (1996, 1999, 2003, 2011), the data are harmonised between European countries, and are updated. From the SARTRE studies, the following issues were selected because they are relevant for road safety: Driver behaviour (self-reported) and Attitudes towards risk taking.

Regarding Driver behaviour, data on the following issues were gathered: speeding frequency by road network type, drink driving frequency during last week (over the legal limit and driving with some alcohol), protective system usage frequency by area type and road network type, red light (amber) running frequency, overtaking frequency in situations where it can just be made, tailgating frequency of too close following of the vehicle in front, giving way to pedestrians frequency.

Regarding Attitudes towards risk taking, data on the following issues were gathered:

- Alcohol and drugs: a) agreement on freedom for people to decide for themselves how much they can drink and drive and b) agreement on more severe penalties for drink-driving offences. This information is also available by age group and gender.
- Speeding: agreement on more severe penalties for speeding. Information is also available by age group and gender.
- Protective system usage: a) feeling of comfort when not wearing a seat belt and b) attitude towards the need of wearing a safety belt.

Moreover, as the costing of road accidents can also be envisaged as a tool of improvement of decision-making and a mean of classifying the politics, the projects, and the research regarding road safety, several existing studies and reports on accident costs calculation were reviewed and a synthesis report has been prepared, providing also recommendations for the harmonization of the calculation methodology between the countries.

### **3. Key road safety analyses and syntheses**

#### *3.1. Annual Statistical Report and Basic Road Safety Fact Sheets*

Several editions of the Annual Statistical Report were delivered (2010, 2011 and 2012) including 52 Tables and 26 Figures with the most interesting combination of selected road accident data related to: Person class, Person killed, Area type e, Motorway, Junction type, Weather conditions, Modes of transport, Month, Day of the week, Hour of day, from 27 European countries for a decade (Yannis et al., 2012a).

As access to the CARE database is only permitted to a restricted range of users, it has been important to develop a comprehensive range of publications based on these data that are accessible to the general public. The concept of the Basic Fact Sheet (BFS) with disaggregated road accident data for a decade on selected road safety topics, with worth-noticing comments outlined in the “highlight boxes” was developed, and progressively more Basic Fact Sheets are prepared and published annually. Within the framework of DaCoTA, three new editions were developed. In the most recent edition (2012) a separate Basic Fact Sheet on Causation was included. The set of eighteen Fact Sheets is listed in the Table 2 below. One part of the development has comprised adding details of accident causation to Fact Sheets where appropriate, based on in-depth accident data collected during the SafetyNet project, health indicators by the EU Injury Database, but also maps on specific road safety topics derived from the CARE system.



Table 2: 2012 Basic Fact Sheets

Basic Fact Sheet	Health indicators section	Causation section
Main figures	Yes	No
Children (aged<15)	Yes	No
Young people (aged 18-24)	No	Yes
The Elderly (aged>64)	Yes	Yes
Pedestrians	No	Yes
Cyclists	Yes	Yes
Motorcycles & mopeds	No	Yes
Car occupants	Yes	Yes
Heavy Goods Vehicles and Buses	No	Yes
Motorways	No	No
Junctions	No	Yes
Urban areas	No	No
Youngsters (age 15-17)	Yes	No
Roads outside urban areas	No	No
Seasonality	No	No
Single vehicle accidents	No	Yes
Gender	Yes	Yes
Accident Causation	No	-

Both the Annual Statistical Report and Basic Road Safety Fact Sheets were prepared according to guidelines (design principles) that are to be followed when such outputs are drafted or redrafted in the future, as more uniform style was desirable. The guidelines concern the formatting, the Tables and Figures design, the use of specific data (i.e. fatality data), the calculation of summaries, as well as statistical principles when presenting data. All these are based as far as possible on scientific principles, even though in order to achieve consistency, in some cases it has been necessary to make rather arbitrary choices.

### 3.2. Country Overviews

In order to facilitate road safety comparisons between countries, Country Overviews were developed in DaCoTA for each country (Aarts, 2012), not only presenting the current state of road safety in terms of annual number of crashes or traffic victims, but also containing information on precursors for crashes, such as behaviour and policy in a country. This information is organised by using the Road Safety Pyramid (Wegman et al., 2005) in which all layers are covered, related to: Structure & Culture, Programs & measures, Road Safety Performance, Indicators, Road Safety Outcomes, Social Cost.

