Road Safety Data, Collection, Transfer and Analysis

Deliverable No. 4.10
Overview Work Package 4

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1. OBJECTIVES OF WORK PACKAGE 4

The DaCoTA project aimed at providing policy makers with adequate data, information and tools for performing evidence-based policy making. In earlier and current EU projects, a rich variety of data, information and methods has been gathered and will continue to be gathered. In this context, the goal of work package 4 was to make this stock of knowledge accessible and directly useable for the development of road safety policy and decision making. Work Package 4 therefore: (1) exploited the data available for analysis by providing forecast of the road safety situation in the different member states and (2) worked on the development of ready-to-use instruments. Tools that were well-appreciated in the past, such as overview fact sheets, or web-texts were up-dated and standardised. The use of standard methods was complemented by research activities to generate new tools like the national forecasts or the composite road safety index. All these activities were conducted in close communication with the user-group itself, the policy makers or those who directly support them.

2. ACTIVITIES OF WORK PACKAGE 4

Three general tasks were conducted in this work package: (1) contacts with the target group - decision makers and other actors directly supporting road-safety decision making - for input and feedback about the products developed,, (2) the analysis of new data collected in WP3, more specifically for the forecasting of fatality numbers in the different member states, and (3) the collection of existing knowledge to form tools for policy support. In the following, we will give a detailed description of the activities in each of the tasks.

2.1. Decision support feedback group

To ensure the usability of tools that are designed to help policy makers in a knowledge-based decision process, it is essential to carefully register the needs of the target group and to re-check the usability of the emerging products. The design of the tools therefore took place in constant interaction with potential users of these products.

2.1.1. Evaluation of available panel

The European Road Safety Observatory is closely linked with a panel of road safety experts that is entertained by the European Commission. For each country, there are two types of experts: an expert on the road safety statistics and an expert on the safety performance of the country in question. This group has been established to build up the CARE database in which all fatal road crashes in Europe since 1991 are registered. Due to the theoretical work in EC projects like SUNflower and SafetyNet, it was recognized that more knowledge is needed on countries´ road safety performance (e.g., the amount of speeding, drunk driving, seat belt usage, etc.) to take a more proactive position. The original group of “CARE experts” was therefore extended to experts on road safety performance indicators and is therefore called the “CARE/RSPI” group.

At the beginning of the DaCoTA project, it became clear that an additional step was necessary to gain knowledge about the type of scientific information and tools needed in road safety policy making. This is essential for Work Package 1 on road safety policy making, but also for the Work Package under discussion here (WP4) to design the tools that should serve policy makers in the most accessible way.

The first step was therefore to map the expertise of the CARE/RSPI group and to evaluate to which extent they would be able to answer questions about policy makers and policy making. On the basis of a questionnaire, it was investigated who would be the suitable target group for questions about policy making (if not the CARE experts themselves, they indicated another person better suited). On the basis of the results, a panel composed – for each country - of a road-safety expert and of an expert involved in decision-making processes was set up.

2.1.2. Registration of policy makers needs

A consultation was launched for the preliminary assessment of knowledge, data and analysis needs within road safety management for evidence-based road safety decision making in the European countries. The results identified specific needs for knowledge, data and tools, which will be taken into account for the creation of useful

and relevant road safety decision support tools (WP4) and the development of a knowledge system (WP3)[1]..

Two parallel consultation methods were implemented; the first concerned semi-directive interviews carried out by partners from WP1 and WP4 with members of the panel mainly from their own countries. The second concerned a request for written contributions (procedure adopted in case of language or time constraints). Particular emphasis was given to the open nature of the questions, both within the interviews and the written contributions, allowing the experts to describe their own experiences, views and messages and to put emphasis on the issues they consider themselves important, without being "directed" by a detailed questionnaire to specific judgments.

The consultation provided a wealth of information on all aspects of road safety management in the European countries. A synthesis of the results of this open consultation was carried out by means of a predefined matrix. In this matrix, the basic road safety management tasks (fact finding, program development, implementation, monitoring, evaluation, etc.) cross-tabulated with distinct categories of needs (knowledge needs, data needs, methodological needs, tools needs etc.), allowed to link specific aspects of road safety policy making to specific benefits from using the necessary knowledge, data, methods and tools.

First of all, the need for setting ambitious yet realistic targets for the improvement of road safety was confirmed. As regards the development of road safety programmes and the selection of measures, a need for methodological advances was identified, including the improvement of cost-benefit and cost-effectiveness analyses, so that they can serve both for setting priorities and for assessing the combined effects of road safety measures. Moreover, the creation of handbooks and databases with accumulated international experience on the evaluation of measures was proposed, with emphasis on the country-specific conditions necessary to take into account in order to reach the maximum benefit of each measure.

