DaCoTA

**Road Safety Data, Collection, Transfer and Analysis**

# Deliverable 1.5 Vol.1 – Analysis of the stakeholder survey: perceived priority and availability of data and tools and relation to the stakeholders' characteristics.

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# EXECUTIVE SUMMARY

This report is part of the 'Policy' Work Package of the DaCoTA project (www.dacota-project.eu). The 'Policy' Work Package is designed to fill in the gap in knowledge on road safety policy making processes, their institutional framework and the data, methods and technical tools needed to base policy formulation and adoption on scientifically-established evidence. This document provides the results of a detailed analysis of a survey conducted with a large panel of stakeholders. The aim was to assess what they considered to be priorities and necessities in terms of scientific data, information, and tools to conduct their road safety activities. The aim is to improve our knowledge of the items that should be included in the ERSO website or that are included in the website already but deserve being highlighted somewhat. Concrete recommendations are eventually made that should contribute to the ERSO's usefulness for a wide variety of road safety actors.

The present report builds on a model that has been previously defined in the same Work Package to formally describe the Road Safety Management process, and to couple it with scientific input. This model conceives road safety management as involving 4 key tasks: (1) Fact Finding; (2) Programme Development; (3) Preparing Implementation; (4) Monitoring and evaluation. For each type of task, scientific support may prove necessary, either in terms of data, tools for the treatment of these data, training tools, or other decision-support tools (see Muhlrad, Gitelman, & Buttler, 2011 for a detailed description of the road safety management model used).

The Road Safety Management model has first served as basis for the interview of a panel of road safety experts (see Muhlrad &, Dupont, 2010 for a complete report of the interview analysis). Their answers served as basis to design a questionnaire which was meant to be submitted to a wider array of stakeholders involved in road-safety. This questionnaire contained questions concerning the background of the stakeholders and, structured around the 4 road safety management tasks listed above, a list of possible data, information, and tools that could be used as input for the different tasks. The stakeholders answering the questionnaire were asked to rate each of these items' level of priority for the type of road safety activities that they were performing along with its availability. In total, 512 stakeholders returned the questionnaire. A first description of the results can be found in Machata, Barnes, & Jahi, 2011.

The present deliverable contains the results of a further in-depth analysis of the stakeholders' answers to that survey. In a first step, common dimensions underlying the priority and availability ratings of the tools listed in the questionnaire have been identified. Then, in a second step, these dimensions were used to identify "groups" (clusters) among the stakeholders. Finally, it was investigated whether the groups formed on the basis of the underlying priority-availability dimensions were associated with variation in the background characteristics of the stakeholders (country, type of organisation they were working for, type of road safety activities in which they were involved).

Each of these analysis steps was performed in 2 different ways: Firstly, treating the priority and availability ratings separately, and secondly, by recoding the priority and availability ratings so as to recombine them into a common scale (the higher the score on this new scale, the more the item is considered to be a priority *and* to be unavailable). For this reason, the second type of data treatment is referred to as the "needs analysis".

The results revealed that meaningful dimensions can be identified that summarize the priority-availability ratings of the items included in the questionnaire in an efficient

way. This was the case both when the priority and availability ratings were treated separately or recombined into a “needs” scale. Although the content of the dimensions identified varies somewhat depending on the type of data treatment, most of them display important similarities in content. Other dimensions, on the other hand, emerge more specifically when analysing the availability ratings or the combined “needs” scale.

These dimensions furthermore ease the grouping of the stakeholders on the basis of their priority and availability ratings of the more than 50 items originally listed in the questionnaire.

Working exclusively on the priority ratings, 4 different clusters were identified:

- Cluster 1 representing the stakeholders with “low priority for everything”;
- Cluster 2 representing the stakeholders considering that data and models are specifically important,
- Cluster 3 includes stakeholders that tend to assign “high priority for everything, but especially implementation”,
- Cluster 4 corresponds to stakeholders assigning high priority to in-depth data mostly

The investigation of the relation between the different clusters the stakeholders are assigned to and their background characteristics reveals no clear relation with the type of country they originate from. They are however more clearly related to the type of organisation the stakeholders work for, e.g. stakeholders from the industry appear to be over-represented in the 4$^{th}$ cluster, while those from associations and interest groups tend to be over-represented in the third one and stakeholders working in national or regional administrations tend to be over-represented in cluster 2.

On the basis of availability ratings, 3 clusters were identified:

- The first one groups stakeholders who basically declare that information on costs and benefits of measures are available, but that models are not.
- Cluster 2 corresponds to stakeholders declaring that models are available, but that data and definitions are needed.
- Finally, stakeholders in Cluster 3 request information about the costs and benefits of measures.

Again, the investigation of background characteristics reveals little association with the countries the stakeholders work in, but a stronger relationship with the type of organisation they work for. Stakeholders from both research institutes and national/regional organisations tend to be over represented in the first cluster, but under-represented in the third one, while stakeholders from associations and interest groups tend to be over-represented in the second cluster.

Finally, when working with the combined “needs” scale, 6 clusters are identified:

- Cluster 1 “needs for most items, especially accident and infrastructure analysis”;
- Cluster 2 “moderate needs for all”,
- Cluster 3 “High needs for models, moderate needs in other, implementation unimportant”,
- Cluster 4 “No needs for models, moderate needs in implementation”
- Cluster 5 “Low importance of implementation and models, moderate needs in crash causation”
- Cluster 6 “High needs for implementation but no use of accident and infrastructure analyses

The stakeholders in the first cluster only rarely state that data and tools are of “high importance” for their professional activities, do not seem to use databases (national and international) much, and tend to declare more that they are “very satisfied” with the data and resources currently available. This cluster does not clearly relate to any particular type of organization, of road safety activity, or of country.

The stakeholders in Cluster 2 generally consider data and tools to be important in their daily road safety activities, report making substantial use of databases (international and national). Stakeholders involved in sensitization activities tend to be better represented in this cluster and generally consider scientific input to be relatively important for their professional activities, without showing a marked preference for any particular type of information.

Stakeholders involved in research and working for road safety organizations tend to be over-represented in Cluster 3. This cluster is the one with the highest proportion of respondents declaring that tools are very important for their road safety activities and tending to assign very high priority to statistical models.

Cluster 4 is also characterized by a substantial proportion of stakeholders involved in research activities. They stress – although to a moderate extent – the needs for information about the implementation of measures, the safety impacts of measures and on accident analysis with regard to road infrastructure.

Cluster 5 contains the highest proportion of policy makers, along with a higher proportion of respondents from the industry. These stakeholders generally tended to consider all data and information types as less important (especially information related to the implementation of measures and statistical models), but they stressed more the importance of accident causation information and information on the safety impacts of measures.

Finally, the stakeholders in Cluster 6 did not report using databases much. This cluster is, along with Cluster 5, the one containing the highest share of policy makers. Clearly “sensitization” is a dominant activity among these respondents. They insisted on the importance of information related to the implementation of measures and, on the other hand, on the lesser importance of accident and infrastructure analysis.

The report ends on a discussion of the implications that the analyses’ results have for the ERSO. On the basis of an overview of the dimensions identified on the basis of the stakeholders ratings, concrete recommendations are made for the future development of ERSO, in terms of project results whose accessibility and visibility should be ensured on the website (EU-funded, national projects or other international research initiatives), but also in terms of data collection.

# 1. INTRODUCTION

A stakeholder survey has been conducted during the first year of the DaCoTA project in order to assess the scientific input (information, data, tools…) that actors involved at various levels and in various areas of road safety consider important and necessary for their work. The survey was designed on the basis of a theoretical framework describing the key tasks and sub-tasks making up the Road Safety Management process developed in the framework of Work Package 1 (see Muhlrad, Gitelman, & Buttler, 2011 for a complete description of this model). The model explicitly foresees that the decisions to be taken in the context of each of these RS management tasks needs to be supported by scientific knowledge and tools. This framework is consequently bi-dimensional (the type of road safety management task and type of scientific support associated with each of them) and is often referred to as to the "RS management matrix".

This framework decomposes the RS management process into 4 main tasks:

• Fact Finding

• Programme Development

• Preparing Implementation

• Monitoring and Evaluation

… which can be coupled with 4 types of scientific support:

• Data

• Tools for data treatment

• Other decision-support tools

• Training tools.

In an exploratory phase, the road safety management matrix has been used as basis to conduct semi-structured interviews among a panel of RS experts (see Muhlrad &, Dupont, 2010 for detailed results). They were asked to describe freely the way in which each of the 4 main tasks was performed in their respective countries and to identify the most important gaps in terms of knowledge, data, or tools that impaired an efficient, proper execution of these tasks.

The majority of the experts interviewed could be qualified as "road safety researchers" although originally the aim was to include to a similar extent people more actively involved in decision making. The material obtained on the basis of these interviews was qualitative: The answers of the expert panel were compared and classified by the Work Package 1 partners. The questionnaire forming the basis of the stakeholder survey is directly based on this first, exploratory step.

In total, around 3150 individual stakeholders have been invited to complete the survey[1], among which 512 effectively did so.

[1] Contact lists from several sources were used to notify stakeholders of the questionnaire and to invite them to participate: The stakeholder list of the EU commission, the contact database

The questionnaire was constructed in two parts. The first one aimed at collecting "background information" allowing to better describe the stakeholders' involvement in the field of road safety, such as: the country to which they belong, the type of organisation they worked for, the types of activities they were primarily involved in concerning road safety, the level of influence they attributed to their organisation in terms of road safety management, and the extent to which they resorted to international/national databases to perform these activities.

The second part consisted in a list of items structured along the key Road Safety Management tasks (see Table 1 for a complete overview, the original questionnaire is available in Machata, Barnes, & Jahi, 2011). All items listed in correspondence to a given task had been identified as important and/or unavailable by the panel of experts previously interviewed. The respondents were expected to evaluate each item listed on two different dimensions: (1) its perceived priority for their personal work, and (2) its perceived availability at the level of their country (i.e., the extent to which, according to their knowledge, the item in question was available would they want to use it).

| **Fact Finding and diagnosis** |
|---|
| A common definition of a fatality |
| A common definition of a serious injury |
| A common definition of a work related crash |
| Data on the under-reporting of road traffic crashes |
| Crash databases that link police and hospital data |
| The use of GPS and/or GIS technologies in accident data collection |
| Information on road user behaviour and attitudes |
| Exposure data |
| Statistical methods for priority setting |
| Results from in-depth crash investigations |
| Results from naturalistic driving studies |
| Results from driving simulator studies |
| Information on the effect of external factors on the number of road traffic crashes |
| Information on frequent crash scenarios and patterns |
| Information on crash causation factors |
| Other (please specify below) |
| **Development of Road Safety related programmes** |
| Statistical models and tools for target setting |
| Information on the impacts of road safety measures on other sectors policies (environment, health…) |
| Standardised procedures and methods for carrying out evaluations of road safety measures |
| Information on the safety impacts of singular road safety measures |
| Information on the safety impacts of combined road safety measures |
| Information on the costs and benefits of a road safety measure |

of the European Transport Safety Council, national contacts of the members of the ETSC PIN panel and national contacts of members of the Forum of European Safety Research Institutes (FERSI).

| |
|---|
| Information on the public acceptance of a road safety measure |
| Comparisons of the frameworks in which road safety policies and measures are implemented |
| Comparisons of safety rules and regulations |
| Comparisons of road safety policies and measures regarding specific road user groups |
| Good practice catalogue of measures -- including implementation conditions |
| Other (please specify below) |

| **Implementation of Road Safety measures** |
|---|
| Detailed information from road safety audits and road safety inspections |
| Detailed road databases providing descriptions of road layouts, signing and marking, etc. |
| Common methodology for identifying high risk sites ("black-spots") |
| Common methodology for in-depth crash analysis |
| Digital road maps for mapping crashes |
| Tools for simulating road user behaviour |
| Comparisons of driver training programmes across Europe |
| Detailed data on the costs of road safety measures across Europe |
| Methods to assess the training needs of individuals involved in road safety implementation processes |
| User-friendly interfaces to assist new users in finding road safety materials on the internet |
| Good practice collection on how countries have implemented specific road safety measures |
| Good practice and methodologies for monitoring implementation |
| Information on potential funding sources for road safety measures |
| Collections of video clips and billboards of road safety campaigns |
| Other (please specify below) |
| **Monitoring and Evaluation** |
| Methods for evaluation of safety impacts of road safety measures |
| Common methodology for the evaluation of costs and benefits of road safety measures |
| Statistical methods for following trends |
| Focusing on seriously injured counts, in addition to fatality counts |
| Short term forecast models (up to 2 years) |
| Medium term forecast models (up to 5 years) |
| Long term forecast models (up to 10 years) |
| Statistical methods for isolating effects of specific policies or measures |
| Crash prediction models for various road types and layouts |
| Comprehensive monitoring of implemented measures across Europe |

**Table 1: Items from the stakeholder survey**

The priority ratings were made on a scale comprising four response options: “High priority” (3); “Medium priority” (2); “Low priority” (1), and “Not relevant to my work” (0). The availability of each item was evaluated on the basis of the following response options: “Already available” (3); “Partially available” (2); “Currently not available” (1); “Unknown” (0).

In total, the stakeholders had to answer 11 background questions and to evaluate 52 items with respect to priority and availability.

A first report of the results can be found in Machata, Barnes, & Jahi, 2011. The aim of the analyses presented here is to go one step further by examining:

(1) Whether a meaningful structure can be identified in the needs and availability ratings that the stakeholders provided for the different items.

(2) Whether, based on these ratings, meaningful "groups" of stakeholders could be identified

(3) Whether these groups – or "clusters" – are associated with background characteristics of the stakeholders (which would be related to variations in their priority and availability ratings).

Each question has been analysed in two different ways: first, treating the priority and availability ratings *separately* (see Sections 3.2.1; 3.2.2 and 4.2.1, 4.2.2), then by recoding these scores to *combine* them in a common scale emphasizing the extent to which the items listed in the questionnaire were considered both as priority *and* as being unavailable (Sections 3.2.3 and 4.2.3). As a consequence, this new scale can be considered to reflect the extent to which the items evaluated are *needed* (items that are both evaluated as priority and as missing). For the sake of clarity, this second type of analysis will be referred to as the "analysis of needs" in the remainder of this deliverable, while the first type of analysis will be referred to as "the separate analysis of priority and availability ratings". Apart from this main difference in the way the stakeholders' responses are coded, the analyses are globally similar from the point of view of the statistical methods used (data reduction techniques to answer the first question followed by clustering analysis to answer the last two questions).

The analyses presented here thus provide important information on the dimensions underlying the priority and availability of the various items presented in the original stakeholder survey, and how the scores on these components vary with other characteristics of the stakeholders, such as country, organisation type, etc. For the sake of completeness – although this was not the primary aim of these analyses – variations in the responses provided by stakeholders from one and the same country were also examined. This question has been investigated for a set of countries (namely: Austria, Poland, Spain, and UK), but focusing on the individual items contained in the original questionnaire, not on the underlying dimensions. The aim was to provide an overview of the items of the original questionnaire which – among the stakeholders coming from the same country – have been evaluated most consensually as important and, on the other hand, the items that have raised the most disagreement in terms of their perceived importance. The results of this additional analysis can be found in Appendix 5 of the present report.

# 2. DATA TREATMENT

## 2.1. Missing values

Of the 512 stakeholders who returned the questionnaire, only 189 answered to all questions. Among the 323 who had returned incomplete questionnaires, 107 did not answer any of the questions. These were consequently excluded from the analyses. The missing values for the other incomplete answers have been imputed using the MI procedure of SAS 9.2[2]. After imputation, 405 cases were available for the analysis. A more detailed description of the no-responses and otherwise incomplete questionnaires ("extent of incompleteness", country of the respondents, type of organisation and of road safety activities) can be found in Appendix 1 of this report.

## 2.2. Coding of variables

### 2.2.1. Background variables

We can reasonably expect a number of characteristics of the stakeholders to be related to their ratings of the priority and availability of the items presented in the questionnaire. This is certainly true for all work-related characteristics, such as the type of organisation the stakeholders work for, and the type of activities they perform. The original questionnaire included eleven "background" questions, some of them with many multiple answers. It was therefore necessary to further summarize this dataset. For this purpose, a factor analysis has been conducted on those of the variables that contained the most numerous response options and re-coding operations have been applied. Both are described below for each of the background variables contained in the questionnaire.

- *Country:*

A first variable was defined to indicate whether the country of residence of the respondent was located inside (1) or outside (0) the European Union.

Another variable, "type of European country" was coded to indicate whether this country could be considered part of "the EU 15", a "new" Member State, or a country from the European Region (but outside the EU).

- *Type of organization:*

Ten categories were defined as follows:

> Associations and Interest Groups (Association, Automobile club, Consumer association, European (umbrella) organization, Interest Group);

[2] It should be noted that the MI procedure performs multiple imputations of missing data. This means that the missing values in this study were not completed with mean values or conditional means across the whole dataset, since these approaches treat missing values as if they were known in the complete-data analysis. Such single imputation methods does not reflect the uncertainty about the predictions of the unknown missing values, with the consequence that the resulting estimated variances of the parameter estimates will be biased toward zero (Rubin, 1987 , p. 13). Hence, we used a Markov Chain Monte Carlo (MCMC) method that assumes multivariate normality, and that can be used for an arbitrary missing data pattern. Since the purpose of this research is mainly descriptive, we used the median of the multiple imputations to avoid the complication of multiple imputations' analysis of the survey results.

Research (Private and public research institutes, Universities);

National/regional administrations (Ministry, National Government, Public enterprise, Regional/local authority, Road administration, Statistics bureau);

Industry (Automotive industry supplier, Automotive manufacturer, Haulier, Insurance industry, Consultancy);

Road safety organizations;

European administration (European Commission, European Parliament);

Services (Health, Emergency services (excluding police));

Media

Police

Other

- *Policy-makers:*

A new variable was created to indicate whether the respondent can be considered a policy-maker (1) or not (0).

A “policy maker” is in this case someone who declared that “Policy Making” was one of their main road safety related activities, or who stated that they worked for an organisation type that was considered to be strongly associated with policy making, but had not stated policy making as one of their main road safety related activities. These organisation types were: European Parliament, European Commission, National government, Local/regional government, Ministry and road administration. Note that the answers from this particular subgroup of stakeholder have been the object of a separate deliverable (Talbot, Dupont, Gitelman, Thomas, 2012)

- *Type of road safety activities:*

The types of activities the stakeholders are involved in were measured in the questionnaire by means of fifteen variables. The factor analysis carried out on the background variables allowed the identification of two factors that efficiently summarize many of the different possible types of activities: a “sensitization” factor, which includes activities like “Campaigns”, “Communication”, “Education”, “Training”, “Government lobbying”, and a “research” factor, which includes activities like “Data collection and analysis”, “Monitoring and evaluation”, “Planning and design”, “Infrastructure safety”, “Research (commissioning)”, “Research (conducting myself)”.