The overviews start with a presentation of basic facts of a country, the organisation in relation to road safety and attitudes of the drivers, presenting the structure and culture layer. Next, the road safety goals, vision, actions and programmes are mentioned following a fixed format. The data for each country are provided along with a European reference (European average or mode) whenever the information is available. Road-user behaviour and other system-quality characteristics of the country are described in the safety performance indicators part. It contains information on speed, drink driving, vehicle safety, and use of protective systems. The next part contains a description of the annual number of road deaths and their characteristics, such as road transport mode, age and gender, location, lighting and weather conditions, and crash type. Numbers are provided for 2001 and the last year available (2009, 2010 or 2011). The average annual change and the share of the number or fatalities in the last year available are also provided. Furthermore, some risk figures can be found, as well as information on under-reporting of fatalities and severely injured road users. The country overview proceeds with information on road safety costs, which constitute the top layer of the road safety pyramid. The most prominent characteristics of the country in relation to road safety are finally summarised in a synthesis, where the safety



position of the country is recorded, the scope of the main problem is noted and any recent progress and any remarkable road safety policy issues are presented.

### *3.3. Road Safety Management Profiles*

The data and information gathered allowed for the preparation of the Road Safety Management Profile for each European country. In particular, a road safety management investigation model and questionnaire was used (Muhlrad et al., 2011), describing road safety management structures and outputs according to the policy-making cycle (agenda setting, policy formulation, adoption, implementation and evaluation) set against the background of a typical hierarchical national government organization. The most complete RS management system which would be obtained for a country fulfilling all the “good practice” criteria identified was used as a reference. For each country, “good practice” elements, lack of such elements and peculiarities were then summarised in a ‘diagnosis’ including structures, processes, policy-making tasks and outputs according to the investigation model.

For each country, the structures and the working processes were charted to provide a graphic picture of the road safety management situation (“country profile”), based on coded answers to the questionnaire and comments of governmental and independent Experts, interviewed within the framework of DaCoTA in the first quarter of 2010. Focus was on the national organization and the relations between national and regional/local structures and not on road safety management at the decentralized level, as it was agreed at an earlier stage of methodology building that this aspect could not be tackled in the time-frame of the DaCoTA project (Papadimitriou et al, 2012).

### *3.4. Forecast Fact Sheets*

Data and information gathered was exploited within DaCoTA for the estimation of road traffic fatalities based on time-series analysis, as it is important to know in what direction the annual casualties are developing, and how fast this development is expected to go. The methods applied to achieve the forecasts are sophisticated statistical tools, not easily understood by non-experts (Thomas et al., 2013). The forecasting results however, are of direct interest for road safety practitioners with all levels of statistical expertise, therefore it was decided not only to develop a technical description of the forecasting model and of the process that lead to its selection for each country, but also the Country Forecast Fact Sheets (Dupont & Martensen, 2012). The forecast factsheets are meant to give a relatively non-technical description of the past development of the fatalities (and of the exposure if available). The road traffic fatalities, the traffic volume and the fatality risks are forecasted to 2020 and also forecasts according to mobility scenarios are carried out for all 30 European countries, with exposure as most important explaining variable. If known, the (possible) reasons for the developments are shortly described. Forecasts of the road safety situation in every country include a description of the method adopted to produce these forecasts.

### *3.5. Syntheses on key road safety issues/web-texts*

Finally, syntheses on key road safety issues were prepared in the form of 22 web texts, containing high quality information on important road safety topics. The information is scientifically founded, easy to read and ready to use and for each of the subject treated, includes an overview of the magnitude of the problem, prevalence and countermeasures. The topics that are covered by the web texts are:

- Age groups: Children o Novice drivers o Older drivers
- Road users: Pedestrians and cyclists, Powered two wheelers
- Hazardous behavior: Driver distraction, Cell phone use while driving, Fatigue, Alcohol/drugs, Speed and speed management, Work-related road safety
- Post-crash: Post impact care, E-safety
- Road safety measures: Roads, Speed enforcement, Vehicle safety
- Policy issues: Quantitative targets, Cost-benefit analysis, Safety ratings, Road safety management, Integration of Road Safety in other policy areas

All these web texts were initially developed in SafetyNet and updated in DaCoTA, under supervision of an editorial group (SafetyNet) and editorial board (DaCoTA), both consisting of international road safety experts,



who were responsible for producing the information about a specific road safety subject. Both editions of the web texts (SafetyNet and DaCoTA) are available in the European Road Safety Knowledge System.