With respect to the planning and implementation of road safety programmes and measures, the need to gather the available information from the international experience of measures implementation was frequently expressed. In particular, the information and data on the procedures, the conditions, the time frame and the costs for implementing the measures need to be made available at European level.

Furthermore, the monitoring and evaluation task is considered to be most essential, not only for assessing the effectiveness of road safety measures, but also for identifying needs for further improvement. Several methodological needs were also mentioned, including the need for standardized assessment tools (statistical models, analysis techniques etc.), that will allow for the identification of the reasons and mechanisms leading to the observed safety effect of the measures.

Finally, a number of issues concerning the availability and quality of data for knowledge-based road safety management were outlined. They include the need to address the injury under-reporting problem at European level, the need for improved methods for determining accident locations by means of GIS technologies and tools, the need for improved exposure data, for increasingly reliable behavioural data and the need to promote the collection and use of in-depth accident investigation data. The Experts also stressed the need for road safety databases of different types

[1] Moreover, this preliminary consultation of the Experts Panel served as a first step towards the full assessment of current practices and future needs of knowledge-based road safety management, that was to be carried out later on by means of a broader consultation of stakeholders (WP1)

(accident data, health data, exposure data etc.) to be linked and to be made more accessible.

For more details on the policy makers´ needs investigation, see D1.1-4.1.

2.1.3. User-based revision of tools

All output generated in Work Package 4 was constantly monitored by the road-safety experts of the CARE/RSPI groups. The members were involved in the whole production process. They were regularly consulted at all stages of the production process, and asked to comments on draft versions of tools produced for the different member states (forecast factsheets, country overviews…). Due to this, the CARE-RSPI experts strongly contributed to the design, the content, and the final appearance of all products.

2.2. Analysis and forecasting

The frequency of accidents and the number of fatalities evolve over time. In fact, the number of fatalities has decreased in most European countries in recent years. It is important to monitor these developments, focusing on a number of key questions

> Has there been a continuous, smooth development or were there abrupt changes?
>
> If there have been changes, are they to be attributed to changes in the actual risk of having (fatal) accidents, or rather to changes in traffic volume?
>
> Where does the present development get us (if continued)?

The yearly number of road traffic fatalities in the different European countries is available in the CARE database. Road safety fatalities – although by no means the only interesting measure – are the key measurement to analyse and compare the development of road safety across countries, because they are less susceptible to underreporting than other measures.

2.2.1. The forecasting model

For the work done in this task, **fatality risk** is a key concept that is assumed to underlie the observed fatalities. Generally speaking, risk is defined as the occurrence of an unwanted event (here dying in a road crash) considered relative to the *exposure* to this risk (here the mobility in a country, usually measured by vehicle kilometers). It is important to consider the risk trend, because it shows to what extent the rises and falls in the development of road traffic fatalities are to be considered a “simple” consequence of the changes in mobility, and to what extent they have to be attributed to changes in the fatality risk.

The Latent Risk Time-series model is an advanced statistical model that allows monitoring the fatality risk. The forecasts of these models are in fact a combination of forecasts of the fatality risk and forecasts of the mobility. This statistical model is tailored to the evaluation of road safety developments, but had not been implemented as a modelling software so far. The first step was consequently to implement the model in the framework of a free statistical software package (R), and to make it available to other interested researchers by the same token. The

underlying theory, the guide through the software, a step by step instruction to conduct the analysis, and a number of exemplary analyses are available in D4.2.

2.2.2. Forecasting fatalities in European countries

Once the method and software to analyse the development of fatality risk were available, a number of important decisions had to be made before producing the forecasts for the different countries.

2.2.2.1. Choosing the right model

The quality of the estimation of the fatality *risk* depends crucially on the quality of the mobility estimator. If the chosen mobility indicator does not accurately reflect mobility, the estimation becomes flawed. The danger is then that changes in the number of fatality (e.g. a drop in fatalities) would be confidently attributed to changes in the fatality risk (i.e. safer roads), while in fact they may only be a consequence of a reduced mobility. We had some indication that this could be a problem for several countries. The question therefore was: “How to evaluate the quality of a mobility indicator?”

The method to test this was to evaluate whether changes in mobility could actually be traced in the development of the fatalities. Although there can be other factors that affect the number of fatalities (i.e. a change in risk), a sudden decrease or increase in mobility should be seen in the development of the number of fatalities. The procedure and results for testing whether this is the case are described in D4.4. It turned out that in 14 of the 30 countries, no influence of mobility could be observed, and consequently it was decided to analyse the development of the road fatalities without including an exposure indicator in the model.