Other activities, such as “Vehicle safety”, “Enforcement”, “Management”, “Policy making” - could not be combined with the others and were therefore considered separately.

- *Level of influence*:

The survey questionnaire included 4 questions aiming at determining the extent to which each stakeholder considered the organisation he/she was working as influential at the European, national, regional, and public levels. The factor analysis carried out on the background data produced a factor reflecting the scores on all four variables: the lower the factor value, the higher the influence of the organisation.

- *Use of international databases:*

The stakeholders were asked whether they resorted to any of the following international databases in the framework of their road safety activities: ERSO,

IRTAD, CARE, UN-ECE, EUROSTAT. On the basis of the factor analysis, one single factor was produced that indicates the extent to which the stakeholders reported using all these databases (the higher the score on this factor, the more numerous the cited databases that the stakeholder reported to use).

*Use of national databases*:

The stakeholders were asked whether they resorted to any of the following national databases in the framework of their road safety activities: road accidents, travel/mobility, other exposure databases. On the basis of a factor analysis, one single factor was produced that indicates the extent to which the stakeholders report using all these databases (the higher the score on this factor, the more numerous the databases used).

The questionnaire contained other background questions that cannot straightforwardly be combined into more general dimensions and have thus been considered separately. These variables comprise "experience in the field of road safety; "use of other (i.e., other than mentioned above) international databases", "use of other (i.e., other than mentioned above) national databases"; as well as general statements concerning the perceived importance of using data and tools in everyday activities along with the satisfaction felt towards the data and resources available.

Note that, when working with the priority and availability ratings separately, only three of these background answers have been taken into consideration, namely, "Type of European country", "Type of organization", and "Policy maker". Only the analysis based on the combined "needs" scale uses the full array of background variables described above.

### 2.2.2. Priority and availability ratings

The stakeholders were asked to indicate the extent to which they considered each item in the questionnaire to be a priority on the basis of one of the following answer options: (3) "High priority", (2) "Medium priority", (1) "Low priority", (0) "Not relevant to my work". The response option "Not relevant to my work" was considered equivalent to a "not a priority at all" answer.

The availability ratings were provided on the following scale: 3 "Already available", 2 "Partially available", 1 "Currently not available" and "Unknown". The status of the "unknown" response option in this scale is a bit problematic (it does not make part of the other response categories). It appears that all items evaluated as "not relevant to my work" were associated with an "unkown" availability rating (as one could logically expect given that stakeholders are not supposed to enquire about the availability of items they don't need). However, "unknown" availability ratings also appear to be evenly distributed across other values of the priority assessments, so that items considered to be of "low priority" or even of "high priority" seem equally likely to be rated as "unknown" on the ground of availability[3]. Consequently, when analysing the availability ratings separately, the choice was made to consider the "unknown" ratings as additional missing values. This resulted in a reduction of the sample, as only 143 responses were eventually retained for the analysis. These "unknown"

[3] The correlations between the answer options to the availability and priority scales have been examined in order to determine whether some correspondence could be established between « unknown » answers on the availability scale and "not relevant for my work" on the priority one, but this does not seem to be the case. More details on this correlation analysis are provided in Appendix 2.

ratings were treated differently in the "needs" analyses (i.e., combining priority and availability estimates), as described below.

To combine priority and availability estimates, the choice was made to put more emphasis on the items that were considered both important *and* unavailable rather than on items rated as already available. As a consequence, the answers to both scales were combined in the way described in Table 2.

| | | **Priority level for my work** | | |
|---|---|---|---|---|
| | | High | Medium | Low/ Not Relevant |
| **Availability at the level of my country** | Already available | 5 | 6 | 9 |
| | Partially available | 2 | 4 | 8 |
| | Currently Not available/ Don't Know | 1 | 3 | 7 |

**Table 2: Rules for creating a combined priority and availability estimate**

A score of 1 was assigned to items that the stakeholders considered to be very important *and* unavailable, a score of 2 was assigned when the item was considered very important *and* partially available, a score of 3 was assigned when the item was considered to be of medium priority *and* as unavailable (or unknown), "4" indicates items evaluated as being of medium importance and partially available. Items that are declared to be available already but considered to be of high or medium priority received a score of 5 and 6, respectively. Finally, all items judged to be of low priority or as irrelevant for the stakeholders' work were assigned a score of 7, if also considered unavailable, a score of 8 if considered partially available, and a score of 9 if available.

As Table 2 indicates, the value "Unknown" was in this case combined to "Currently not available". As a consequence, the total number of cases used for this analysis is higher than the one available for the separate analysis of the availability ratings. Given the important number of "unknown" responses for the availability ratings, this also implies that, on the new scale, all scores involving either the "currently not available/don't know" response options (i.e.: scores 1, 3, and 7) become more numerous.

# 3. DIMENSIONS UNDERLYING THE AVAILABILITY AND PRIORITY RATINGS

## 3.1. Method

Two data reduction techniques have been applied: Principal Component Analysis (PCA) for the *separate analysis of priority and availability scores* and Factor Analysis (FA) for the analysis of the combined *needs scale*.

Both analysis techniques aim at accounting for the largest possible amount of variance in the observations (in this case the individual items from the original questionnaire) on the basis of the smallest possible number of factors (Nardo et al., 2005). To state it otherwise: they aim at uncovering, in a set of observed variables, variables that together form coherent subsets that are also relatively independent of the others. "Variables that are correlated with one another but largely independent of other subsets of variables are combined into factors or components" (Tabachnik & Fidell, 2001).

The two techniques are close to each other and rest on the same basic analytic steps. We will therefore not discuss the differences between the two techniques in this report[4]. The reader just has to remember that Factor Analysis produces *factors*, while Principal Component produces *components.*

In both cases, the correlation structure of the data is analysed in a first step. Before extracting components or factors, one has to ascertain that the data at hand are indeed suited for PCA/FA. First, the Kaiser-Meyer-Olkin (KMO) measure can be used, which is an indicator of "sampling adequacy" (Cerny & Kaiser, 1977). Values above 0.7 are considered to be very satisfactory. Kaiser-Meyer-Olkin (KMO) statistics are used to demonstrate if the data are likely to factor well, based on their correlations and partial correlations[5]. There is a KMO statistic for each individual variable, and an overall KMO statistic. It is customary that the overall KMO should be 0.60 or higher to proceed with the analysis. If this condition is not satisfied, one should drop the variables with the lowest individual KMO statistic values, until the overall KMO rises above 0.60.

For the PCA, the *variable communalities* were also considered. The communality values express the extent to which the variance of a variable is accounted for by the factors identified[6]. Variables with low communality values are also variables that do not have much in common with the others in the dataset (and therefore are poorly predicted by the set of factors or components). It is therefore logical to remove them from the analysis.

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[4] The main difference between PCA and FA lies in the variance that is analysed: In PCA, all the variance in the observed variables is analyzed. In FA, only shared variance – or the variance that is common to the various observed variables – is analyzed (see Tabachnik et Fidell, 2001, for further details).

[5] The KMO statistic is a summary of how small the partial correlations are, relative to the original correlations. The partial correlation for each pair of variables in the factor analysis is comprised of the correlation between those variables after partialling out the influence of all of the other variables in the factor analysis. If the variables share common factor(s), then the partial correlations should be small and the KMO should be close to 1.0. The KMO measure should equal 0.5 when the correlation matrix equals the partial correlation matrix.

[6] It is the squared multiple correlation of the variable as predicted by from the factors.

In a second step, the researcher needs to select which and how many factors/components should be selected in the final solution. The number of factors has to be smaller than the number of items representing the data, but how smaller? The *eigenvalues* and proportion of variance explained by the different factors and components play a crucial role in this respect: One wants to favour "powerful" factors, i.e., those that maximize the amount of variance accounted for in the data. Note, however, that in addition to this "proportion of variance explained" criterion, the researcher may also consider important that the number of components or factors eventually selected *covers the full list* of original items analysed. This is actually the point of view that has been adopted for the analysis of the availability and priority scores combined in a common "needs" scale.

Another important criterion to select the factors/components is their *interpretability.* The so-called *loading* matrix reveals how the variables initially observed correlate with the different factors/components extracted. More specifically, the factor/component *loadings* are the correlation coefficients between the variables and factors/components extracted.The higher the loading of a variable on a factor/component, the more important is its relationship with that factor. Usually, loadings inferior to 0.32 are ignored. According to Comrey and Lee (1992), loadings above 0.71 should be considered "excellent", 0.63 or more as "very good", 0.55 and more as "good", 0.45 and more as "fair", and 0.32 and more as "poor". When there are only one or two variables that load highly on a factor, the factor is poorly defined. The loadings of the individual variables on the factors and components are used to determine the *meaning* of the factor. Variables with higher loadings should be given more importance in this process. A good factor/component solution is one for which the variables with high loadings on the different factors have a clear common meaning.

Below, the components and factors that have eventually been selected are described for both the separate analysis of priority and availability ratings, and for the combined analysis of needs. Details of the statistical results underlying the selection of the final number of components/factors can be found in Appendix 3.

## 3.2. Results

### 3.2.1. Principal Component Analysis (PCA) on priority ratings

The KMO values calculated on the basis of the priority observations (405 observations, 52 items in the analysis) were around 0.95, which can be considered largely satisfactory. Items with component loadings lower than 0.50 have been ignored in this analysis, in order to focus on the most important items.

In total, 9 components have been extracted from the analysis. The results indicate, however that only the first 6 efficiently account for the variation in the ratings provided by the stakeholders to the various items of the questionnaire. A detailed description of the analysis results, of the 9 components extracted from the analysis, and of the reasons underlying the selection of the 6 components solution is provided in Appendix 3 of this report. The remainder of this section describes in details the meaning of the 6 components eventually selected, which will serve as basis for the following analyses steps, namely the grouping of the stakeholders and the investigation of the relation between these groups and their background characteristics.

Table 3 below shows the loadings of the original items on each of the 6 components selected.

| **Component 1 – Guidelines for the implementation of measures** | |
|---|---|
| | ***Loading*** |
| Collections of video clips and billboards of RS campaigns | 0.72 |
| Methods to assess the training needs of individuals involved in RS implementation processes | 0.70 |
| Good practice collection on how countries have implemented specific RS measures | 0.69 |
| Comparisons of driver training programmes across EU | 0.68 |
| User-friendly interfaces to assist new users in finding RS materials on the internet | 0.65 |
| Information on potential funding sources for RS measures | 0.64 |
| Good practice and methodologies for monitoring implementation | 0.63 |
| Detailed data on the costs of RS measures across EU | 0.61 |
| Comprehensive monitoring of implemented measures across EU | 0.57 |
| **Component 2 – Statistical models for the monitoring of road safety trends** | |
| | ***Loading*** |
| Medium term forecast models (up to 5 years) | 0.68 |
| Long term forecast models (up to 10 years) | 0.65 |
| Short term forecast models (up to 2 years) | 0.64 |
| Statistical methods for following trends | 0.63 |
| Statistical methods for isolating effects of specific policies or measures | 0.61 |
| Statistical models and tools for target setting | 0.57 |
| **Component 3 – Cost and safety impacts of measures** | |
| | ***Loading*** |
| Information on the safety impacts of combined RS measures | 0.65 |
| Information on the costs and benefits of a RS measure | 0.64 |
| Standardised procedures and methods for carrying out evaluations of RS measures | 0.6 |
| Information on the safety impacts of singular RS measures | 0.58 |
| Statistical methods for priority setting | 0.54 |
| Methods for evaluation of safety impacts of RS measures | 0.51 |
| Common methodology for the evaluation of costs and benefits of RS measures | 0.51 |
| **Component 4 Road infrastructure and accident analysis** | |
| | ***Loading*** |
| Common methodology for in-depth crash analysis | 0.57 |
| Crash prediction models for various road types and layouts | 0.58 |
| Detailed information from RS audits and RS inspections | 0.69 |
| Common methodology for identifying high risk sites ("black-spots") | 0.74 |
| Digital road maps for mapping crashes | 0.75 |
| Detailed road databases providing descriptions of road layouts, signing and marking, etc. | 0.82 |
| The use of GPS and/or GIS technologies in accident data collection | 0.55 |

| **Component 5 - Common definitions and under-reporting** | |
|---|---|
| | ***Loading*** |
| A common definition of a fatality | 0.69 |
| A common definition of a serious injury | 0.58 |
| Crash databases that link police and hospital data | 0.57 |
| A common definition of a work-related crash | 0.55 |
| **Component 6 - Crash causation** | |
| | ***Loading*** |
| Information on crash causation factors | 0.70 |
| Information on frequent crash scenarios and patterns | 0.66 |
| Results from in-depth crash investigations | 0.56 |

**Table 3: Loadings of the original variables on the components extracted from the analysis of priority ratings and selected for the next analysis steps**

The 6 components selected can be interpreted and labeled as follows:

*Component 1 - "Guidelines for the implementation of measures"*,

All items loading on this component come from the "Implementation of measures" section of the questionnaire. They relate to different aspects of the implementation procedure: costs, good practice examples and implementation examples from other countries, funding and monitoring of the implementation. The component also includes the comparisons of driver training programmes and the access to road safety material on the internet. These latter variables may be considered less relevant to the others included in this component, but they have nevertheless the highest loadings on the component. This, along with the fact that other "implementation" items (for example: items related to the road infrastructure e.g. digital maps) do not load substantially on this component, suggests that the need for *practical guidelines* is central here.

*Component 2 - "Statistical models for the monitoring of road safety trends"*

This component corresponds to the needs for advanced statistical models to support the monitoring of road safety trends and of the effect of specific measures.

*Component 3 - "Cost & Safety impacts of measures"*

This component concerns methods for estimating safety effects, costs and benefits of measures - individual or combined - as well as evaluation methods. Most of the items loading on this component belong to the "Programme Development" section of the questionnaire, but also to "Monitoring and evaluation" (only one item, namely 'methods for target setting' comes from the "Fact finding" section.

*Component 4 - "Road infrastructure and accident analysis"*

All items loading on this component reflect the importance of road infrastructure: the identification of high-risk sites, digital road maps, road layout, road databases that would include information on signing and marking, road safety audits and inspections; data and accident models for different road layouts. Crash prediction models and in-depth crash analysis methods are also included in this component. Many of the items loading on this component come from the "Implementation" list, but

not all (one item from “Monitoring and evaluation” and one item from “Fact finding” also had substantial loadings).

*Component 5 - “Common definitions and under-reporting”*

This component includes the needs for common definitions and for databases that would link police and hospital data.

*Component 6 – “Crash causation”*

The three items loading on this component all relate to the need to better understand the unfolding of crashes and related causation factors.

It is obvious that the first components are more concise and rich in information than the last ones. The solution is nevertheless highly interpretable, as most components bring together variables with obvious common attributes. The components can therefore be labeled intuitively.

The results suggest that each component reflects a specific area of needs and priorities, with important contribution to the overall variance in the stakeholders’ responses.

### 3.2.2. Principal Component Analysis on availability ratings

Given that the “unknown” answer category for the availability ratings was treated as a missing value in this analysis, the sample is reduced compared to the one used for the analysis of the priority ratings (143 observations for availability against 405 for the priority ratings). Despite the smaller size of the sample available for this analysis (143 observations), the KMO measure of sampling adequacy was acceptable, with a value of 0.89.

Eleven components have been originally extracted from the analysis, but eventually 7 of them have been selected on the basis of their contribution to the overall variation in the responses (see Appendix 3 for a complete description of the results and of the rationale applied for the selection of the final solution). Table 4 below shows the loadings of the various items from the questionnaire on each of the 7 components selected. In this case as well, items with component loadings lower than 0.50 have been ignored in this analysis, in order to focus on the most important items.

| **Component 1 - Cost & Safety impacts of measures** | |
|---|---|
| | ***Loading*** |
| Information on the costs and benefits of a RS measure | 0.71 |
| Common methodology for the evaluation of costs and benefits of RS measures | 0.7 |
| Standardised procedures and methods for carrying out evaluations of RS measures | 0.68 |
| Methods for evaluation of safety impacts of RS measures | 0.64 |
| Focusing on seriously injured counts, in addition to fatality counts | 0.54 |
| Information on the safety impacts of singular RS measures | 0.53 |
| Information on the safety impacts of combined RS measures | 0.53 |
| Common methodology for identifying high risk sites ("black-spots") | 0.51 |
| **Component 2- Statistical models** | |
| | ***Loading*** |
| Short term forecast models (up to 2 years) | 0.88 |
| Medium term forecast models (up to 5 years) | 0.87 |
| Long term forecast models (up to 10 years) | 0.84 |
| Statistical methods for isolating effects of specific policies or measures | 0.67 |
| Crash prediction models for various road types and layouts | 0.59 |
| Statistical methods for following trends | 0.56 |
| **Component 3 - Implementation of measures** | |
| | ***Loading*** |
| Good practice collection on how countries have implemented specific RS measures | 0.76 |
| Collections of video clips and billboards of RS campaigns | 0.73 |
| Good practice and methodologies for monitoring implementation | 0.69 |
| Comprehensive monitoring of implemented measures across EU | 0.64 |
| Methods to assess the training needs of individuals involved in RS implementation processes | 0.62 |
| Information on potential funding sources for RS measures | 0.6 |
| Comparisons of driver training programmes across EU | 0.59 |
| **Component 4 - Road infrastructure and accident analysis** | |
| | ***Loading*** |
| Detailed databases providing descriptions of road layouts, signing, marking, etc | 0.73 |
| Digital road maps for mapping crashes | 0.7 |
| Detailed information from RS audits and RS inspections | 0.52 |
| **Component 5 - Exposure & behaviour** | |
| | ***Loading*** |
| Exposure data (e.g., kilometres driven, numbers of trips) | 0.73 |
| Information on road users' behaviour and attitudes | 0.59 |
| Information on the effect of external factors on the number of road traffic crashes | 0.52 |

| **Component 6 - Road safety policies, rules and regulations** | |
|---|---|
| | ***Loading*** |
| Comparisons of safety rules and regulations | 0.71 |
| Comparisons of RS policies and measures regarding specific road user groups | 0.69 |
| **Component 7 - Common definitions** | |
| | ***Loading*** |
| A common definition of a serious injury | 0.85 |
| A common definition of a fatality | 0.74 |
| A common definition of a work-related crash | 0.57 |

**Table 4: Variables loading on the components extracted from the availability ratings and selected for the next analysis steps**

The 7 components selected can be interpreted and labeled as follows:

*Component 1 - "Cost & Safety impacts of measures"*

This component is equivalent to component 3 extracted from the priority ratings, with the exception of two items (Methods for identifying 'black-spots' and the Focus on serious injuries in addition to fatalities). It also concerns methods for estimating the safety effects of measures, their costs and benefits, and methods to evaluate them.