#### 4. Integrated Road Safety Knowledge System

The structure of a web-based Integrated Road Safety Knowledge System (see <http://safetyknowsys.swov.nl>) was designed and developed as a comprehensive and integrated road safety information system containing in a structured way all gathered road safety data and knowledge, as well as the outputs of their analyses (Figure 1).



Fig. 1 Integrated Road Safety Knowledge System

In this system different types content were included and respective structures were tested, allowing their future exploitation into the EC European Road Safety Observatory system by giving easy access to data, information and tools to anyone interested in road safety issues and thus supporting the road safety policy making in Europe. More specifically, persons using the system will be those interested in road safety related issues, in conducting their own analysis on basis of this data, or in comparing the performance of countries to determine what can be done to improve road safety. For those users who want to do their own analysis, it means that a certain level of knowledge of the quality and analyses of road safety data and tools is required. It is therefore expected that the users of the European Road Safety Knowledge System will consist of policy makers, researchers and press. Based on the stated objectives and the target groups, the system was designed to meet certain specifications: the data should be easily accessible and also be as interactive as possible. In terms of content, the System consists of five main components (Yannis et al., 2012b): Safety issues, Countries, Statistics, Methods, Links.

The safety issues part is the knowledge base meant for the Integrated Road Safety Observatory of the European Commission, where the user can find high quality information on important road safety issues in the form of web texts. The information is scientifically founded, easy to read and ready to use. For each of the subject treated, the information consists of an overview of the magnitude of the problem, prevalence and countermeasures. The subjects are broadly related to Age groups, Road users, Hazardous behaviour, Post-crash, Road safety measures and Policy issues.

Moreover, in order to help policy makers and researchers to have a good view of the road safety state of European countries, a number of country tools have been included in the System, including the Country Overviews, and Forecasts.

The statistics part contains road safety related data and important information on what to do with crash data. The data is organised either as part of an interactive data browsing tool (e.g. crash and exposure data) or as static data (Annual Statistical Report, Basic Fact Sheets, data about Safety Performance Indicators and driver behaviour/attitude).





To get high quality data, information and well-structured tools, for each road safety product included in the System a respective methodology has been developed and is described. The procedures of gathering safety issues and collecting information for the country tools are presented, as well as the procedure for collecting statistics and the related information (meta-data) and in-depth accident investigation.

Additionally, a complete set of more than 400 links to external files is developed, gathering, linking and standardising road safety data as well as other sources, by providing reciprocal web links. The type of information that can be disclosed includes National data files, International data files, Research project links and Stakeholder links. The list includes the link to the website, a brief description of the organisation, project or database. Also the country and the type of link are specified and can be used to search. In total, more than 400 links are organised in several user-friendly ways, allowing the users to search for the information/data they need by Alphabetic order, Country, Focus (each divided by sub-categories) and Organisation.

Regarding the functional specifications of the System, these have been defined within the Dakota partnership, in consultation with the CARE Experts Group. The Cognos PowerPlay was used as software allowing the development of a full-fledged data browser tool within the budget and the time available in the project.

## **5. Conclusion and next steps**

During the last two decades, the systematic efforts for gathering and harmonising road accident data at the European level have led to a significant upgrade and enhancement of the EU databases. Moreover, important data collection and harmonization efforts have provided very useful results as regards exposure data and safety performance indicators; however, the availability, completeness and level of harmonization of this data varies significantly. At the same time, additional data and related information sources have been established at EU level, including in-depth data, behaviour / attitudes data, programmes and measures data, social cost data etc., mainly in the framework of European research projects. However, these data sources are still not of sufficient comparable quality, are still not sufficiently linked, and the aggregate data are not always accessible. Finally, an important amount of national data remains unexploited at the European level.

The European Road Safety Knowledge System presented in this paper is a solid but easily accessible, integrated road safety system that allows not only for better integration of the various data assembly processes, but also for the provision of a complete set of data services, with full documentation of the data and information and their sources, in order to support road safety knowledge and the related decision making. This system is developed as a complete working tool for road safety stakeholders, for which not only a full description of the structure, format and content is designed and specified, but also the related content is provided, consisting of a complete set of aggregate road safety related data (road accident data, risk exposure data, safety performance indicators, in-depth data, health indicators/data), knowledge (programmes, measures, legislation, social cost, behaviours/attitudes, regulations) and the related key road safety analyses and syntheses outputs (Annual Statistical Report, Basic Fact Sheets, Country Overviews, web-texts, Road safety management profiles, Forecast Fact Sheets, etc.).