2.2.2.2. What to do about the recession?

The most recent figures for most countries concerned the year 2010. For many countries there had been a sharp drop in fatalities since the year 2008 and there is reason to suspect a relation with the economic recession that started in the end of 2007. The investigation of similar phenomena in the past indicated that it is unlikely that these drops will continue as steeply in the future. There are different techniques to deal with this (described in D4.4) but it comes down to the choice between two evils: (1) being very conservative and therefore running in danger to ignore some real progress that has been made in road safety in the recent years or (2) to come up with overconfident forecasts that assume a continuation of the most recent trends that is probably unrealistic. Generally, we opted for the more conservative approach, however, for 7 countries (AT, IT, RO, ES, UK, CZ, LT) this was not possible and the forecasts for these countries must be considered very optimistic.

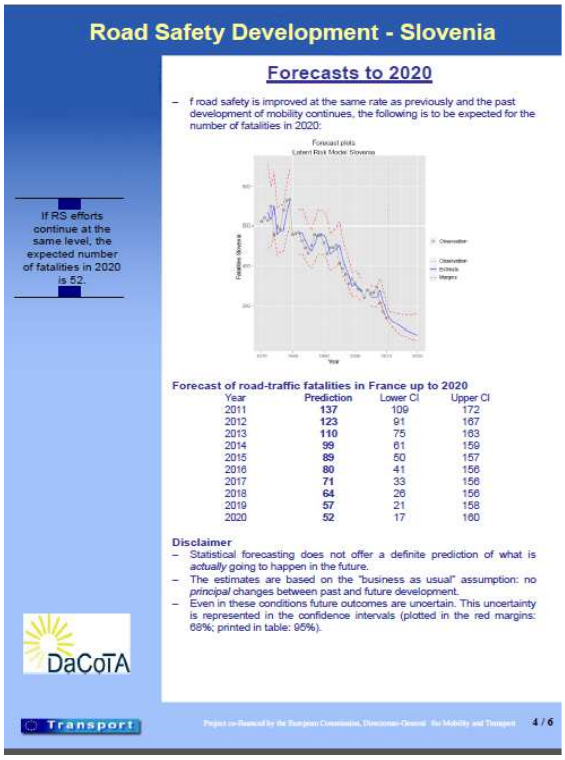
2.2.2.3. Presenting the forecasts

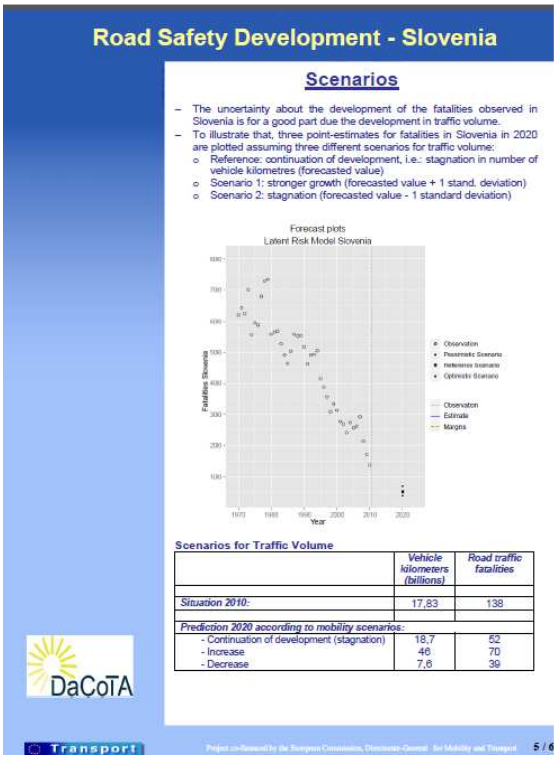
The methods applied to achieve the forecasts are sophisticated statistical tools, not easily understood by non-experts. The forecasting results however, are of direct interest for road safety practitioners with all levels of statistical expertise. We therefore decided to have two different types of report for each country:

The *full report* is a technical description of the forecasting model and of the process that lead to its selection. These detailed country reports are written for experts with an understanding of the statistical principals underlying latent state modeling (see D4.2).

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). If known, the

(possible) reasons for the developments are shortly described. The forecasts of the fatality numbers up to 2020 (assuming the continuation of the past development!) are also provided. Whenever an exposure measure of the necessary quality was available, an estimation of the fatality risk is presented along with three scenarios based on different assumptions for the development of mobility in the next 20 years.





2.2.3. Towards an European forecasting model

The example of the recession had shown us that it is very important to look at the development of the number of road traffic fatalities (or other outcomes) in the European countries in parallel. After the recession had started, we saw a drop in fatalities that occurred in different countries in a similar way. This example shows that it is interesting to look for certain prototypical developments that were shared to varying extent by several countries. In D4.7, we explored the possibility to formalize this approach and to express the development in different countries each as the sum of the *same underlying prototypical developments*. For each country, the prototypes would be weighted in a different way, which leads to the different developments that we actually observe. The technique proposed is based on macro panel analysis methods and is situated in the front-line of research concerning the analysis of data that is simultaneously related over time and across units (e.g., countries).