*Component 2 - "Statistical models"*

This component is equivalent to component 2 of priorities. It refers mainly to the availability of models for monitoring and forecasting road safety trends. To the difference of the priority evaluations however, the availability ratings led to the inclusion of "crash prediction models".

*Component 3 - "Implementation of measures"*

This is a less homogenous component, as it includes elements related to the implementation of road safety measures, covering good practice examples and implementation examples from other countries, funding and monitoring the implementation, campaigns etc. The component also includes the comparisons of driver training programmes. It is equivalent to Component 1 of priorities.

*Component 4 - "Road infrastructure and accident analysis"*

This component includes the availability of databases that would include information on road signing and marking, information about road safety audits and inspections, digital road maps, road layout. It is equivalent to Component 4 of priorities.

*Component 5 - "Exposure & behaviour"*

This component includes the availability of exposure data, road safety attitudes and behaviours, and the effects of external factors on road safety.

*Component 6 - "Road safety policies, rules and regulations"*

This component is equivalent to component 8 of priorities.

*Component 7 - "Common definitions"*

This component is equivalent to Component 5 of priorities.

Although separate analyses were carried out, the similarity between the components extracted from the priority ratings with those extracted from the availability ratings is striking. This suggests that the same principles have guided both types of ratings and that they are correlated in some way.

### 3.2.3. Factor Analysis on the combined "needs" scale

As a next step, the combined "needs" scale was examined, in order to test whether there are *factors* reflecting similar ratings on the basis of both priorities and availability in data and tools. All individual variables had a KMO value higher than 0.86 and the overall KMO value was 0.94, enabling to proceed to the Factor Analysis. In addition, the correlations for all variables were high.

13 factors were originally extracted. To select the appropriate number of factors, the proportion of total variance explained was taken into account, as well as the interpretability of the factors. As indicated earlier, it was also considered preferable that the factor selected covered the complete list of items rated by the stakeholders. As a consequence a 9-factor solution, explaining 94% of the variation in the ratings and including all items from the questionnaire was eventually selected. Details of the results, as well as of the unselected extraction solutions are provided in Appendix 3.

Table 5 presents an overview of the variables loadings on the different factors (only variables with loadings superior to 0.32 are presented). Note that the threshold adopted for this analysis being more relaxed compared to the separate priority / availability analyses). As a reminder, the loading values can be interpreted as the correlations between the variables and the factors.

The 9-factor solution selected has two advantages: it explains 94% of the variance, and each factor can be interpreted easily, due to the fact that there are enough variables with sufficiently high loadings on each factor. Note that some variables loaded on more than one factor (see Table 5). The item " common methodology for in-depth analysis", for example, loaded mostly on factor 2, but also - although to a lesser extent - on factor 5. Hence, the interpretation of the factors' content should account for such "double loadings" as well[7].

[7] Further analysis however revealed that such variables usually have low coefficients in estimating factor's score compared to the "major" variables composing the factor. So, variables with "double loadings" were accounted for in the interpretation of the factors only when their loading value was comparable to that of the variables with the highest loadings on the same factor.

| **Factor 1 – Implementation of measures** | |
|---|---|
| | ***Loading*** |
| Methods to assess the training needs of individuals involved in RS implementation processes | 0.63 |
| Collections of video clips and billboards of RS campaigns | 0.63 |
| User-friendly interfaces to assist new users in finding RS materials on the internet | 0.62 |
| Good practice and methodologies for monitoring implementation | 0.60 |
| Good practice collection on how countries have implemented specific RS measures | 0.59 |
| Comparisons of driver training programmes across EU | 0.58 |
| Information on potential funding sources for RS measures | 0.57 |
| Comprehensive monitoring of implemented measures across EU | 0.53 |
| Detailed data on the costs of RS measures across EU | 0.47 |
| Tools for simulating road user behaviour | 0.42 |
| **Factor 2 – Accident and infrastructure analysis for implementation of measures** | |
| | ***Loading*** |
| Detailed road databases providing descriptions of road layouts, signing and marking, etc. | 0.68 |
| Common methodology for identifying high risk sites ("black-spots") | 0.65 |
| Digital road maps for mapping crashes | 0.61 |
| Detailed information from RS audits and RS inspections | 0.60 |
| Common methodology for in-depth crash analysis | 0.57 |
| Crash prediction models for various road types and layouts | 0.50 |
| **Factor 3 – Statistical models** | |
| | ***Loading*** |
| Medium term forecast models (up to 5 years) | 0.88 |
| Short term forecast models (up to 2 years) | 0.82 |
| Long term forecast models (up to 10 years) | 0.82 |
| Statistical methods for isolating effects of specific policies or measures | 0.46 |
| Statistical models and tools for target setting (e.g. forecasts and time series analysis etc.) | 0.42 |

| **Factor 4 – Exploring implementation frameworks** | |
|---|---|
| | ***Loading*** |
| Comparisons of RS policies and measures regarding specific road user groups | 0.63 |
| Comparisons of safety rules and regulations | 0.56 |
| Information on the public acceptance of a RS measure | 0.53 |
| Comparisons of the frameworks in which RS policies and measures are implemented | 0.53 |
| Information on the costs and benefits of a RS measure | 0.44 |
| Examples of the successful integration of RS policies with others (e.g. environmental or health policies) | 0.43 |
| Information on the impacts of RS measures on other sectors' policies (environment, health, mobility etc.) and/or vice versa | 0.42 |
| Good practice catalogue of measures - including implementation conditions | 0.42 |
| Information on the socio-economic cost of crashes, fatalities and injuries | 0.39 |
| **Factor 5 – Crash causation** | |
| | ***Loading*** |
| Results from in-depth crash investigations | 0.61 |
| Information on frequent crash scenarios and patterns | 0.59 |
| Information on crash causation factors | 0.59 |
| Results from driving simulator studies | 0.56 |
| Results from naturalistic driving studies (using data recorders and/or cameras in vehicles) | 0.52 |
| Information on road users' behaviour and attitudes | 0.40 |
| Information on the effect of external factors on the number of road traffic crashes (e.g. the economy or the weather) | 0.37 |
| Common methodology for in-depth crash analysis* | 0.36 |
| Tools for simulating road user behaviour* | 0.34 |
| **Factor 6 – Evaluation of measures** | |
| | ***Loading*** |
| Common methodology for the evaluation of costs and benefits of RS measures | 0.65 |
| Methods for evaluation of safety impacts of RS measures | 0.60 |
| Statistical methods for following trends | 0.43 |
| Standardised procedures and methods for carrying out evaluations of RS measures | 0.39 |
| Focusing on seriously injured counts, in addition to fatality counts | 0.37 |
| Comprehensive monitoring of implemented measures across EU* | 0.37 |
| Information on the socio-economic cost of crashes, fatalities and injuries* | 0.36 |
| Information on the costs and benefits of a RS measure* | 0.34 |
| Statistical methods for isolating effects of specific policies or measures* | 0.34 |
| Statistical methods for priority setting (e.g. to rank RS measures) | 0.33 |

| **Factor 7 – Common definitions** | |
|---|---|
| | ***Loading*** |
| A common definition of a fatality | 0.72 |
| A common definition of a serious injury | 075 |
| A common definition of a work related crash (i.e. a crash that occurs whilst commuting or during professional activities) | 0.39 |
| Data on the under-reporting of road traffic crashes (i.e. underestimation of the true number of accidents)* | 0.37 |
| **Factor 8 – Information on safety impacts** | |
| | ***Loading*** |
| Information on the safety impacts of singular RS measures | 0.64 |
| Information on the safety impacts of combined RS measures | 0.61 |
| **Factor 9 – Improving data collection** | |
| | ***Loading*** |
| Crash databases that link police and hospital data | 0.52 |
| Data on the under-reporting of road traffic crashes (i.e. underestimation of the true number of accidents) | 0.49 |
| The use of GPS and/or GIS technologies in accident data collection | 0.49 |
| Exposure data (e.g. kilometres driven, numbers of trips) | 0.46 |

**Table 5: Variables loading on the different factors extracted from the analysis of the combined priority and availability ratings, along with associated loading values ("*" indicates variables loading on more than one factor)**

Inspecting these variables and the size of their loadings on the various factors, the nine factors can be interpreted as follows:

*Factor 1 –"Implementation of measures"*

It includes the core items related to implementation of road safety measures and an item on the monitoring of implemented measures.

*Factor 2: - "Accident and infrastructure analysis for implementation of measures"*

It comprises the first five items related to the implementation of road safety measures and items related to crash prediction ("identification of high-risk sites", "crash prediction models for various types of road layouts", …). The essential aspects are the detailed analysis of accidents taking infrastructure into account to prepare the implementation of road safety measures.

*Factor 3 – "Statistical models"*

It includes the "statistical model" items related to the monitoring of road safety trends and measures and the item of crash prediction models from the domain of "Development of road safety programmes".

*Factor 4 – "Exploring implementation frameworks"*

The variables refer both to information that would allow facilitating the selection of measures (comparison of various measures and of rules and regulations, information about their public acceptance), the know-how of implementation of measures, and various characteristics of implementation frameworks.

*Factor 5 – "Crash causation*"

The items with the highest loadings on this factor belonged to the section "Fact Finding and Diagnosis" in the original questionnaire. The variables included in this factor emphasize all knowledge sources that could contribute to the understanding of crash causation (in-depth methods, behavioural aspects, results from naturalistic driving studies or from studies conducted with a driving simulator…)

*Factor 6 - "Evaluation of measures"*

The items loading on this factor mostly relate to methods and data values required for estimating safety effects and/or economic evaluation of measures, at such stages of the RS management process as: diagnosis, the development of measures, their monitoring and evaluation.

*Factor 7 - "Common definitions"*

This factor includes items that concern common definitions issues, but also the problem of underreporting, as was the case in the separate analysis of priority and availability ratings.

*Factor 8 – "Information on safety impacts"*

Factor 8 concerns information on the safety impacts of combined or individual road safety measures.

*Factor 9 – "Improving data collection"*

It mainly reflects items from the domain of fact finding and diagnosis, such as "data on the under-reporting of crashes", "databases that link police and hospital data", "the use of GPS/GIS technologies in accident data collection", and "exposure data".

As this was the case with the separate analysis of availability and priority ratings, the factors obtained on the basis of their combination in the needs scale provided factors that can be labelled intuitively. This was the case even though the factors brought together a substantial number of items. Factors made up of long lists of variables may sometimes be difficult to interpret, but in this case interpretation of most factors was clear-cut, as they brought together variables with obvious similarities in content.

### 3.2.4. Conclusions

The above analyses showed that the dataset containing the stakeholders' priorities and availability ratings of data and tools can be considerably reduced on the basis of PCA and FA techniques. In both cases, an acceptable number of components was obtained, explaining a significant proportion of the total variance in the data. Besides, the interpretation of components and factors is straightforward in most cases, as they grouped items of the same nature.

There appears to be little redundancy in the components or factors emerging from the different analyses, despite the fact that several issues are expressed in many variables covering either similar or complementary aspects, in different parts of the questionnaire. Only in a few cases, the interpretation of components proved more difficult, as they gathered somewhat heterogeneous items.

One will note that there are important similarities between the components identified on the basis of the priority ratings, those identified on the basis of the availability ratings, and the factors extracted from the combined ratings. Although the content of these components/factors is not perfectly similar, they show striking similarities that deserve being mentioned.

Table 6 provides an overview of all components selected on the basis of each of the three analyses. Similar colors indicate components/factors extracted that show the most important similarities in terms of the items from the original questionnaire that they contain.

| | *PCA : Priority ratings* | *PCA : Availability ratings* | *FA : Combined priority and availability ratings* |
|---|---|---|---|
| Component/Factor 1 | "Implementation of measures" | "Costs and safety impacts of measures" | "Implementation of measures" |
| Component/Factor 2 | "Statistical models" | "Statistical models" | "Accident and infrastructure analysis for the implementation of measures" |
| Component/Factor 3 | "Costs and safety impacts of measures" | "Implementation of measures" | "Statistical models" |
| Component/Factor 4 | "Road infrastructure and accident analysis" | "Road infrastructure and accident analysis" | "Exploring implementation frameworks" |
| Component/Factor 5 | "Common definitions and under-reporting" | "Exposure and behaviour" | "Crash causation" |
| Component/Factor 6 | "Crash causation" | "Policies, rules and regulations" | "Evaluation of measures" |
| Component/Factor 7 | "Advanced research methods" | - | "Common definitions" |
| Component/Factor 8 | - | | "Information on safety impacts" |
| Component/Factor 9 | - | | "Improving data collection" |

**Table 6: Overview of the components/factors selected on the basis of the separate and combined analysis of priority and availability ratings**

Of course, the overlap in the content of the dimensions which have been assigned similar colours is not perfect, but generally speaking it is interesting to observe that working with priority ratings exclusively, with availability ratings exclusively, or with a combination of the two ratings resulted for a part in the identification of "similar" components (as a reminder: the exact content of each dimension can be found in Table 3 – p. 17-18, Table 4 – p.20-21, and in Table 5 – pp 25-26-27 for the analysis of priority ratings, of availability ratings, and of their combination, respectively).

Some dimensions, on the other hand, seem to emerge more specifically when analysing availability ratings or the scale combining priority and availability ratings. This is the case, for example, for "Exposure and behaviour data", and "Road safety policies, rules and regulations".

One will note that the ratings of the stakeholders appear to be underlain by the *topics* on which knowledge/data/tools could be needed/made available rather than on the stage at which they are supposed to intervene in the RS management process. The components reflecting "evaluation of measures", for example, gather all items

relevant to the evaluation of measures, independently of the fact that they were originally presented in the “programme development” section of the questionnaire, or as belonging to other RS management tasks, such as “monitoring and evaluation”. In other words, the ratings suggest that, when a topic is considered important, for example the evaluation of the potential effects of a measure, it is considered so whatever the stage of the RS management process at which it is supposed to be involved.

# 4. CLUSTERING: GROUPING THE STAKEHOLDERS ON THE BASIS OF THE DIMENSIONS IDENTIFIED

## 4.1. Objectives

In the previous section, components and factors were found to underlie the way stakeholders rated the priority and availability of various types of data, information, and tools. The objective of the analyses presented in this section is to identify groups (clusters) of stakeholders sharing similarities in the extent to which they consider these data, information, and tools to be priorities, and in the extent to which they consider them to be available for their daily road safety activities. Once clusters are identified, possible relations with the background characteristics of the stakeholders can be explored. The question examined in this last stage of the analysis being "do stakeholders with similar characteristics (e.g., working for the same types of organizations, or involved in the same types of road-safety activities) tend to rate the various items in a similar way, and in a way that differs from stakeholders with different characteristics?"

This will be done on the basis of the components and factors identified in the previous section. As a consequence, the clustering analysis will first be conducted on the basis of the *components* identified for the priority and availability ratings separately, and then on the basis of the combined needs scores.

The general procedure is the same in both cases: the components or factor scores are calculated for each individual respondent, saved, and used as new variable. The calculation of the component and factor scores can be described as follows:

(1) The ratings of all respondents to all original items of the questionnaire are standardized (which means that the original scores are subtracted their mean and divided by their standard deviation).

(2) The equation defining each component/factor is then "solved" for each observation (i.e., for each respondent): The standardized scores for the items belonging to each factor are multiplied by the coefficients they are assigned in the factor/component equation, then summed[8].

The relationship between the clusters and the background characteristics of the stakeholders is then examined. Note, however, that the number of background variables examined is more extensive in the case of the analysis of the combined needs scale, as the separate analyses of priority and availability ratings only take into account the variables "type of EU country", "type of organization" and, "policy maker".

[8] It is important to note that, in all 3 data reduction analyses presented, the coefficients for the individual items in the components/factors were positive. Hence, each item "participating" to a given component/factor did so in a positive way (so, the higher the score on the original variable, the higher the component/factor score will be). One has to bear in mind, however, that the combined priority/availability estimates were so defined that lower values of the combined ratings reflected *higher* importance attributed to a given item.

### 4.1.1. Method

The identification of clusters in the component or factor scores of the stakeholders rests on an evaluation of their respective *distances* (observations that are close from each other will tend to be clustered together, while observations that are remote from each other will tend to end up in separate clusters). The distance measure used in the analysis of the *separate priority and availability ratings* was the Euclidean distance, calculated as follows:

$$D_{ij} = \sqrt{\sum_{k=1}^{n} (x_{ki} - x_{kj})^2}$$

Where $D_{ij}$ is the distance between cases i and j, and $x_{ki}$, $x_{kj}$ are the values of variable $x_k$ for cases i and j. For the clustering based on the *combined priority and availability scores*, *weighted* Euclidian distances among all the observations were calculated. The weights are defined so as to account for the variance explained by each factor (i.e., factors that explained larger proportions of variance were assigned larger weights)[9].

Clustering procedures are generally divided in two groups: hierarchical clustering and non-hierarchical clustering. Hierarchical methods may be agglomerative (i.e. starting from n clusters to get to 1 cluster) or divisive (i.e. starting from 1 cluster, to get to n clusters) and are not always conclusive as regards the number of clusters, nor informative about the differences between clusters, the membership of respondents etc. In non-hierarchical procedures, also known as k-means clustering, the researcher defines the number of clusters to be used and all units are assigned to the nearest cluster centre.

In order to exploit all their advantages, both methods were used to select the final number of clusters in the analyses presented here:

- First, a hierarchical cluster analysis was performed, in order to identify the optimal number of clusters;

- Second, a k-means cluster analysis was performed with the fixed number of clusters identified in the first step, in order to actually form the clusters and classify the respondents.

In all hierarchical analyses the Ward method was used, on the basis of which the sum of squared distances within clusters is computed, and clusters with the minimum increase in the overall sum of squares are aggregated. On this basis, a classification tree is produced, which shows the classification of the respondents into similar groups (clusters). The component or factor scores of stakeholders assigned to the same clusters are close to each other. The distance is larger between the factor/component scores of individuals assigned to different groups.

Once all clusters are identified, the researcher is left with the task of selecting the adequate number of clusters.

For the identification of the optimal number of clusters, the “elbow rule” was applied on the values of the scree plot of the distance coefficients, according to which the optimal number of clusters is the number of steps at which the agglomeration algorithm makes a bigger “jump”.

[9] Clustering was done using the SAS 9.2 CLUSTER procedure.

## 4.2. Results

### 4.2.1. Grouping stakeholders on the basis of the priority component scores

The first 6 components identified on the basis of the stakeholders' priority ratings were used first[10], with 405 cases (respondents) considered valid for the analysis.