The European Road Safety Knowledge System can also serve as example for the further enhancement of the European Road Safety Observatory (ERSO), as new structures and features were tested during the development procedure and new data, knowledge and analyses outputs have been assembled and have become available for incorporation into the existing ERSO.

Next steps for the improvement of this road safety data and knowledge tool concern carrying out more surveys for collection of exposure data, development of additional performance indicators and detailed recording of driver behaviour. These should be supplemented by more large scale experiments on in-depth accident investigation, naturalistic driving and driving simulator, more research and analyses, enabling the identification of more solutions to real life problems, thus leading to a more rigid European Road Safety Observatory.

Moreover, it is noted that decision making of national and international Authorities and Stakeholders will significantly benefit from the operation of a powerful European Road Safety Observatory making available



complete data sets and targeted road safety analyses and syntheses, since more data and more knowledge widely available will progressively lead to the continuing reduction of casualties at the European roads.

### **Acknowledgements**

This paper is based on work carried out within the scope of the DaCoTA (Data Collection Transfer and Analysis) project of the 7th Framework RTD Program of the European Commission. Additionally, the members of the EC CARE Experts Group, representing the 27 Member States have given considerable support to the project.

### **References**

Aarts L. (2012). Implementation of Country Overviews: Meta-Data. Deliverable 4.5. of the EU project DaCoTA. Available on-line at: [http://www.dacota-project.eu/Deliverables/Country%20overviews/Country%20overview%20meta%20data\\_def.pdf](http://www.dacota-project.eu/Deliverables/Country%20overviews/Country%20overview%20meta%20data_def.pdf)

Broughton, J., Brandstaetter, C., Yannis, G., Evgenikos, P., Papantoniou, P., Candappa, N., Christoph, M., van Duijvenvoorde, K., Vis, M., Pace, J-F., Tormo, M., Sanmartín J., Haddak, M., Pascal, L., Amoros, E., Thomas, P., Kirk, A., Brown, L. (2012) Assembly of Annual Statistical Report and Basic Fact Sheets - 2012, Deliverable D3.9 of the EC FP7 project DaCoTA.

Dupont & Martensen (Eds.) 2012. Forecasting road traffic fatalities in European countries. Deliverable 4.4 of the EC FP7 project DaCoTA. Available on-line at: [http://www.dacota-project.eu/Deliverables/DaCoTA\\_D4\\_4%20Final2.pdf](http://www.dacota-project.eu/Deliverables/DaCoTA_D4_4%20Final2.pdf)

Muhlrad, N, Gitelman V, Buttler I. (Ed) (2011) Road safety management investigation model and questionnaire, Deliverable 1.2 of the EC FP7 project DaCoTA.

Papadimitriou, E., Yannis G., Muhlrad N., Gitelman V., Butler I., Dupont E. (Eds) (2012) Analysis of road safety management in the European countries, Deliverable 1.5 Vol.II of the EC FP7 project DaCoTA.

Thomas, P, Muhlrad, N, Hill, J, Yannis, G, Dupont, E, Martensen, H, Hermitte, T, Bos, N (2013) Final Project Report, Deliverable 0.1 of the EC FP7 project DaCoTA.

Wegman, F., Eksler, V., Hayes, S., Lynam, D., Morsink, P. and Oppe, S. (2005). SUNflower: A comparative study of the development of road safety in the SUNflower+6 countries: Final Report. SWOV Institute for Road Safety Research, Leidschendam, the Netherlands.

Yannis, G., Evgenikos, P., Aarts, L., Kars, V., Brandstaetter, C., Bauer, R., Broughton, J., Haddak, M., Lefèvre, M., Pascal, L., Amoros, E., Zielinska, A, Wnuk, A., Lucas, M., Pace, J.-F., Sanmartin, J., Kirk, A., Thomas, P., (2012a). Data Warehouse - Final Report, Deliverable 3.8 of the EC FP7 project DaCoTA.

Yannis, G., Evgenikos, P., Aarts, L., Kars, V., van den Berg, T. (2012b). Design and development of the road safety data warehouse – Final Report, Deliverable 3.7 of the EC FP7 project DaCoTA.