2.3. Tools for policy support

A lot of information has been collected within DaCoTA and other European projects. This ranges from databases to analysis results, best practices and software. The aim

of this task is to take the necessary steps to make this information accessible to policy makers.

The focus of the products in this task is the presentation of knowledge in topical form, on the one hand, and on using the data collected from WP3 (data warehouse) on the other hand. All information and tools are meant to be included in the European Road Safety Observatory.

2.3.1. Updating and adding web texts

One of the valuable products that were initialised in SafetyNet, are the web texts on a number of relevant road safety issues. Within DaCoTA, these web texts have been updated and also a few issues have been added. Another aim regarding the web texts was to organise them better in order to prevent problems when they are transferred to ERSO.

The information in the web texts is scientifically founded, easy to read and ready to use. For each subject, the information consists of an overview of the magnitude of the problem, prevalence and countermeasures.

In order to guarantee the quality of the web texts and the state-of-the-art of the updates, a sound production and controlling procedure has been set up. In this procedure, experts were asked to write or update the text, and this was done under supervision and responsibility of an editorial board.

In DaCoTA, the following highly esteemed experts were member of the DaCoTA Editorial Board, which was chaired by Divera Twisk (SWOV Institute for Road Safety Research):

- Rune Elvik, TOI, Norway
- David Lynam, TRL, UK
- Ralf Risser, Factum, Austria
- Claes Tingvall, Swedish Road Administration, Sweden
- Pete Thomas, VSRC Loughborough university, UK

The topics that are covered by the web texts are:

- Age groups
  - Children
  - Novice drivers
  - Older drivers
- Road users
  - Pedestrians and cyclists
  - Powered two wheelers
- Hazardous behaviour
  - 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

The organisation of the web texts in relation to ERSO has been tackled by transferring the original web text format into an interactive pdf-format. This enables users still to navigate within the text, but also to use the texts as print-out for other uses. A short introduction of the problem has been added in the website to attract the attention of the user to the text and to indicate the relevance of the issue at hand.

2.3.2. Functional specification and evaluation of browsing tool for data-warehouse

Within WP3 of DaCoTA, a data-warehouse has been set up in which products of WP4 and other WPs have got their place in a user friendly environment. In this subtask of WP4, the aim was to define functional specifications that could be used as guidelines by producing a data browsing tool (DBT).

In the functional specifications of the DBT, user groups as well as types of data have been defined. Also the importance on information on the data at hand has been emphasised: meta-data. Finally, functional aims have been defined: data should be easily accessible and interactive and meta-data should be visible as well. In the final data-warehouse that has been built within WP3 (the Safety Knowledge System), these functional specifications were met as far as possible. For some data that was available, there was no use in making them interactive. These data are then presented in fixed format. Also, a few examples of meta-data have been implemented.

2.3.3. Specification and implementation of country overviews

To help policy makers and researchers to have a good view of the road safety state of European countries, country overviews of all 30 European countries have been developed. Furthermore, a meta-document has been produced to give some background information on definitions and calculations used.

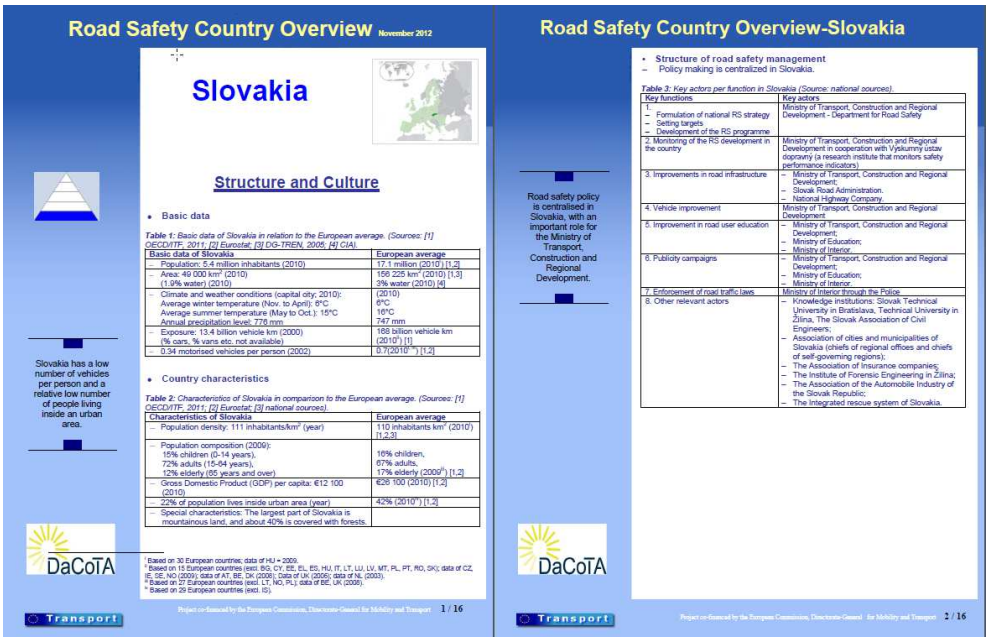
The country overviews not only present the current state of road safety in terms of annual number of crashes or traffic victims, it also contains information on precursors for crashes, such as behaviour and policy in a country. This information is organised by using the road safety pyramid as theoretical framework:

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 underregistration 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.