The results of the hierarchical clustering suggest that the optimal number of clusters is 4. Details of the results that yield to the selection of this final number of clusters can be found in Appendix 4. The remainder of this section provides a detailed description of each of the clusters selected.

Remember that the component scores are standardised, with mean zero and standard deviation. Therefore, scores close to zero suggest that the component (or the items composing it) is considered to be of "average priority", while scores around -1.000 suggest that the component is considered to be of low priority, and scores around 1.000 suggest that the component has high priority.

In order to make the interpretation of the results easier, the component scores within the clusters are highlighted in a coloured scale from dark red (very low priority) to yellow (medium priority) to green (very high priority).

| | Cluster | | | |
|---|---|---|---|---|
| **Component scores** | 1 | 2 | 3 | 4 |
| Comp.1: Implementation of measures | -0.155 | -1.101 | 0.446 | 0.029 |
| Comp.2: Statistical models | -0.202 | 0.487 | 0.237 | -1.177 |
| Comp.3: Costs & safety impacts of measures | -0.730 | 0.139 | 0.163 | 0.062 |
| Comp.4: Road infrastructure & accident analysis | -0.121 | -0.729 | 0.470 | -0.548 |
| Comp.5: Common definitions & underreporting | -0.819 | 0.612 | 0.248 | -0.711 |
| Comp.6: Crash causation | -1.262 | 0.132 | 0.099 | 0.852 |
| **Number of cases** | 65 | 75 | 204 | 61 |
| **% of cases** | 16% | 19% | 50% | 15% |

**Table 7: Mean scores of the clusters to the components identified on the basis of the separate analysis of priority and availability ratings**

It is interesting to note that two pairs of "complementary" clusters are identified. On the one hand, cluster 1 includes respondents that have assigned low priority scores to all components, whereas cluster 3 includes respondents that have high (positive) priority scores on all components. On the other hand, clusters 2 and 4 have mixed high and low (positive and negative) priority scores, but on different components: Respondents in cluster 2 have assigned high priority to statistical models, whereas those in cluster 4 have given very low priority to this component. Respondents in cluster 2 saw very little interest in crash causation, while this is the highest priority for cluster 4.

Looking closer at the mean scores on each component within each cluster, the clusters can be interpreted and labelled as follows:

[10] Exploratory analyses with all 9 components suggested that the 3 last components indeed did not add variability in the clustering.

*Cluster 1 - "Low needs"*

This cluster includes 16% of the respondents and is characterized by average to negative scores on all components. The scores for crash causation data, common definitions, underreporting data and cost/benefit data are particularly low. The remaining issues are considered to be of average priority. One has to be cautious when interpreting these low scores, however, as it is possible that the respondents in this cluster have indicated high priority in other issues, not included in the 6 major components examined. On the other hand, is also possible that the majority of the issues raised in the survey are indeed of little or no relevance to the work of these respondents.Further analysis of the characteristics of this group would be required to interpret their low priority scores.

*Cluster 2 - "Need data and models"*

This cluster includes 19% of the respondents and is characterized by a strong preference in information, data, and tools that allow reliable and quantitative road safety analyses, such as statistical models, costs and safety effects of measures and common data definitions. On the other hand, respondents in this cluster assign very low priority to issues related to the implementation of measures and to the road infrastructure.

*Cluster 3 - "Need everything, especially implementation" - the typical policy makers?*

Half of the survey respondents appear to belong to this cluster, which is characterized by average to high scores on all the components. They appear to be the counter-image of cluster 1, as they are strongly interested in all issues addressed in the survey. They also share many priorities with respondents in cluster 2, the major difference being that they assign high priority to data and tools related to the implementation of road safety measures, and to road infrastructure and accident analysis.

*Cluster 4 - "Need in-depth analysis"*

This cluster includes 15% of the respondents, who attribute a striking high priority to accident causation data (in-depth crash investigation data, accident scenarios and patterns, as well as contributory factors). These respondents assign rather low priority to all other issues and are only mildly interested in costs, benefits and implementation issues of road safety measures.

#### 4.2.1.1. Relation between clusters and characteristics of the stakeholders

Further insight into the clusters may be obtained by examining the characteristics of the respondents classified in each. First, the distribution of cluster membership by country is examined (see Figure 1). At the top panel, the counts of responses are analysed per country and cluster membership. Overall, more than half of the responses come from stakeholders from the old EU-15 countries, with another 20% coming from the new Member States. "Other countries from the European Region" is a rather heterogeneous group, including eastern countries (e.g. Albania, Ukraine etc.) to north-western European countries that have not accessed the EU (e.g. Norway, Switzerland, Monaco etc.). "Other countries" include the US, Canada etc.

At the bottom panel, the share of respondents assigned to the 4 clusters is presented for each country group. Note that the distribution of respondents into clusters is very similar for the different country groups. This suggests that stakeholders' profiles in terms of needs and priorities are not significantly affected by country characteristics, and that the different types of stakeholders are equally represented in all groups of countries. This is not necessarily surprising, as in each country groups of

stakeholders with different interests naturally exist. The similarity in the proportions is nevertheless interesting.

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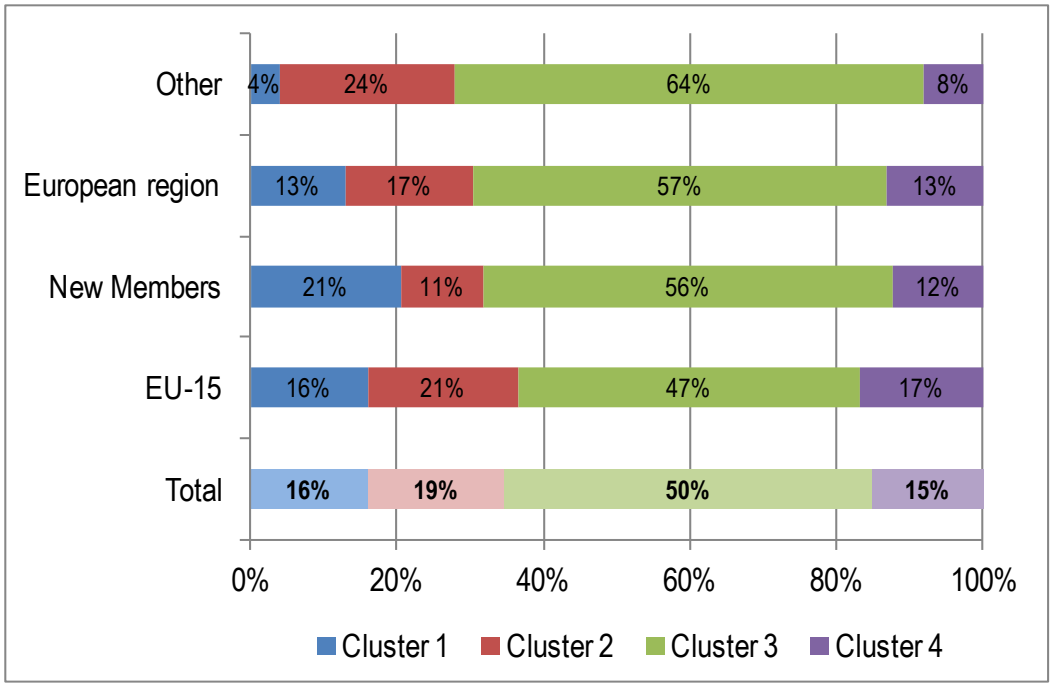


**Figure 1. Distribution of clusters in different country groups – Priority ratings**

The distribution of stakeholders in the clusters may be affected more by the type of road safety organisation they work for, or the type of road safety activities they exert. Figure 2 presents the counts and shares of each cluster for different types of organizations.

National/regional administrations, Research and Industry are each represented by a proportion of around 18-20% respondents in the sample. Then, Associations/Interest groups and Road Safety Organisations are represented by 14% and 11% respectively. All other types of organizations are represented by less than 5% (less than 15 respondents) and can not be analysed in detail.

The clusters distribution per type of organization presented in Figure 2 indicate that all clusters of stakeholders are present in all types of organizations (at least in the 5 major types of organizations mentioned above). The “in-depth analysis” cluster is over-represented in the industry, as would be expected. On the other hand, respondents classified in the “high priorities - focus on implementation” cluster (cluster 3) are over-represented in associations/interest groups, road safety organizations, and the police, indicating that these organizations put more emphasis on practical aspects of road safety analysis and policy making.

It is interesting to note that respondents belonging to research organizations and to national/regional administrations are identically distributed across the various clusters. Both types of organizations are over-represented in the “need data and models” cluster (Cluster 2).

Finally, all clusters of stakeholders are represented even in the types of organizations that are the least represented in the sample. For instance, “Police” and “Services” include stakeholders who are mostly interested in research and quantitative analysis (cluster 2), “Media” includes stakeholders strongly interested in “in-depth analysis” etc. However, it is rather surprising that the police is not represented at all in the

cluster “in-depth analysis”, given that in many countries the police forces participate in in-depth accident investigations.

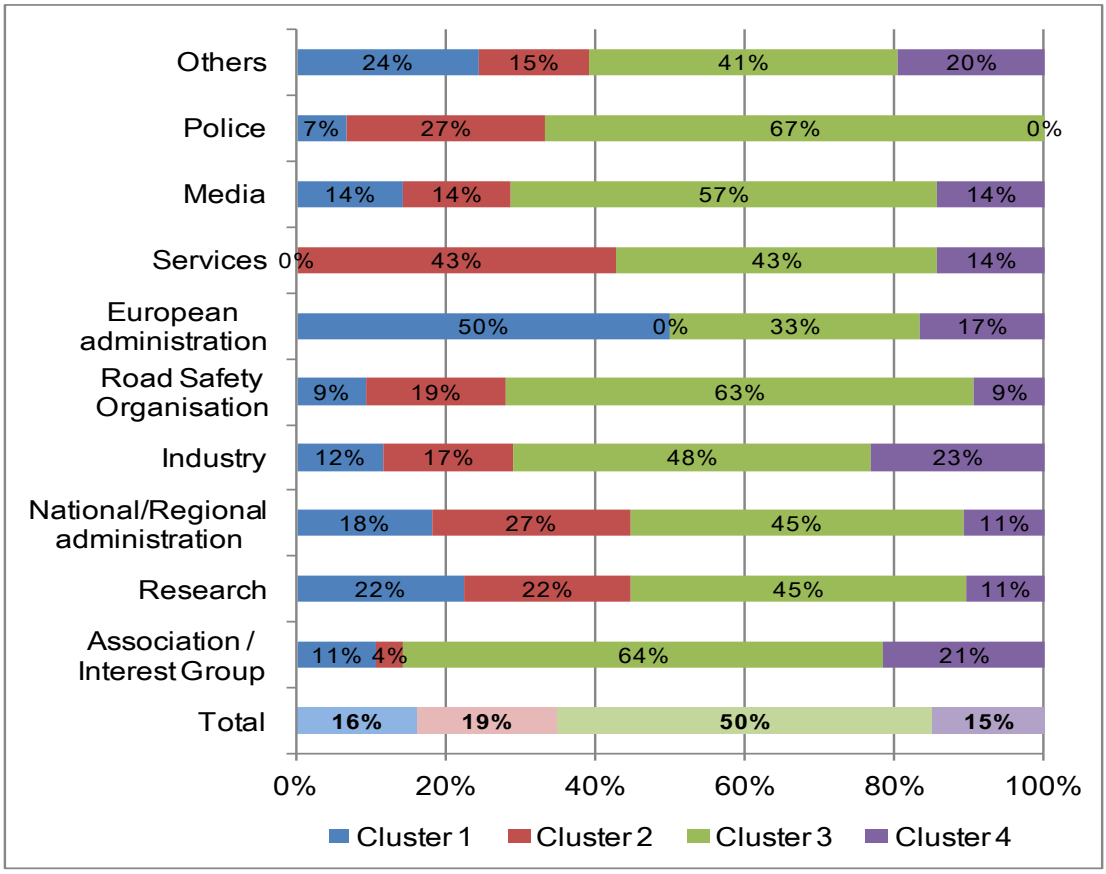


**Figure 2**: **Distribution of clusters in different types of organizations – Priority ratings**

As a final step, the distribution of the clusters within the “Policy Makers”’ group was examined. This group includes 150 respondents who either reported that their main road safety related activity is policy making or to work for an organisation that is strongly associated with policy making. As shown in the pie-chart of Figure 3, cluster 3 (“need everything, but especially implementation”) dominates in the “Policy-maker” group, as would be expected.

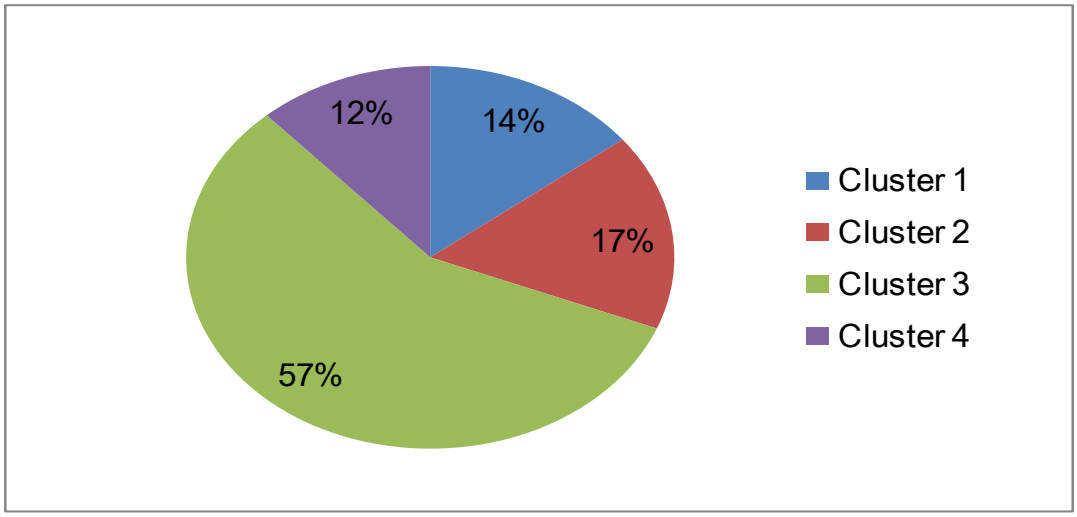


**Figure 3. Distribution of clusters in the "Policy Maker" group of respondents – Priority ratings**

### 4.2.2. Grouping stakeholders on the basis of availability component scores

The 7 first components extracted from the availability ratings were used.[11] The reader should bear in mind that only 153 cases (respondents) were available for this analysis.

The results of the hierarchical clustering suggest that the optimal number of clusters is 3. A detailed description of these results and of the selection of the final number of clusters is provided in Appendix 4.

| | Cluster | | |
|---|---|---|---|
| **Components** | 1 | 2 | 3 |
| Comp.1: Costs & safety impacts of measures | 0.969 | 0.113 | -0.804 |
| Comp.2: Statistical & forecasting models | -0.432 | 0.628 | -0.229 |
| Comp.3: Implementation of measures | 0.224 | -0.156 | -0.029 |
| Comp.4: Road infrastructure | 0.072 | -0.402 | 0.295 |
| Comp.5: Exposure & behaviour | 0.312 | -0.334 | 0.061 |
| Comp.6: RS policies, rules & regulations | 0.449 | -0.175 | -0.176 |
| Comp.7: Common definitions | 0.331 | -0.715 | 0.376 |
| **Number of cases** | 43 | 51 | 59 |
| **% of cases** | 28% | 33% | 39% |

**Table 8: Mean scores of the clusters to the components identified on the basis of the separate analysis of availability ratings**

Overall, stakeholders assigned to clusters 1 and 3 consider all components to be moderately available, while those in cluster 2 consider that availability is poor for most components.

*Cluster 1 - "Have costs and benefits of measures, lack models"*

The respondents grouped together in this cluster (28% of all respondents) indicated a satisfactory availability of the various data and tools components. They appear to have access to a lot of data and knowledge, especially as regards the costs and impacts of road safety measures. However, they lack the statistical models and tools required for quantitative analysis and forecasting.

*Cluster 2 - "Have models, lack definitions and data"*

The respondents in cluster 2 (33% of all respondents) indicated that the availability of models and tools for the analysis and forecasting was very good, but that common definitions, exposure and behaviour data, as well as road infrastructure data were missing.

[11] An exploratory analysis with all 12 components originally extracted showed that the 5 last components did not add variability in the clustering.

*Cluster 3 - "Lack costs and benefits of measures"*

The majority of stakeholders (39%) were assigned to cluster 3, where a mixed picture is drawn as regards the availability of the various components. In most cases, respondents in this cluster assigned slightly higher or lower availability scores than average. As it comes to the costs and safety impacts of measures, however, the availability ratings of this cluster are particularly low.

#### 4.2.2.1. Relation between the clusters and the characteristics of the stakeholders

The availability ratings of 3 components present striking differences between the clusters, namely "costs and benefits of measures", "statistical models" and "common definitions". It is interesting that each one of these 3 components is reported to be highly available by one group of stakeholders, but to be hardly available by another. Given that the "unknown" responses have been excluded from this analysis, this means either that some type of data and tools are indeed available/accessible to different stakeholders to different degrees (e.g. according to their country, type of organization, background, expertise etc.), or that some stakeholders are less informed/concerned about the actual availability of these types of data or tools.

Figure 4 presents the distribution of clusters per country type. One will note that the share of respondents classified in cluster 3 ("lack costs and benefits of measures") increases when moving from the EU-15 to the New Member States and further to other countries of the European Region. It is possible that fewer RS scientific activities have been conducted in the Member States that joined the EU after 2004 (less access to EU research projects, for example), or that the potential for transferring good practices from other countries is reduced by differences in terms of setting. One should note, however, that 6 out of the 10 responses regarding data availability from European Region (and 5 out of the 6 that belong to cluster 3) come from 4 countries, namely Switzerland, Iceland, Israel and Norway.

Similarly, the proportion of stakeholders that "have models, but lack definitions and data" decreases when moving from the EU-15 to the new Member States and the other countries of the European continent.

As regards the type of organization the various stakeholders belong to (see Figure 5), one will note that those working in "Research institutes and universities" are over-represented in cluster 1 ("have costs and benefits of measures, lack models"), while stakeholders working in road safety organisations and in associations/interest groups are under-represented in cluster 2 ("have models, lack definitions and data"). Finally, stakeholders from the research field and from national/regional administrations are under-represented in cluster 3 ("lack costs and benefits of measures"). As it was the case for the analysis based on priority ratings, the distribution of the stakeholders from research and those from national/regional administrations over the different clusters is similar. Furthermore, all 3 clusters are quite strongly represented in all types of organizations, at least for the major categories for which an adequate sample (i.e.: large enough) was available. No particular profile seems to clearly 'dominate' (e.g. by more than 50%) in a particular type of organization.

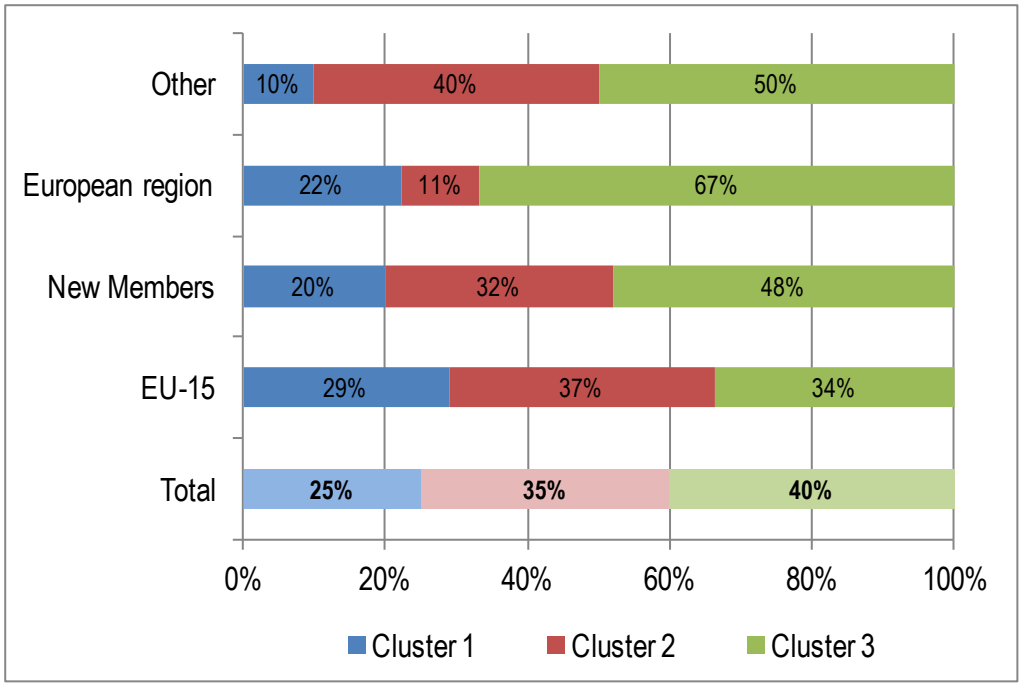


**Figure 4: Distribution of clusters in different country groups – Availability ratings**

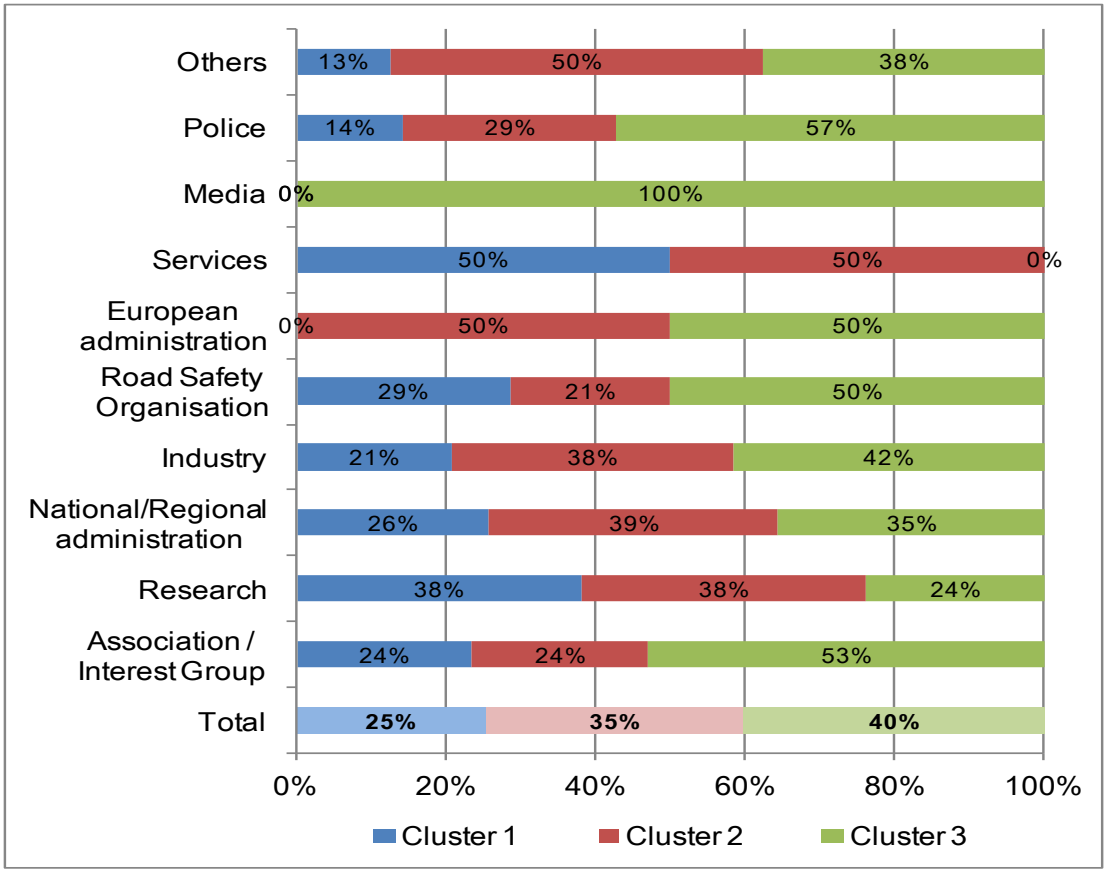


**Figure 5: Distribution of clusters in different types of organizations – Availability ratings**

Finally, Figure 6 shows the distribution of clusters in the “Policy Makers” group in particular (out of whom only 59 individuals were included in the availability analysis).

It can be seen that the distribution of clusters in this group is practically the same as the total clusters distribution, suggesting that the data available to policy makers are not fundamentally different from those available to the whole group of stakeholders.

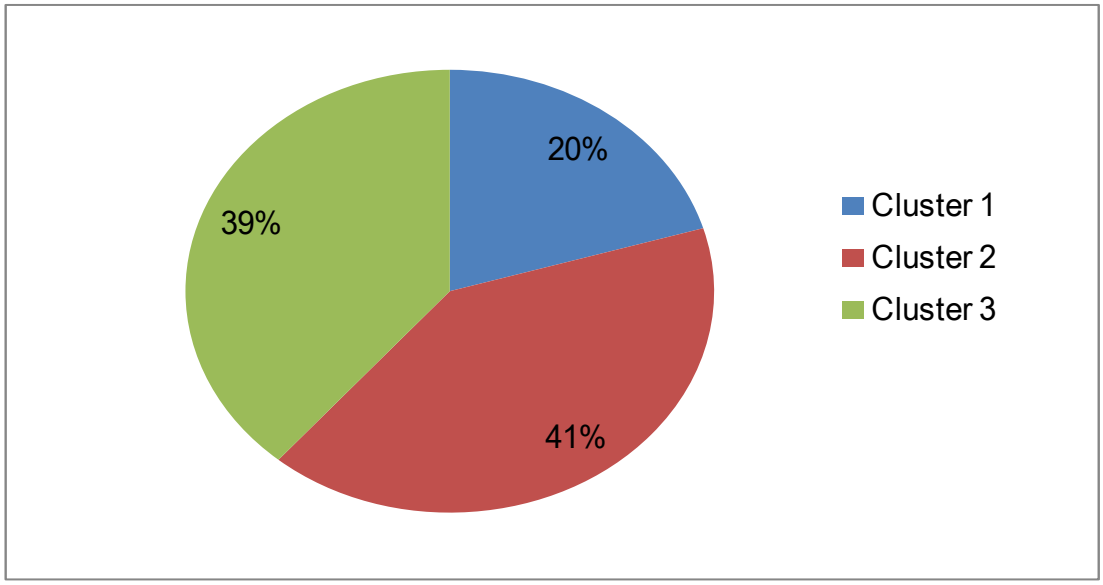


**Figure 6. Distribution of clusters in the Policy Makers' group of respondents**

Nevertheless, given that the total sample is 153, the above findings should be considered with some caution, as they may not be representative of the actual availability of the data, tools, and information assessed in the survey.

### 4.2.3. Conclusions from the separate analyses

European stakeholders can indeed be clustered into groups sharing common needs and priorities, and dealing with similar data availability issues. Four clusters (profiles) of stakeholders were identified on the basis of the **priority ratings**, each one presenting a strong characteristic, distinguishing it from the others.

Cluster 1 "Low priorities" includes stakeholders who appear to be uninterested in most of the issues proposed in the survey. Note however that it is possible that these respondents have indicated high priority in other issues, not included in the 6 major components examined. It is also possible that the majority of the issues raised in the survey are indeed of little or no relevance to the work of these respondents.

Cluster 2 "need data and models", seem to include mainly researchers or people involved in road safety analysis from a more theoretical viewpoint.

Cluster 3 has been labelled: "need everything, but especially implementation" data and tools. This group appears to bring together the "typical policy makers", including the people involved in policy making, their consultants etc. These respondents are interested in all kinds of data and tools that may be useful at all stages of policy making, but put particular emphasis on implementation issues.

Cluster 4 -"need in-depth analysis" data and tools - is over-represented in stakeholders from the industry.

The different types of clusters are equally represented in all groups of countries. Moreover, all clusters of stakeholders are represented in all types of organizations (at least in the 5 major types of organizations for which adequate samples were available).

It has long been discussed that researchers and administrations may have quite different priorities in data and tools, but the results from this analysis offer little support to this idea. The distribution of clusters in these two types of organizations was indeed practically identical. It may therefore be the case that different profiles of stakeholders are involved in both research and policy making organizations, and that their priorities are defined on the basis of their background (e.g. researcher or practitioner) and specific duties within their organization (e.g. analysis / consulting or decision-making).

However, we also observed that cluster 3 is over-represented in the 'policy maker' group' in particular, suggesting that the actual policy makers are indeed more interested in implementation issues, although people working in other organizations involved in policy making may have different priorities.

As regards data **availability ratings**, 3 clusters of stakeholders were identified.

*Cluster 1 - "have costs and benefits of measures, but lack statistical models". These* stakeholders appear to have sufficient data for cost / benefit analyses or other qualitative analysis, but not sufficient tools and methods for quantitative analysis.

*Cluster 2 - "have models, but lack definitions and data"*

It is likely that this cluster includes people involved in road safety research from a more theoretical viewpoint, as they have access and are aware of the availability of statistical techniques, but are concerned about the availability and quality of the data that will be used in these techniques.

*Cluster 3 - "lack costs and benefits of measures"*

This cluster is characterized by the reported very poor availability of data on costs and safety impacts of measures.

As was the case in the priorities analysis, all clusters are adequately represented in all countries and in all types of organisations and no considerable differences were identified between "researchers" and "administrations" or "policy makers".

However, the large share of "unknown" responses in the data availability, which limited the total sample, is an important finding by itself, indicating that European stakeholders often lack information about the availability of several data and tools required for evidence-based policy making.

### 4.2.4. Grouping stakeholders on the basis of the combined needs factors

6 clusters were formed on the basis of the factors extracted from the combined analysis of priority and availability ratings. Details of the clustering procedure and of the final number of clusters selected are presented in Appendix 4. Below, the contents of the clusters are described.

To ease the interpretation of clusters, the mean factor scores of each cluster are presented in Table 12. Remember that lower factor values indicate higher priority and **un**availability ratings for the items loading on the respective factors.

To interpret the factor values associated with the various clusters, the following colour-coding scale was used:

(1) Factor values lower than the mean minus one standard deviation indicate that the items loading on the factor are considered to be of very high importance. These values are represented in dark green;

(2) Factor values between minus one and minus 0.5 standard deviation indicate that the items loading on the factor are considered to be of high importance. They have been assigned a light green colour;

(3) Factor values between the mean and minus 0.5 standard deviation indicate that the items loading on the factor are considered to be of medium importance. They are represented in light yellow;

(4) Factor values between the mean and plus 0.5 standard deviation indicate that the corresponding items were considered to be of medium to low importance (dark yellow).

| | *Clusters* | | | | | | |
|---|---|---|---|---|---|---|---|
| *Factors* | 1 | 2 | 3 | 4 | 5 | 6 | SD |
| 1-Implementation of measures | 0.28 | -0.43 | 0.89 | -0.20 | 1.22 | -0.72 | 0.91 |
| 2-Accident and infrastructure analysis for implementation of measures | 0.55 | -0.39 | -0.32 | -0.24 | 0.31 | 1.63 | 0.89 |
| 3-Statistical models | 0.00 | -0.43 | -1.34 | 1.23 | 0.64 | -0.35 | 0.96 |
| 4-Exploring implementation frameworks | 0.73 | -0.16 | -0.21 | 0.02 | -0.10 | -0.24 | 0.88 |
| 5-Crash causation | 0.65 | -0.24 | 0.43 | 0.11 | -0.29 | -0.24 | 0.88 |
| 6-Evaluation of measures | 0.47 | -0.12 | -0.17 | -0.07 | 0.11 | -0.08 | 0.87 |
| 7-Common definitions | 0.29 | -0.10 | -0.37 | 0.03 | 0.13 | 0.07 | 0.88 |
| 8-Information on safety impacts | 0.74 | 0.01 | -0.38 | -0.20 | -0.17 | -0.33 | 0.85 |
| 9-Improving data collection | 0.16 | -0.06 | -0.15 | 0.00 | -0.05 | 0.26 | 0.82 |
| Number of respondents | 59 | 164 | 32 | 74 | 49 | 27 | |
| % of respondents | 15% | 40% | 8% | 18% | 12% | 7% | |

**Table 12: Mean priority-availability factor scores of each cluster in the six-cluster solution**

(5) Factor values between plus 0.5 and plus 1 standard deviation indicate that the items loading on the factor were considered to be of low importance. They are represented in light red;

(6) Finally, factor values higher than the mean plus 1 standard deviation indicate that the items loading on the factor were considered to be of very low importance and were assigned a dark red colour[12].

Table 12 shows that no strong systematic differences exist between the clusters in terms of mean factor scores[13]. Yellow colours are dominant in the table, which indicates that most of the respondents attributed a medium priority/availability score

[12] The definition of these categories is based on the characteristic of a normal distribution, where 40% of the distribution lies between the mean (0) plus/minus 0.5 standard deviation, while 15 additional percent lie between 0.5 and 1 standard deviation on each side of the distribution. This should give the reader an idea of the proportion of all factor scores in the sample that is covered by each of the categories employed.

[13] An Analysis of Variance (ANOVA) was carried out to examine which factor scores differed significantly across the clusters. Most significant differences between the clusters were observed for ”Implementation of measures” (Factor1), ”Accident and infrastructure” (Factor 2), and “Statistical Models” (Factor 3), whereas the comparisons based on the other factors yielded fewer and weaker differences.

to most items that define the factors. High factor scores are rare, which means that only some stakeholders expressed a strong need (high priority but partial or low availability) for the development of the items covered by the various factors. On the contrary, some factors were assigned low or very low scores from some clusters.

The mean factor scores observed for the different clusters of stakeholders allow interpreting and labelling them the following way:

*Cluster 1 - "Low needs for most items"*

This cluster includes 15% of the respondents and is characterized by medium to low priority scores for all factors. The stakeholders in this cluster found accident and infrastructure analysis, the exploration of implementation frameworks, crash causation, the evaluation of measures and information on their safety impacts to be of particularly low importance. To the remaining issues they assigned a medium to low priority score.

*Cluster 2 - "Moderate needs in all"*

This cluster includes 40% of the respondents and is characterized by medium need scores on most factors. The dominant light yellow colour in this cluster indicates "medium priority and unavailability" for most factors for this cluster, with the exception of information on the safety impacts of measures, which was also considered as being of medium priority but also as partially available.

*Cluster 3 - "High needs for models, moderate needs in other, implementation not important"*

8% of respondents belong to this cluster, which is characterized by the very high priority assigned to statistical models, the moderate needs expressed on most factors (light yellow), and the low priority given to the implementation of measures (light red).

*Cluster 4 - "No needs for models, moderate needs in implementation"*

This cluster includes 18% of the respondents and is characterized by the low priority attributed to statistical models (dark red). These stakeholders indicated to need information about the implementation of measures, accident and infrastructure, and on the safety impacts of measures only to a medium extent (light yellow). All remaining issues are given a medium priority and considered as partially available (dark yellow).

*Cluster 5 - "Low importance of implementation and models, moderate needs in crash causation"*

This cluster includes 12% of the respondents. Stakeholders in this cluster were those that assigned the lowest priority scores to items related to the implementation of measures, which were also considered as partially available (dark red). They also assigned low priority scores to statistical models, which however also tended to be considered "unavailable" by this cluster (light red). Accident causation and information on the safety impact of measures were evaluated as being of moderate importance. The scores that this group attributed to all other issues indicated medium importance and either full or partial availability.

*Cluster 6 - "High importance of implementation but no use of accident and infrastructure analysis"*

This cluster includes 7% of the respondents. This group assigned the highest scores to items related to the implementation of measures (light green, indicated that this information was considered as "partially available"), and the lowest scores to items related to accident and infrastructure analysis for the implementation of measures (dark red), compared to all other clusters. These respondents assigned medium to low importance to common definitions and the improvement of data collection. For all

other topics (i.e., statistical models, the exploration of implementation frameworks, crash causation, the evaluation of measures, and information on the safety impacts of measures) they reported moderate needs.

#### 4.2.4.1. Relation between the clusters and the background characteristics of the stakeholders

Working with the combined "needs" scores also allowed the identification of distinct clusters among the stakeholders. Clearly, there are overlaps with the clusters identified on the basis of the separate treatment of the priority and availability ratings. Remember, however that the two analyses have adopted different solutions to handle the very substantial number of "unknown" responses characterizing the availability ratings. While these unknown responses have been discarded from the separate analysis of the availability scores, they have been assimilated to "unavailable" answers prior to the combination with the priority scores into the "needs" scale. Given that these answers actually represent the highest proportion of the availability answers, this helped keeping the sample size sufficient for the combined analysis, but at the same time it resulted in homogenizing the scores provided by the different stakeholders, and in all cases implies that – using the combined scale – the priority scores have played a larger role in differentiating the stakeholders.

To ease the interpretation of the factor values associated with the various clusters, the following colour codes and categories were defined:

1 – Dark green: very high relevance of the factor;

2 – Light green: high relevance of the factor;

3 – Light yellow: medium to high relevance of the factor;

4 – Dark yellow: medium to low relevance of the factor;

5 – Light red: low relevance of the factor;

6 – Dark red: very low relevance of the factor.