Country overviews are available for the following countries:

- Austria
- Belgium

- Bulgaria
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Latvia
- Lithuania
- Luxemburg
- Malta
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- United Kingdom



2.3.4. Advancing road safety performance index

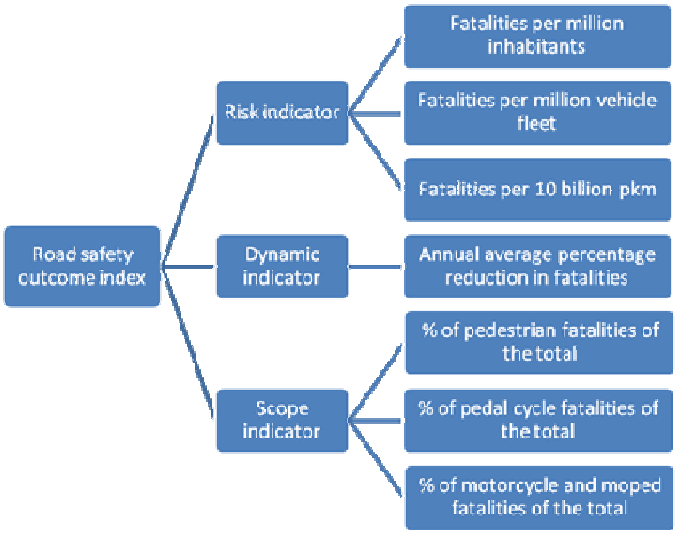
In this study, it was investigated whether it is possible to develop a Road Safety Index. The Road Safety Index is a so-called Composite Index: an index composed of several indicators which each separately and all together measure a specific field, in this case road safety. Such an instrument is used in various policy fields. Examples of composite indexes in other fields are the Sustainable Development Index, the Innovation Index and the Human Development Index. A composite index is an instrument to benchmark performances between countries, in this case road safety performances. This enables countries to compare themselves to others, it stimulates positive competition and shows specific improvement possibilities. Composing various indicators into one figure prevents policymakers and politicians from having to construct a complete picture out of a large number of indicators themselves. Despite the added value, there are specific features that a composite index does not offer. For example, it does not explain the differences between countries. Countries have to use the detailed figures from which it is composed to clarify their own scores. Furthermore, the Road Safety Index is not a prediction of road safety in the future and due to lack of (reliable and recent) data, the indicators used to compose the index cannot explain all variance between the countries.

Like the road-safety country overviews, the road safety index uses the road safety pyramid as a theoretical basis for benchmarking. The Road Safety Index however, uses only four layers of the pyramid:

1. The Outcome layer, containing the number killed and injured
2. The layer of the Safety Performance Indicators
3. The Policy Indicators layer
4. The Structure and Culture layer, to group countries into two groups with more or less comparable characteristics

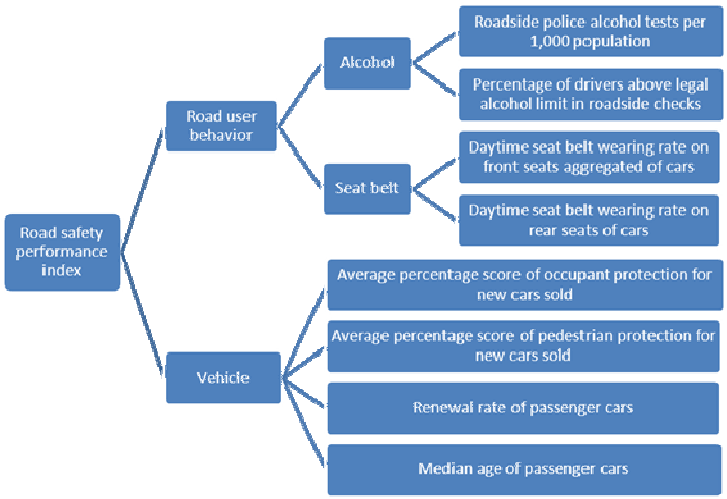
The Index does not use the Social Costs layer , because all available indicators for social costs are directly based on the outcome layer. On the one hand, the choice of variables or indicators within these layers is based on the theoretical framework developed in the SUNflower project and extended in the SafetyNet project (SUNflowerNext report). On the other hand, the indicators included were determined on the basis of data availability. We used various data sources for the index, such as IRTAD/OECD, CARE, UNECE, Eurostat, ETSC. The data of the 27 EU countries plus Norway, Iceland and Switzerland are used in the Index.