The categories of factors values are represented in Table 13 using the different colour codes. As we observed when relating the clusters with the values of the factors extracted from the combined priority and availability ratings, it appears that the clusters do not show striking differences in terms of background variables[14]. Dark yellow is still the dominant colour in that table, which indicates that most factors are of medium to low relevance for most of the clusters. One factor – "Type of activities: Sensitization) appears to be of high relevance to one cluster (Cluster 6) and two others – "Type of activities: Sensitization", and "Use of international databases" have low relevance for Cluster 1 and 6.

[14] An Analysis of Variance (ANOVA) has been conducted to investigate whether the mean scores on each factors obtained for the different clusters varied significantly from each others. Most differences between the clusters were observed on the basis of the scores for "Level of influence", "Use of international databases", and "Type of activities – Sensitization". The scores for "Use of national databases", and "Type of activities – Research" differ less across the various clusters.

| | *Clusters* | | | | | |
|---|---|---|---|---|---|---|
| *Background factors* | 1 | 2 | 3 | 4 | 5 | 6 |
| Level of influence | 0.17 | -0.23 | 0.00 | 0.23 | 0.29 | 0.07 |
| Use of international databases | -0.23 | 0.18 | 0.10 | -0.28 | -0.11 | -0.58 |
| Use of national databases | -0.33 | 0.12 | 0.11 | -0.09 | -0.10 | 0.01 |
| Types of activities: Sensitization Campaigns, Communication, Education, Training, Government lobbying | -0.36 | 0.38 | -0.06 | 0.12 | 0.09 | 0.69 |
| Type of activities: Research | -0.04 | 0.25 | 0.48 | 0.25 | 0.15 | 0.13 |

**Table 13: Mean background factor scores for each cluster**

Table 14 provides an overview of the percentages of respondents in the various clusters associated with the background variables that have not been entered in the factor analysis.

This table shows that, in all clusters, the vast majority of the respondents came from EU countries, although respondents from the new Member States tend to be over-represented in clusters 1 and 2, and the proportion of stakeholders from "other countries of the European Region" is the highest in cluster 3. The proportion of respondents who declared working for the EU administration, for "services", the media, or the police was considerably lower than the proportion of respondents who reported working for associations or interest groups, for research organisation, national or regional administration, the industry, road safety organisation, or "other" organisation. The majority of the respondents in all clusters declared that tools and data were of "high importance" for their daily road safety activities. This proportion was, however, clearly lower in cluster 1 than in all others.

*Cluster 1 - "Low needs for most items"*

Respondents in this cluster reported that their organization had a medium to low level of influence on various levels of decision-making. They also reported to make moderate to low use of the various international and national databases mentioned in the questionnaire. Actually, compared to all other clusters, this is the one with the lowest score on the factor "use of national databases". Sensitization activities are irrelevant for these stakeholders, whereas they have medium to low scores on the "Research" factor. The different types of activities were evenly distributed among the stakeholders in this cluster, there is thus no one which "stands out" particularly.

This cluster is characterized by a higher share of stakeholders from the new member states, as well as a higher share of stakeholders working for national/regional administrations or "other" organizations (not specified). The level of experience in this group can be described as "average". Compared to the other clusters, the proportion of stakeholders in Cluster 1 who report that data and tools are generally of "high importance" for their daily road safety activities is markedly smaller. Interestingly enough, they are also more numerous than respondents in other clusters to report being "Very satisfied" with the data and resources already available to support their daily activities.

| | | Percent in cluster : | | | | | |
|---|---|---|---|---|---|---|---|
| ***Background variable*** | ***Values on the background variables c*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** |
| EU country | « Yes » | 95% | 96% | 97% | 97% | 92% | 96% |
| Type of European country | EU15 | 64% | 68% | 77% | 76% | 86% | 81% |
| | New Member State | 31% | 26% | 13% | 17% | 9% | 15% |
| | Other | 5% | 6% | 10% | 7% | 5% | 4% |
| Type of organization | *Associations/Interest Groups* | 7% | 18% | 6% | 15% | 14% | 7% |
| | *Research,* | 19% | 15% | 28% | 26% | 20% | 7% |
| | *National/regional admin.* | 29% | 19% | 19% | 14% | 22% | 30% |
| | *Industry* | 14% | 15% | 16% | 19% | 27% | 19% |
| | *Road safety org.* | 12% | 12% | 19% | 7% | 4% | 15% |
| | *European admin.* | 0% | 1% | 3% | 3% | 4% | 0% |
| | *Services,* | 3% | 2% | 3% | 0% | 2% | 0% |
| | *Media* | 0% | 3% | 0% | 3% | 0% | 0% |
| | *Police* | 2% | 5% | 3% | 3% | 0% | 11% |
| | *Other* | 15% | 10% | 3% | 11% | 6% | 11% |
| Policy-making | Yes | 27% | 37% | 34% | 33% | 45% | 44% |
| Experience in road safety | <5 years | 17% | 16% | 13% | 16% | 15% | 25% |
| | 5-20 years | 56% | 52% | 55% | 67% | 62% | 42% |
| | >20 years | 27% | 32% | 32% | 16% | 23% | 33% |
| Importance of data and tools in everyday activities | High importance | 68% | 89% | 90% | 84% | 87% | 81% |
| Satisfaction with data and resources available | Very satisfied | 17% | 15% | 7% | 14% | 11% | 12% |
| | Not at all satisfied | 14% | 15% | 13% | 17% | 15% | 12% |

**Table 14: Distribution of the various background characteristics in the different clusters**

*Cluster 2 - "Moderate needs in all"*

Respondents in this cluster reported that their organisation has a medium to high level of influence on various levels of decision-making. Respondents in this group also declared to make moderate to high use of international and national databases. It is important to note that the score for the use of international databases is actually the highest in this group of stakeholders (along with those in cluster 3). The mean score on the factor "Type of activities – sensitization" is also relatively high for this cluster.

As it was the case with cluster 1, cluster 2 is characterized by a higher share of respondents from the new Member States and by a higher share of respondents working for associations/interest groups. Compared to all other clusters (with the exception of number 3), this group is also characterized by a higher proportion of people with more than 20 years of experience in the field of road safety. The proportion of respondents who declared that data and tools were of "high importance" for their daily activities was the highest in this cluster.

*Cluster 3 - "High needs for models, moderate needs in other, implementation not important"*

This cluster is in many ways similar to Cluster 2, although there are noticeable exceptions: (1) the level of influence reported for the organisation was higher than in cluster 2, (2) the respondents in Cluster 3 are clearly less involved in sensitization activities and more in research-related activities.

Cluster 3 is also characterized by higher proportions of respondents working for research and road safety organizations, and by a higher share of stakeholders with more than 20 years experience. Cluster 3 is the one with the highest proportion of respondents declaring that data and tools are "very important" for their daily activities.

*Cluster 4 - "No needs for models, moderate needs in implementation"*

Along with cluster 5, cluster 4 is the one for which the factor score for "level of influence" is the highest (score indicating medium to low influence). Respondents in this group report using national and international databases from a medium-to-low extent. Sensitization activities are less relevant for this group, whereas research related activities have medium-to-high relevance.

This cluster has an average mix of representatives from various countries. The proportion of stakeholders with 5-20 years of experience is also slightly higher than in other clusters.

*Cluster 5 - "Low importance of implementation and models, moderate needs in crash causation"*

This cluster is, along with cluster 4, the one in which the respondents reported the lowest "level of influence" of their organisation. The scores for the various factors range from medium to low. All the types of activities aggregated in the background factors are relevant, to some extent, to this stakeholders' group.

This cluster is characterized by a slightly higher share of respondents from non-EU countries and by a higher proportion of respondents from the "old" Member States. The proportion of respondents from the industry is also higher in this group. Importantly enough, this cluster is also (along with cluster 6) the one with the highest proportion of respondents classified as "policy-makers". The proportion of stakeholders having between 5 and 20 years of experience is similar to that of cluster 4 and generally higher than for other clusters.

*Cluster 6 - "High importance of implementation but no use of accident and infrastructure analysis"*

This is the cluster with the highest score on the "Type of activities – sensitization" factor (this cluster's score on the "research" factor is considerably lower) and the lowest score on the factor "Use of international databases" (the score on "use of national databases" is in the medium-to-high range). Clearly, the stakeholders in this group do not describe the organisation they work for as very influential (the mean score for this factor is in the medium-to-low range). Similarly to cluster 5, this cluster is characterized by a slightly higher share of "old" Member States. It also includes more representatives of the national/regional administrations and of the police.

Cluster 6 also has the highest proportion of respondents classified as “policy makers” along with cluster 5. Among the people in this group higher proportions of those with short (up to 5 years) and long (over 20 years) experience in the field can be indicated.

### 4.2.5. Conclusions from the combined needs analysis

Working with the combined “needs” scores also allowed the identification of distinct clusters among the stakeholders. There are clear similarities with the clusters identified on the basis of the separate treatment of the priority and availability ratings. Remember, however that both analyses have adopted different solutions to handle the very substantial number of “unknown” responses characterizing the availability ratings. While these unknown responses have been discarded from the separate analysis of the availability scores, they have been assimilated to “Unavailable” answers prior to the combination with the priority scores into the “needs” scale. Given that these answers actually represent the highest proportion of the availability answers, this may have resulted in homogenizing the scores provided by the different stakeholders, and in all cases implies that – using the combined scale – the priority scores have played a larger role in the differentiating the stakeholders.

One can note that Cluster 1 of the separate analysis of priority ratings (“Low needs”) corresponds to Cluster 1 (“Low needs for most items”) as identified on the basis of the combined needs scale, and that Cluster 2 (“Need data and models”) of the separate analysis of priority ratings is alike to Cluster 3 of the combined needs scale (“High needs for models, moderate needs in other, implementation not important”). Cluster 3 as identified on the basis of the separate analysis of priority ratings (“Need everything, but especially implementation”) resemble much Cluster 4 identified on the basis of the combined needs scale (“No needs for models, moderate needs in implementation”). Finally, Cluster 4 obtained from the separate analysis of priority ratings (“Need in-depth data”) has much in common with Cluster 5 of the combined needs scale (“Low importance of implementation and models, moderate needs in crash causation”). Similarities between the clusters derived from the two types of analyses can also be observed on the grounds of the distribution of the background characteristics of the stakeholders categorized in the various clusters.

However, the investigation of the relationship between the clusters of stakeholders, their content in terms of ratings of the data and information tools and their background characteristics was more extensive when the combined needs scale was used. Below, we briefly summarize how the needs ratings and the background characteristics relate in each cluster identified on the basis of the latter approach.

In terms of background characteristics, the stakeholders in Cluster 1 distinguish themselves from the others by the fact that they only rarely state that data and tools are of “high importance” for their professional activities, the fact that they do not seem to use databases (national and international) much, and the tendency to declare more often than stakeholders in other clusters that they are “very satisfied” with the data and resources currently available (which is easier given that they don’t seem to need much of these). This cluster does not clearly relate to any particular type of organization, of road safety activity, or of country. The information obtained on the basis of the background variables is clearly consistent with its mean scores on the factors calculated by means of the combined needs scale, which indicate that they express low needs for about all types of information and data issues.

The analysis of the background characteristics associated with Cluster 2 indicate that the stakeholders grouped in this cluster generally consider data and tools to be important in their daily road safety activities, and that they substantially use

databases (international and national). Stakeholders involved in sensitization activities tend to be better represented in this cluster. The scores on the various factors derived from the combined needs scale are rather uniform in this cluster, and indicate that these stakeholders generally consider scientific input to be relatively important for their professional activities, without showing a marked preference for any particular type of information.

Stakeholders involved in research and working for road safety organizations tend to be over-represented in Cluster 3. This cluster is the one with the highest proportion of respondents declaring that tools are very important for their road safety activities. These respondents also tended to assign very high priority to statistical models and moderate needs for all other data and information issues.

Cluster 4 includes respondents who declared that the institution they work for has the highest level of influence, compared to respondents in other clusters. This cluster is also characterized by a substantial proportion of stakeholders involved in research activities, and consequently does not clearly distinguish itself from Cluster 3 on this point of view. Yet, to the difference of Cluster 3, the stakeholders here do not consider statistical models to be a priority and would rather stress – although to a moderate extent – the needs for information about the implementation of measures, the safety impact of measures and information on accidents and infrastructure.

Respondents assigned to Cluster 5 also reported the institution they work for to have a high level of influence. This is also the cluster containing the highest proportion of policy makers, along with a higher proportion of respondents from the industry. These stakeholders generally tended to consider all data and information types as relatively unimportant (certainly information related to the implementation of measures and statistical models), but they stressed more the importance of accident causation information and information on the safety impacts of measures.

Finally, the stakeholders in Cluster 6 described their organization as “not being very influential”, and did not report using databases much. This cluster is, along with Cluster 5, the one containing the highest share of policy makers. Clearly in this case “sensitization” is a dominant activity among the respondents. These respondents insisted on the importance of information related to the implementation of measures and, on the opposite, on the little importance of accident and infrastructure analysis.

# 5. DISCUSSION AND RECOMMENDATIONS

One of the main objective of DaCoTA's Work Package 1 was to shed light on road safety stakeholder's **needs** and **availability** of data and tools, with a view to further developing the European Road Safety Observatory (ERSO, www.erso.eu)

An extensive survey was successfully carried out among more than 3000 road safety stakeholders in Europe and beyond. The response rate was around 16%. The assessment was carried out along four dimensions of road safety management: Fact finding, Road safety programme development, Preparing implementation, and Monitoring and evaluation.

Response rates were specifically high for national statistics bureaus, research institutes and consultancies. Also the health sector and associations / interest groups / European (umbrella) organisations responded at above-average rates.

The aim of this section is to offer a synthesis of the main conclusions derived from the analysis of the survey results which are available in Machata, Barnes & Jahi (2011) and of those obtained from the detailed analyses presented in this report. The implications of these conclusions in terms of recommendations for the improvement of the ERSO website are also discussed.

Generally speaking, stakeholders expressed significant demand for data and knowledge in road safety-related decision making. They also expressed discontent about the current poor availability of such information, although it should also be noted that (1) stakeholders generally appear to ignore the availability status of items that they consider to be irrelevant for their work, and (2) that stakeholders also seem to be poorly informed about the availability of data and tools in general. The large share of "unknown" responses for the availability ratings indeed indicates an inherent lack of information among stakeholders, even on already available items. Improving knowledge about the steadily growing portfolio of available data should therefore be one of the prime concerns of future public relations work in relation with ERSO.

The cluster analyses presented in this report aimed at identifying profiles of stakeholders sharing common needs/priorities as well as common concerns regarding availability of data and tools. The results indicate that stakeholders involved in road safety on the basis of research or administration and policy makers share – to a certain extent at least – common needs and availability issues. Beyond this "common ground" however, the analyses also showed that they do have needs that specifically relate to the types of activities they exert and the type of organisations they work for.

These results are encouraging for the further development of ERSO, as they indicate that one single platform can provide added value for all stakeholder groups.

Table 15 provides an overview of the issues declared important by the stakeholders, based both on the analysis of the answers to the individual survey items (Machata, Barnes, & Jahi, 2011) and on the basis of the common dimensions underlying these ratings as identified in this report. The individual items rated as important are replaced in the context the dimensions (components/factors) they relate to, and these are in turn put in the wider framework of the road safety management tasks. The colours used to represent the different colours are the same as those used in Table 6 of this deliverable (see p. 27), so that they can more easily be related to the dimensions extracted from each of the three analyses (separate analysis of priority ratings, of availability ratings, and of the combined needs scale).

| Fact finding and diagnosis | Programme development | Implementation | Monitoring and evaluation |
|---|---|---|---|
| Common definitions, under-reporting | Exploring implementation frameworks | | Statistical models |
| A common **definition of a fatality** *Already widely available; should be presented upfront in a definition section of ERSO* | Comparisons of **road safety policies, rules and regulations** *Make sure that relevant DaCoTA results are made available on ERSO* | Information on **funding sources for RS measures** | Statistical **models for following trends** *Make sure that relevant SafetyNet & DaCoTA results are made available on ERSO* |
| **"Seriously" injured counts**, in addition to fatality counts *Make IRTAD report on Serious Road Traffic Casualties and results of High Level Group available on ERSO* | **Good practice catalogue** of measures *SUPREME, BestPoint, and other good practice catalogues* | | Statistical models for **forecasting** *Make sure that relevant DaCoTA results are made available on ERSO* |
| Exposure and behaviour | Costs and safety impacts of measures | | |
| Information on **road users' behaviour and attitudes** *SARTRE results, relevant results of EuroBarometer* | Information on the **costs and benefits** of a road safety measure *Make results such as of SUPREME and ROSEBUD available on ERSO* | | Common methods for **evaluations** of road safety measures *see ROSEBUD methodology* |
| **Exposure data** (e.g. kilometres driven, numbers of trips) *Start data collection e.g. among CARE experts and take the IRTAD process as an example. Make also use of EuroSTAT data.* | Information on the **safety impacts of combined measures** *possible from SUNFlower Next and other initiatives of composite RS indices?* | | Common methodology for the **evaluation of safety impacts, costs and benefits** of road safety measures *see ROSEBUD methodology* |
| Road infrastructure and accident analysis | | | |
| **Digital road maps** for mapping crashes *provide links to good practices such as the German EUSKA or the NZ CAS system* | **Crash prediction models** *Make results of RIPCORD-ISEREST (Deliverable D2) available on ERSO* | **Databases with road layouts** | |
| Common methodology for identifying **high risk sites** *Make results of RIPCORD-ISEREST (Deliverable D6) available on ERSO* | | Detailed information from road **safety audits** and **road safety inspections** *make relevant RIPCORD-ISEREST results (from Deliverables D4, D5) available* | |
| Crash causation | | Implementation of measures | |
| Information on **crash causation** factors *Build on results e.g. of ND and In-Depth Research (PROLOGUE, SHRP, SafetyNet, MAIDS, …) and make core results available on ERSO. Tender additional research on knowledge gaps* | | **Good practice collection** on implementation *SUPREME, BestPoint, and other good practice catalogues* | Standardised methods for **monitoring implementation** |

**Table 15: Overview of the dimensions (components and factors) identified within the context of the road safety management framework.**

The table additionally provides proposed actions for improving the ERSO, including when the required information is available from Deliverables of EU projects – the aim should in this case be to make this wealth of information easily accessible on the ERSO and to have it updated where necessary and feasible.

It is important to mention that, in addition to the above “high scores”, other issues, such as in-depth investigations, naturalistic driving and simulator studies reached low priority scores (or were considered more important by specific subgroups of stakeholders, such as those working for the industry), but will be at the heart of European research for the coming years. Hence, one of the future functions of ERSO will be to present stakeholders with results from that type of recent EU research.

# 6. REFERENCES

Cerny, C.A., & Kaiser, H.F. (1977). A study of a measure of sampling adequacy for factor-analytic correlation matrices. Multivariate Behavioral Research, 12(1), 43-47.

Compey, A. L. & Lee, H. B. (1992). A first course in Factor Analysis. 2nd edition. Psychology Press.

Machata, K, Barnes, J, Jahi, H (Eds.) (2011) Stakeholder's contribution, Deliverable 1.3 of the EC FP7 project DaCoTA.

Muhlrad, N, Dupont, E (Eds.) (2010) Consultation of a panel of experts on the needs for data and technical tools in road safety policy-making, Deliverable 1.1/4.1 of the EC FP7 project DaCoTA.

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

Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., (2005). Handbook on Constructing Composite Indicators: Methodology and User Guide, OECD Statistics Working Papers, STD/DOC(2005)3, Organisation for Economic Co-operation and Development.

Rubin, D. B. (1987). Multiple Imputation for Nonresponse in Surveys. New York: John Wiley & Sons, Inc.

Tabachnick, B. G., Fidell, L. S. (2001). Using Multivariate Statistics (4th ed.). Needham Heights, MA: Allyn and Bacon.

Talbot, R., Dupont, E., Gitelman, V., Thomas, P. (2012) An investigation of Policy Makers' priorities for data and tools and their availability, Deliverable 1.4 of the EC FP7 project DaCoTA.

# APPENDIX 1: CHARACTERISTICS OF NO-RESPONSES AND INCOMPLETE QUESTIONNAIRES

98 respondents did not provide any useful information (ID only & 1 with just country information). Below further information is provided about the various types of incomplete questionnaires received, along with details on some of the characteristics of the stakeholders who returned them: their country, the type of organisation they work for, and the type of road safety activities they conduct. Note that the respondents could provide several answers to describe their type of activity, so the number of observations for this variable exceeds the total number of respondents who returned each type of incomplete questionnaire described below.

17 respondents filled in part or all of the first section and no or only a few priority items (no information at all on availability)

| **Country** | | **Organisation** | | **Type of RS activities** | |
|---|---|---|---|---|---|
| Belgium | 2 | Association | 1 | Data collection and analysis | 6 |
| Croatia | 1 | Automotive manufacturer | 1 | Campaigns | 3 |
| Cyprus | 1 | Consultancy | 3 | Communication | 4 |
| Czech Republic | 1 | European (umbrella) organisation | 1 | Education | 7 |
| Germany | 2 | Media | 1 | Training | 2 |
| Greece | 1 | Ministry | 2 | Monitoring and evaluation | 3 |
| Irish Republic (Eire) | 1 | Police | 1 | Planning and design | 2 |
| Italy (also Vatican City) | 1 | Regional/local authority | 1 | Infrastructure safety | 4 |
| Poland | 1 | Research institute (Public) | 1 | Vehicle safety | 4 |
| Sweden | 1 | Road Administration | 1 | Enforcement | 3 |
| Switzerland | 1 | Road safety organisation | 2 | Research (commissioning) | 3 |
| United Kingdom | 1 | University | 1 | Research (conducting myself) | 4 |
| Other | 2 | Other | 1 | Management | 1 |
| No answer | 1 | | | Policy making | 3 |
| | | | | Government lobbying | 4 |
| ***Total*** | ***17*** | | ***17*** | | |

17 respondents filled in most of the questionnaire including priorities but answered none or very little of the availability questions.

| **Country** | | **Organisation** | | **Type of RS activities** | |
|---|---|---|---|---|---|
| Belgium | 5 | Association | 2 | Data collection and analysis | 10 |
| Czech Republic | 2 | Consultancy | 1 | Campaigns | 7 |
| Denmark | 1 | Consumer association | 1 | Communication | 7 |
| Greece | 2 | European (umbrella) organisation | 3 | Education | 8 |
| Poland | 1 | European Commission | 1 | Training | 7 |
| Romania | 1 | European Parliament | 1 | Monitoring and evaluation | 4 |
| Spain | 1 | Health | 2 | Planning and design | 3 |
| Turkey | 1 | Interest Group | 1 | Infrastructure safety | 5 |
| Other | 2 | Ministry | 1 | Vehicle safety | 7 |
| Total | 16 | Regional/local authority | 2 | Enforcement | 5 |
| System | 1 | Road safety organisation | 2 | Research (commissioning) | 4 |
| | | | | Research (conducting myself) | 5 |
| | | | | Management | 2 |
| | | | | Policy making | 6 |
| | | | | Government lobbying | 7 |

6 respondents filled in most of the questionnaire except the Programme development and/or implementation sections

| **Country** | | **Organisation** | | **Type of RS activities** | |
|---|---|---|---|---|---|
| Czech Republic | 1 | Police | 1 | Data collection and analysis | 3 |
| Finland | 1 | Research institute (Private) | 1 | Campaigns | 2 |
| Greece | 1 | Research institute (Public) | 2 | Communication | 3 |
| Norway | 1 | University | 1 | Education | 2 |
| Romania | 1 | Other | 1 | Monitoring and evaluation | 1 |
| Sweden | 1 | Total | 6 | Planning and design | 1 |
| Total | 6 | | | Infrastructure safety | 1 |
| | | | | Vehicle safety | 3 |
| | | | | Enforcement | 1 |
| | | | | Research (conducting myself) | 2 |
| | | | | Policy making | 1 |

6 respondents filled in most of the questionnaire except the Evaluation section

| **Country** | | **Organisation** | | **Type of RS activities** | |
|---|---|---|---|---|---|
| Czech Republic | 1 | Consultancy | 2 | Data collection and analysis | 2 |
| Finland | 1 | Ministry | 1 | Campaigns | 1 |
| Germany | 1 | Regional/local authority | 1 | Communication | 1 |
| Italy (also Vatican City) | 1 | Total | 4 | Education | 1 |
| Total | 4 | | | Training | 1 |
| | | | | Monitoring and evaluation | 2 |
| | | | | Planning and design | 3 |
| | | | | Infrastructure safety | 3 |
| | | | | Management | 1 |
| | | | | Policy making | 1 |

# APPENDIX 2: CROSS-TABULATION OF PRIORITY AND AVAILABILITY SCORES

In order to decide whether the "unknown" response option for the availability ratings should be included in the analysis, it was explored whether the "unknown" availability responses were associated with the "not relevant to my work" priority responses. Table 1 shows a cross-tabulation of responses on priorities and availability for four selected questions. It reveals that, on the one hand, all "not relevant to my work" priority responses are associated with an "unknown" response for availability, as was expected. However, "unknown" availability responses are rather uniformly distributed throughout the range of the priority scale, suggesting that there is no clear correlation between the two types of ratings.

| Q12_a | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | | 3 | 1 | 9 | 1 | 14 |
| 1 | 1 | 10 | 29 | 10 | 1 | 51 |
| 2 | 1 | 28 | 55 | 4 | 4 | 92 |
| 3 | 12 | 40 | 167 | 4 | 16 | 239 |
| (blank) | | 1 | 2 | | 113 | 116 |
| Total | 14 | 82 | 254 | 27 | 135 | 512 |

| Q14_h | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | 2 | 1 | | 31 | 5 | 39 |
| 1 | 32 | 15 | 1 | 22 | 6 | 76 |
| 2 | 47 | 69 | 3 | 26 | 10 | 155 |
| 3 | 31 | 45 | 10 | 11 | 7 | 104 |
| (blank) | | 3 | | 1 | 134 | 138 |
| Total | 112 | 133 | 14 | 91 | 162 | 512 |

| Q12_o | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | | | | 9 | 1 | 10 |
| 1 | 4 | 6 | 4 | 4 | 4 | 22 |
| 2 | 9 | 64 | 6 | 13 | 2 | 94 |
| 3 | 26 | 143 | 57 | 16 | 15 | 257 |
| (blank) | | 3 | | 1 | 125 | 129 |
| Total | 39 | 216 | 67 | 43 | 147 | 512 |

| Q16_m | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | 9 | 2 | 1 | 47 | 9 | 68 |
| 1 | 17 | 28 | 4 | 21 | 4 | 74 |
| 2 | 21 | 46 | 3 | 16 | 5 | 91 |
| 3 | 40 | 62 | 18 | 15 | 6 | 141 |
| (blank) | | | | 1 | 137 | 138 |
| Total | 87 | 138 | 26 | 100 | 161 | 512 |

| Q14_c | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | 2 | | 1 | 18 | 5 | 26 |
| 1 | 8 | 9 | 3 | 11 | 3 | 34 |
| 2 | 18 | 71 | 8 | 17 | 7 | 121 |
| 3 | 54 | 81 | 40 | 14 | 9 | 198 |
| (blank) | 1 | 1 | | | 131 | 133 |
| Total | 83 | 162 | 52 | 60 | 155 | 512 |

| Q18_e | Availability | | | | | |
|---|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 99999 | (blank) | Total |
| 0 | 3 | 1 | | 44 | 7 | 55 |
| 1 | 29 | 19 | 5 | 34 | 10 | 97 |
| 2 | 45 | 45 | 10 | 17 | 10 | 127 |
| 3 | 41 | 31 | 19 | 4 | 5 | 100 |
| (blank) | | | | 1 | 132 | 133 |
| Total | 118 | 96 | 34 | 100 | 164 | 512 |

**Table 1. Cross-tabulation of responses on priorities and availability for selected questions**

On the other hand, while it was rather straightforward to integrate the "not relevant" responses in the priorities scale (i.e. lower than "low priority"), it seems difficult to find a logical coding of the "unknown" availability values in relation to the other categories. Consequently, it was opted to consider the "unknown" availability values as 'new' (untreated) missing values. This resulted in the sample for analysis to be significantly reduced, as only 143 responses were retained for analysis. However, the KMO measure of sampling adequacy was still acceptable at 0.89.

# APPENDIX 3 SELECTION OF COMPONENTS AND FACTORS

***Principal Component Analysis of priority ratings:***

The KMO values calculated on the basis of the priority observations (405 observations, 52 items in the analysis) were around 0.95, which can be considered largely satisfactory.

The communalities for all variables were in this case above 0.8, and thus no variable was eliminated from this part of the analysis

In total, 9 components have been extracted from the analysis[15]. Figure 1 shows the "scree plot", which sorts the components according to the size of their Eigenvalues.

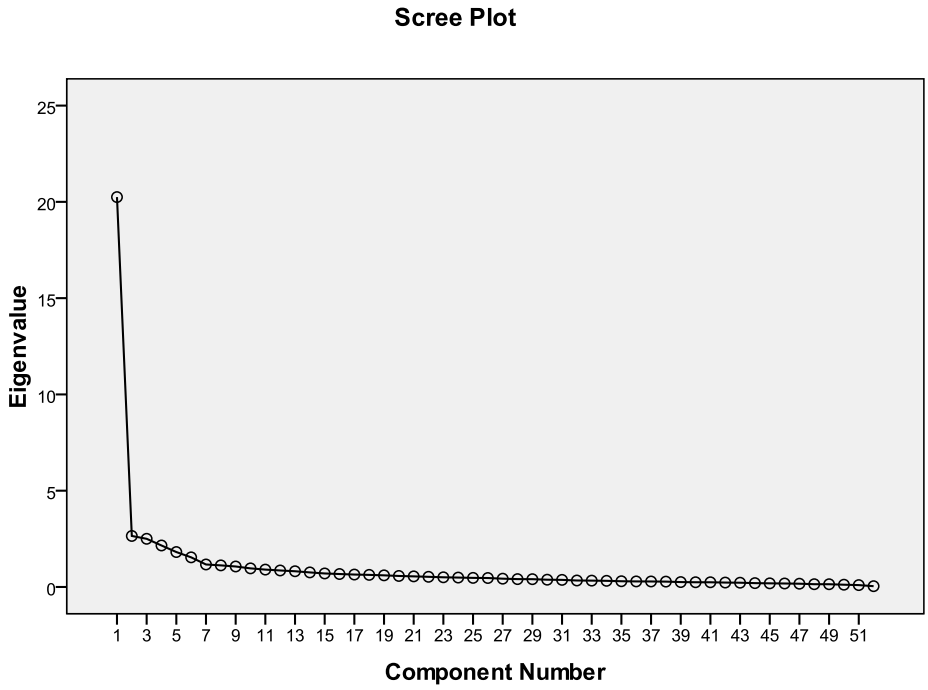


**Figure 1 : Scree plot of the components extracted from the priority ratings**

Table 1 shows the Eigenvalue of each component, the corresponding percent of variation that this component accounts for, as well as the *cumulative* percent of variation explained by the components altogether. The nine components obtained explain 65.9% of the total variance.

[15]Orthogonal (Varimax) rotation has been applied to the solution to ensure that the components extracted from the data would be independent from each other, which eases their interpretation.

| | Eigenvalue | % of Variance | Cumulative % |
|---|---|---|---|
| **Component** | | | |
| **1** | 6.9 | 13.2 | 13.2 |
| **2** | 5.4 | 10.4 | 23.7 |
| **3** | 5.0 | 9.6 | 33.3 |
| **4** | 4.9 | 9.3 | 42.6 |
| **5** | 3.3 | 6.3 | 48.9 |
| **6** | 2.6 | 4.9 | 53.8 |
| **7** | 2.3 | 4.4 | 58.2 |
| **8** | 2.1 | 4.0 | 62.2 |
| **9** | 1.9 | 3.7 | 65.9 |

**Table 1: Eigenvalues, percents of variance and cumulative percents of variance associated with the different components extracted from the priority ratings**

As Table 1 indicates, the first components account for a largest part of variation in the data. The first 6 components explain in total 54% of the variance, while the last 3 contribute another 12%, which is a rather small proportion. On the other hand, the first 6 components have initial Eigenvalues above 2.6, whereas the 3 subsequent ones all have Eigenvalues lower than 2.3.

Table 2 below provides a complete description of the items loading on each component, along with the loading values, for all 9 components initially extracted. Only the first six ones have been eventually selected to perform the next steps of the analysis. The 3 unselected components are nevertheless described here, for the completeness of the information:

*Component 7 - "Advanced research methods"*

Namely: driving simulator studies and naturalistic driving studies.

*Component 8 - "Road safety policies, rules and regulations"*

Given that the two items loading on this component have a clear common meaning ("Comparison of road safety rules and regulations", "Comparisons of RS policies and measures regarding specific road user groups"), its interpretation is straightforward. Note, however, that components on which only one or two variables load should be considered with caution.

*Component 9 -* "*Integration of road safety policies with others"*

The only item loading on this component concerns the possibility of integrating road safety policies with policies developed in other sectors, such as the health and environment sectors. Again, caution is required when assessing this component because there is only one variable loading on it.

| **Component 1** | |
|---|---|
| | ***Loading*** |
| Collections of video clips and billboards of RS campaigns | 0.72 |
| Methods to assess the training needs of individuals involved in RS implementation processes | 0.70 |
| Good practice collection on how countries have implemented specific RS measures | 0.69 |
| Comparisons of driver training programmes across EU | 0.68 |
| User-friendly interfaces to assist new users in finding RS materials on the internet | 0.65 |
| Information on potential funding sources for RS measures | 0.64 |
| Good practice and methodologies for monitoring implementation | 0.63 |
| Detailed data on the costs of RS measures across EU | 0.61 |
| Comprehensive monitoring of implemented measures across EU | 0.57 |
| **Component 2** | |
| | ***Loading*** |
| Medium term forecast models (up to 5 years) | 0.68 |
| Long term forecast models (up to 10 years) | 0.65 |
| Short term forecast models (up to 2 years) | 0.64 |
| Statistical methods for following trends | 0.63 |
| Statistical methods for isolating effects of specific policies or measures | 0.61 |
| Statistical models and tools for target setting | 0.57 |
| **Component 3** | |
| | ***Loading*** |
| Information on the safety impacts of combined RS measures | 0.65 |
| Information on the costs and benefits of a RS measure | 0.64 |
| Standardised procedures and methods for carrying out evaluations of RS measures | 0.6 |
| Information on the safety impacts of singular RS measures | 0.58 |
| Statistical methods for priority setting | 0.54 |
| Methods for evaluation of safety impacts of RS measures | 0.51 |
| Common methodology for the evaluation of costs and benefits of RS measures | 0.51 |
| **Component 4** | |
| | ***Loading*** |
| Common methodology for in-depth crash analysis | 0.57 |
| Crash prediction models for various road types and layouts | 0.58 |
| Detailed information from RS audits and RS inspections | 0.69 |
| Common methodology for identifying high risk sites ("black-spots") | 0.74 |
| Digital road maps for mapping crashes | 0.75 |
| Detailed road databases providing descriptions of road layouts, signing and marking, etc. | 0.82 |
| The use of GPS and/or GIS technologies in accident data collection | 0.55 |
| **Component 5** | |

| **Component 5** | |
|---|---|
| | ***Loading*** |
| A common definition of a fatality | 0.69 |
| A common definition of a serious injury | 0.58 |
| Crash databases that link police and hospital data | 0.57 |
| A common definition of a work-related crash | 0.55 |
| **Component 6** | |
| | ***Loading*** |
| Information on crash causation factors | 0.70 |
| Information on frequent crash scenarios and patterns | 0.66 |
| Results from in-depth crash investigations | 0.56 |
| **Component 7** | |
| | ***Loading*** |
| Results from driving simulator studies | 0.70 |
| Results from naturalistic driving studies | 0.69 |
| **Component 8** | |
| | ***Loading*** |
| Comparisons of safety rules and regulations | 0.70 |
| Comparisons of RS policies and measures regarding specific road user groups | 0.69 |
| **Component 9** | |
| | ***Loading*** |
| Examples of the successful integration of RS policies with others (e.g. environmental or health policies) | 0.52 |

**Table 2: Total number of components extracted from the separate analysis of priority ratings – loading table**

### *Principal Component Analysis of availability ratings*

Despite the smaller size of the sample available for this analysis (143 observations), the KMO measure of sampling adequacy was acceptable, with a value of 0.89.

All variables communalities were above 0.5, so no variables were eliminated from the analysis. 12 components were extracted, which together explained 71% of the variance in the observations. The scree plot is presented in Figure 2, the Eigenvalues, percents and cumulative percents of variance explained are shown in Table 3. The variables loading on each component as well as the loadings and coefficient values are presented in Table 4.

The first 7 components explain a larger proportion of variance than the 5 subsequent ones. In fact, the 7 first components together explain 53% of the variance[16]. The 5

[16] In this case as well, Varimax rotation was applied to the initial component solution to ensure that the components extracted are independent from each other and can easily be interpreted. The results presented in the remainder of this section relates to the solution *after* Varimax rotation.

other components contribute another 17%, a much smaller proportion. Besides, the number of variables loading on the last components is also much smaller (there is only one variable, for example, that loads on Component 12, and this variable already loads on Component 1). As a consequence, only the first 7 components were retained for the remainder of the analysis.