The indicators used to measure the outcome layer (number of killed and injured) are shown in the figure below. These are indicators such as fatalities per million inhabitants, but also more specific indicators such as percentage of cycle fatalities, or the annual average percentage of reduction in fatalities.



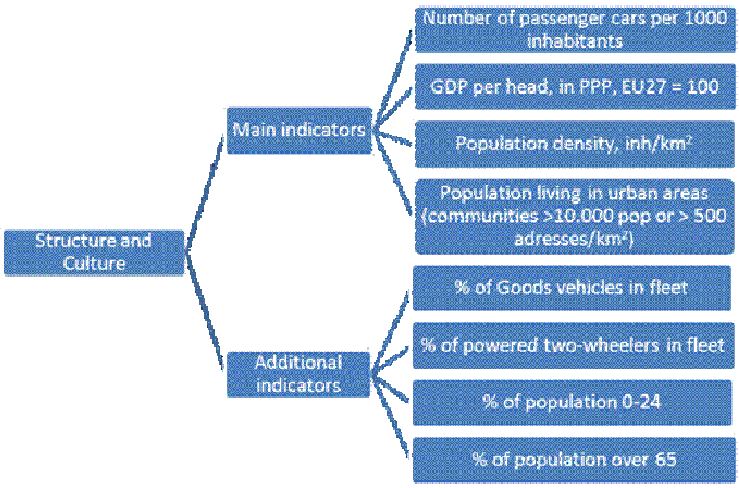
We also decided on indicators to measure the safety performance of countries, focussing on indicators for alcohol, seat belt wearing and car safety. Of course there are many more

equally important safety performance indicators. The limitations encountered in this case relate mainly to lack of reliable, complete and recent data. The figure below shows the indicators chosen for safety performance:



For the policy indicators layer, several theoretical frameworks are available, but there is not much empirical evidence for the effect of road safety management structures -- as measured by policy indicators -- on road safety. WP 1 has done an empirical study on this topic, and their work shows interesting preliminary results: some clusters of policy indicators are positively correlated with road safety outcome, and some individual indicators are positively correlated with safety performance indicators (see Deliverable 1.5 – Vol. II). However, all in all, the current knowledge available on this issue is insufficient for the formulation of policy indicators As a consequence, although a theoretical framework for organising the indicator for this layer has been developed in this work package, no index was actually calculated for this layer.

The last layer of the pyramid, the structure and culture layer is used to divide the countries into two groups with more or less comparable characteristics with respect to road safety. The indicators for this layer are represented in the figure below:



Within each layer, the indicators are composed into one figure, using the Data Envelopment Analysis method which is widely used for the construction of composite indexes. The result should of course be scientifically sound, but it is also important that the results are recognisable and understandable for policymakers. The structure and culture layer is used to form two groups with a maximum of comparability within the groups and a maximum of diversity between the groups. The first group includes 10 countries: RO, BG, HU, SK, LV, PL,

EE, PT, CZ, LT, and, on average, is characterized by lower values of economic development. The second group includes the remaining 20 countries, that score generally higher, but also more diverse on the structure and culture characteristics.

In a composite index in the original sense of the word, the sub-indices on (1) outcomes, (2) road safety performance indicators (SPIs) would again be combined into a single figure to represent the road safety for each country by means of one single number. According to the methodology of composite indices, this would not be justified if these two indices would correlate so strong that they measure practically the same concept; in that case, a composite index would be superfluous. An investigation into the associations between the two indices revealed indeed a correlation between the SPI index and the final outcome index. But still, the index scores differ in so many instances that a composite index would make sense provided that corrections are made for the correlations.

Ideally, an overall Road Safety Index (the RSI) would provide an unambiguous ranking of all countries, taking into account all indicators of safety outcomes. However, we came across some serious theoretical and practical problems when developing such RSI. It can be concluded that further research with respect to the weighting of layer- indexes is needed In this study, we opted to visualize the two constructed layer- indices in a graph (with four quadrants) in order to enable a country to compare itself with the 'best of class'. This will be illustrated for the two groups of countries. For each group, a graph with two dimensions is composed, representing the score of each country on both composite indices. The dotted green lines indicate the boundaries of "moderately high" safety performance levels, according to the results of both analyses. Thus the countries in the 2nd green quadrant (positioned in the upper right corner) are considered to be the best of class.

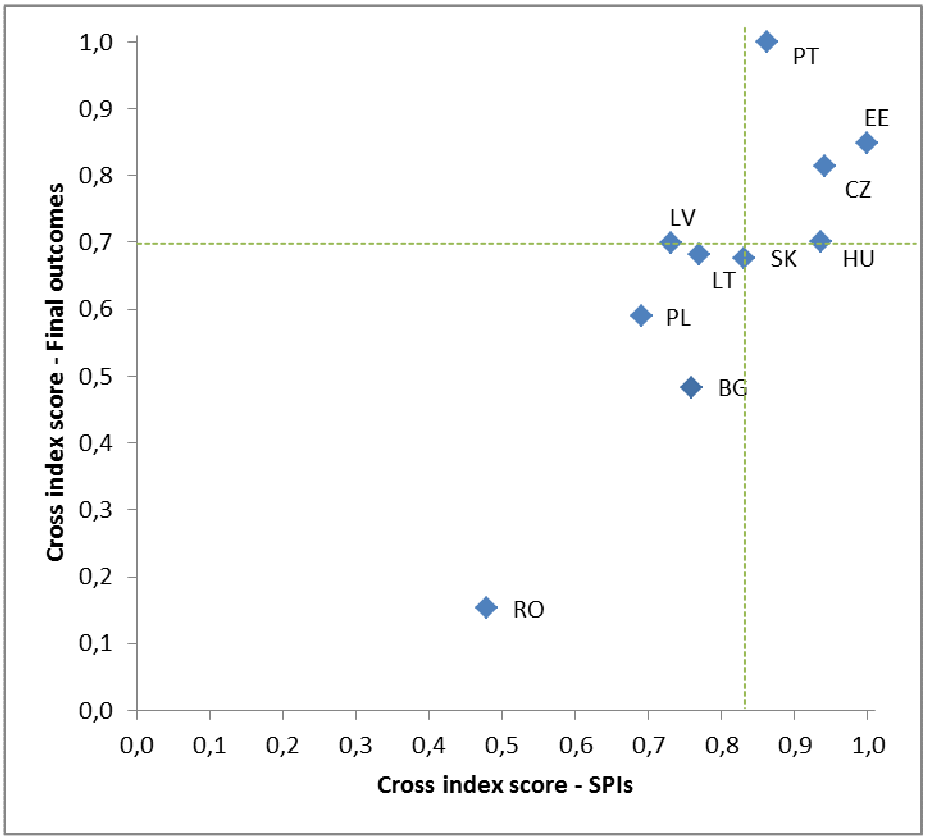


Figure Countries of group 1 plotted in accordance with their composite index scores.

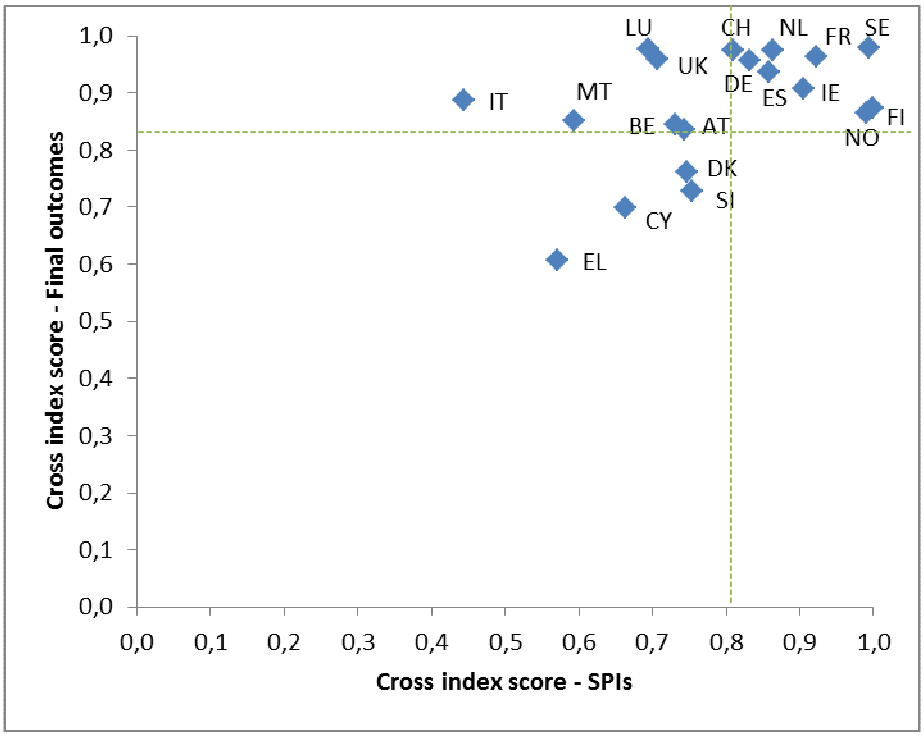


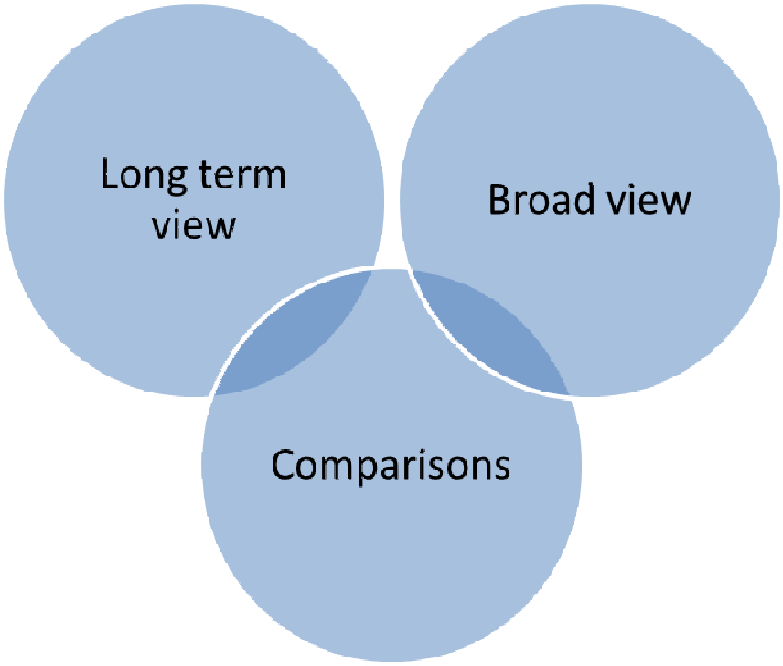
Figure Countries of group 2 plotted in accordance with their composite index scores.

These figures enable any country outside the upper right corner to compare itself with the best performing countries. A better final outcomes and/or SPI index value would allow them to move to the best quadrant. Further comparisons of the indicators composing the relevant layer-index make clear on which SPI(s) and/or on which final outcome(s) indicator one should focus. This method does not offer the possibility to compare countries that are better on the one and worse on the other index. For such comparison, the relative weight of both indices need to be established.

To answer the research question of this study: is it possible to develop a composed Road Safety Index. The Road Safety Index that has been designed here can be further improved in the future. In the design process, it became clear that more reliable and comparable data on SPI's, as well as additional fundamental research on road safety management and on the relevant structure and culture indicators are needed. Also, research on the exact relationship between the various layers of the road safety pyramid is necessary. Finally, the aim for the future should be to improve and to update the Road Safety Index, to make sure that policymakers and politicians will use this instrument to improve road safety in their country.

3. CONCLUSION

Work Package 4 integrated research results from other EU research projects (e.g. SUNflower, SUNflowerNext, SafetyNet, COST329, Rosebud, etc.) as well as data from other Work Packages of DaCoTA (WP3, WP1), and complemented it with own research to form ready-to- use products for road safety practitioners.



A large part of the information presented by WP4 focusses on the *countries* and enables a number of different views for each country:

- A *long term view* that allows to describe past road safety developments and to project them in the future so as to be able to evaluate actual future developments in the light of these projections.
- A *broad view*, enabling policy makers to see a complete picture of the road safety situation in a particular country. Instead of focussing on the outcomes, a broader array of aspects is considered that (might) determine the observed outcomes: structural and cultural characteristics of the country, its management structure, the measures taken to address road safety issues, various safety performance indicators concerning speed, alcohol, seat-belts, vehicles, enforcement, the social costs resulting from road unsafety in the country, and - last but not least - the fatality numbers and risk calculations for a wide range of different user groups and accident constellations.
- A *country comparison*, giving to composite scores for (1) road accident outcomes, and (2) road safety performance.

Next to the country information, WP4 also produced *topical information*. While the country information has mostly been gathered in this or previous EC projects, the topical information given in the web-texts summarizes research results from all over the world in an easily accessible text.

A good cooperation with the other Work Packages was essential for the functioning of Work Package 4. Together with Work Package 1, the needs of road safety policy makers were established that served as a guide for the present and future activities.

There was a strong interaction between Work Package 3 and Work Package 4. Work Package 3 delivered the data necessary for the analyses in the present Work Package, while Work Package 4 delivered the specifications for the knowledge system and helped significantly filling it with its products.

An important principle in Work Package 4 was the continuous consultation of the potential users and other road safety experts. The on-going communication with the road-safety experts group entertained by the European Commission helped shaping the products eventually presented here. Four well-known road safety experts guided the production of the web-texts, and another group of road renowned experts reviewed the methodology of the composite road safety index. All these continuous interactions contributed to the production of tools that are both methodologically sound and accessible to road safety practitioners.