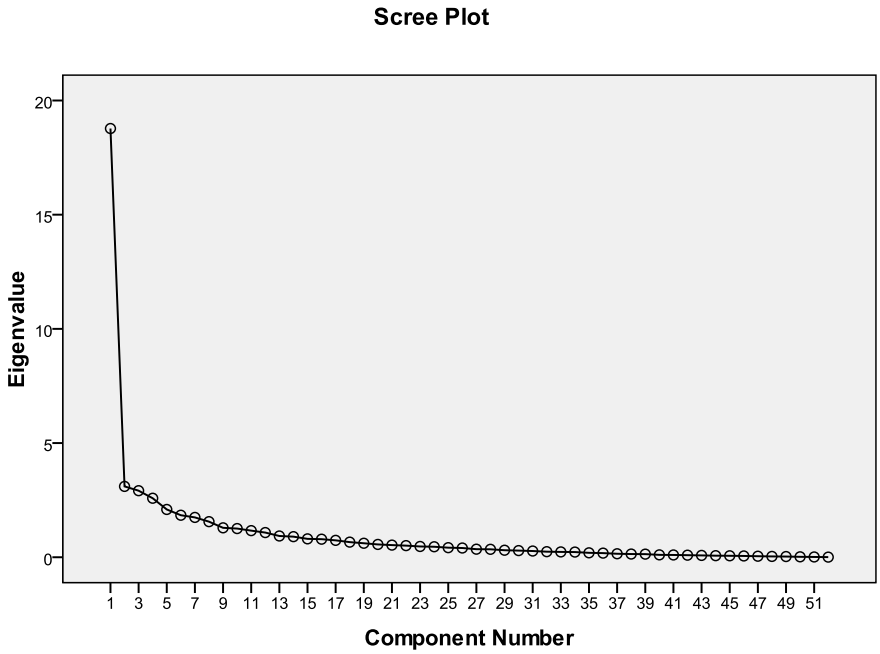


**Figure 2. Scree-plot of the components on availability**

| | Eigenvalue | % of Variance | Cumulative % |
|---|---|---|---|
| **Component** | | | |
| **1** | 5.9 | 11.4 | 11.4 |
| **2** | 5.4 | 10.5 | 21.9 |
| **3** | 5.4 | 10.3 | 32.2 |
| **4** | 3.2 | 6.1 | 38.3 |
| **5** | 3.0 | 5.7 | 44.0 |
| **6** | 2.4 | 4.6 | 48.6 |
| **7** | 2.4 | 4.5 | 53.2 |
| **8** | 2.4 | 4.5 | 57.7 |
| **9** | 1.9 | 3.6 | 61.3 |
| **10** | 1.8 | 3.5 | 64.8 |
| **11** | 1.5 | 3.0 | 67.7 |
| **12** | 1.5 | 2.9 | 70.6 |

**Table 3: Eigenvalues, percents of variance explained and cumulative percents of variance explained for the different components extracted from the analysis of the availability scores**

| **Component 1** | |
|---|---|
| | ***Loading*** |
| Information on the costs and benefits of a RS measure | 0.71 |
| Common methodology for the evaluation of costs and benefits of RS measures | 0.7 |
| Standardised procedures and methods for carrying out evaluations of RS measures | 0.68 |
| Methods for evaluation of safety impacts of RS measures | 0.64 |
| Focusing on seriously injured counts, in addition to fatality counts | 0.54 |
| Information on the safety impacts of singular RS measures | 0.53 |
| Information on the safety impacts of combined RS measures | 0.53 |
| Common methodology for identifying high risk sites ("black-spots") | 0.51 |
| **Component 2** | |
| | ***Loading*** |
| Short term forecast models (up to 2 years) | 0.88 |
| Medium term forecast models (up to 5 years) | 0.87 |
| Long term forecast models (up to 10 years) | 0.84 |
| Statistical methods for isolating effects of specific policies or measures | 0.67 |
| Crash prediction models for various road types and layouts | 0.59 |
| Statistical methods for following trends | 0.56 |
| **Component 3** | |
| | ***Loading*** |
| Good practice collection on how countries have implemented specific RS measures | 0.76 |
| Collections of video clips and billboards of RS campaigns | 0.73 |
| Good practice and methodologies for monitoring implementation | 0.69 |
| Comprehensive monitoring of implemented measures across EU | 0.64 |
| Methods to assess the training needs of individuals involved in RS implementation processes | 0.62 |
| Information on potential funding sources for RS measures | 0.6 |
| Comparisons of driver training programmes across EU | 0.59 |
| **Component 4** | |
| | ***Loading*** |
| Detailed databases providing descriptions of road layouts, signing, marking, etc | 0.73 |
| Digital road maps for mapping crashes | 0.7 |
| Detailed information from RS audits and RS inspections | 0.52 |
| **Component 5** | |
| | ***Loading*** |
| Exposure data (e.g., kilometres driven, numbers of trips) | 0.73 |
| Information on road users' behaviour and attitudes | 0.59 |
| Information on the effect of external factors on the number of road traffic crashes | 0.52 |

| **Component 6** | |
|---|---|
| | ***Loading*** |
| Comparisons of safety rules and regulations | 0.71 |
| Comparisons of RS policies and measures regarding specific road user groups | 0.69 |
| **Component 7** | |
| | ***Loading*** |
| A common definition of a serious injury | 0.85 |
| A common definition of a fatality | 0.74 |
| A common definition of a work-related crash | 0.57 |
| **Component 8** | |
| | ***Loading*** |
| Results from driving simulator studies | 0.73 |
| Medium term forecast model (up to 5 years) | 0.56 |
| **Component 9** | |
| | ***Loading*** |
| Examples of the successful integration of RS policies with others (e.g. environmental or health policies) | 0.64 |
| **Component 10** | |
| | ***Loading*** |
| Crash databases that link police and hospital data | 0.49 |
| Results from naturalistic driving studies | 0.32 |
| **Component 11** | |
| | ***Loading*** |
| Information on crash causation factors | 0.62 |

**Table 4: Total number of components extracted from the separate analysis of availability ratings – loading table**

Table 4 provides all loading values for all items corresponding to each of the 12 components initially extracted. Obviously, components 8-12 include rather heterogenous groups of no more than 3 variables, making their interpretation difficult.

***Factor analysis on the "combined needs scale":***

Table 5 and Figure 3 provide the Eigenvalues and proportions of variance explained by the different factors. The first factors explain 59% of the variance, while additional factors offer comparatively smaller increases in the total variance explained (which raises to 66% with the addition of the second factor, to 72% with the third one…).

To determine the number of factors required for the data, account has been taken of the variance that each of them allowed explaining. An additional criterion was also applied in this case, namely that the factors selected should cover the *whole list* of initial items.

Several FA solutions have also been explored (for example a 1-factor solution that accounted for 59% of the variance, or a 6-factor solution which accounted for 86% of the variance). Both solutions allowed the calculation of factor scores on the basis of which the stakeholders could subsequently be clustered (see Section 4.2.3). But both

solutions also implied that some of the original items be omitted from the analysis. Therefore, we decided to select the solution that would provide a coverage of the whole set of original items (without having to exclude some of them from the analysis). This was a nine-factor solution which explained 94% of the variation in the observations.

| | Eigenvalue | % of Variance | Cumulative % |
|---|---|---|---|
| **Component** | | | |
| **1** | 17.68 | 58.87% | 58.87% |
| **2** | 2.19 | 7.31% | 66.17% |
| **3** | 1.89 | 6.31% | 72.48% |
| **4** | 1.57 | 5.23% | 77.71% |
| **5** | 1.35 | 4.49% | 82.21% |
| **6** | 1.12 | 3.72% | 85.92% |
| **7** | 0.95 | 3.17% | 89.10% |
| **8** | 0.80 | 2.65% | 91.75% |
| **9** | 0.71 | 2.35% | 94.10% |
| **10** | 0.58 | 1.93% | 96.03% |
| **11** | 0.53 | 1.78% | 97.81% |
| **12** | 0.43 | 1.44% | 99.25% |
| **13** | 0.40 | 1.34% | 100.59% |

**Table 5: Eigenvalues, percents of variance explained and cumulative percents of variance explained by the factors extracted from the analysis of the combined priority and availability ratings.**

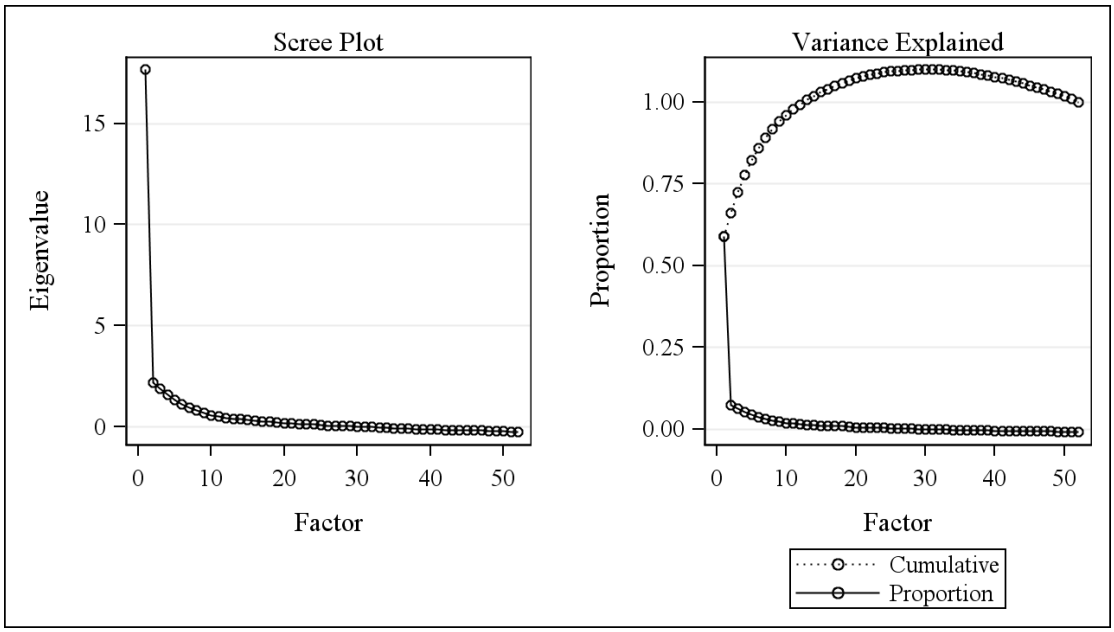


**Figure 3. Scree-plot of the factors and variance explained.**

An overview of the variables loadings on the different factors (only variables with loadings superior to 0.32 are considered) is provided in Table 5 on pp 22-25 of this deliverable. As a reminder, the loading values can be interpreted as the correlations between the variables and the factors.

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# APPENDIX 4 SELECTION OF CLUSTERS:

***Clustering based on the components extracted from the separate analysis of priority ratings***

The results of the hierarchical clustering suggest that the optimal number of clusters is 4. This can be explained as follows: Table 1 shows a reduced version of the agglomeration schedule, focusing on the last steps of the algorithm. It can be seen that the first major "jump" in the coefficients, looking from bottom up, takes place at step 401 (i.e. all reductions before and after this step are smaller ones). This is also highlighted in Figure 1, where the "elbow" in the scree plot becomes visible when examining a more focused view of the final stages of the estimation.

Therefore, the optimal number of clusters can be defined as the differences between the total number of steps (i.e. number of valid cases) and the number of steps at which the "elbow" occurs, thus 405-401= 4 clusters.

| Stage | Cluster Combined | | Coefficients |
|---|---|---|---|
| | Cluster 1 | Cluster 2 | |
| 1 | 163 | 190 | .000 |
| 2 | 385 | 425 | .020 |
| 3 | 4 | 144 | .042 |
| 4 | 389 | 509 | .069 |
| 5 | 174 | 276 | .098 |
| … | … | … | … |
| … | … | … | … |
| 394 | 50 | 61 | 1300.964 |
| 395 | 28 | 33 | 1360.604 |
| 396 | 4 | 6 | 1420.892 |
| 397 | 14 | 50 | 1488.770 |
| 398 | 28 | 43 | 1558.473 |
| 399 | 4 | 5 | 1633.532 |
| 400 | 14 | 19 | 1725.387 |
| 401 | 2 | 4 | 1825.310 |
| 402 | 3 | 28 | 1985.495 |
| 403 | 2 | 3 | 2188.063 |
| 404 | 2 | 14 | 2424.000 |

**Table 1: Agglomeration schedule at the different stages of the algorithm**

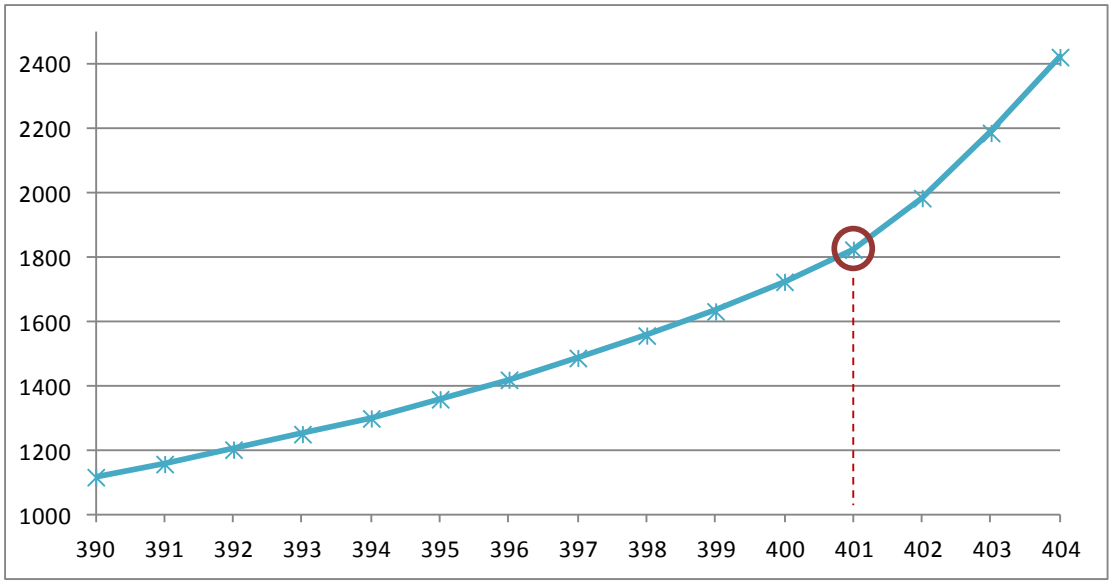


**Figure 1: Scree plot of hierarchical clustering – Priorities**

***Clustering based on the components extracted from the separate analysis of priority ratings:***

Table 2 shows a reduced version of the agglomeration schedule, focusing on the last steps of the algorithm and the first major "jump" in the coefficients, looking from bottom up, takes place at step 150 (i.e. all reductions before and after this step are smaller ones). This is also highlighted in Figure 7, where the "elbow" in the scree plot becomes visible when examining a more focused view of the final stages of the estimation. Therefore, the optimal number of clusters is defined as 153-150=3 clusters. As in the previous case, a k-means cluster analysis with a pre-defined number of 3 clusters was then performed.

| Stage | Cluster Combined | | Coefficients |
|---|---|---|---|
| | Cluster 1 | Cluster 2 | |
| 1 | 190 | 367 | .000 |
| 2 | 226 | 229 | .044 |
| 3 | 5 | 190 | .136 |
| 4 | 240 | 356 | .307 |
| 5 | 245 | 416 | .489 |
| ... | ... | ... | ... |
| ... | ... | ... | ... |
| 147 | 7 | 76 | 741.735 |
| 148 | 3 | 38 | 787.412 |
| 149 | 4 | 12 | 838.382 |
| 150 | 7 | 9 | 894.535 |
| 151 | 3 | 7 | 975.301 |
| 152 | 3 | 4 | 1064.000 |

**Table 2: Agglomeration schedule at the different stages of the algorithm**

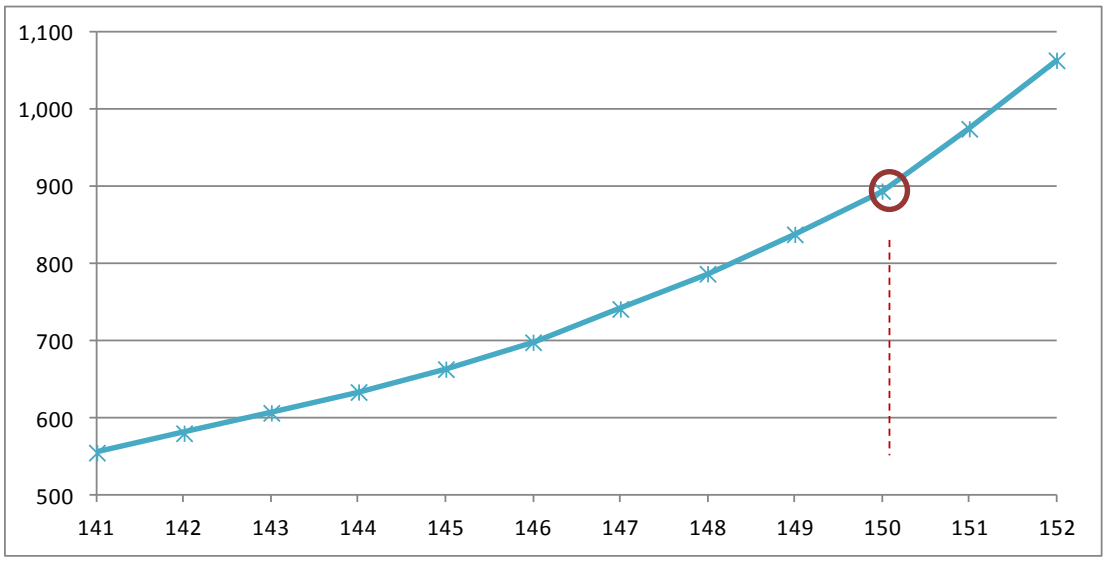


**Figure 2: Scree plot of hierarchical clustering – Availability ratings**

***Clustering based on the components extracted from the combined needs scale***

The classification tree obtained on the basis of the combined priority and availability scores is presented in Figure 3. The length of the tree links along the horizontal axis indicates the magnitude of the distances between the clusters. This tree suggests that the respondents can be subdivided in two, three, six or even more clusters. In order to work with a substantial, but still manageable number of clusters, the six-cluster solution was selected (see vertical line on Figure 2).

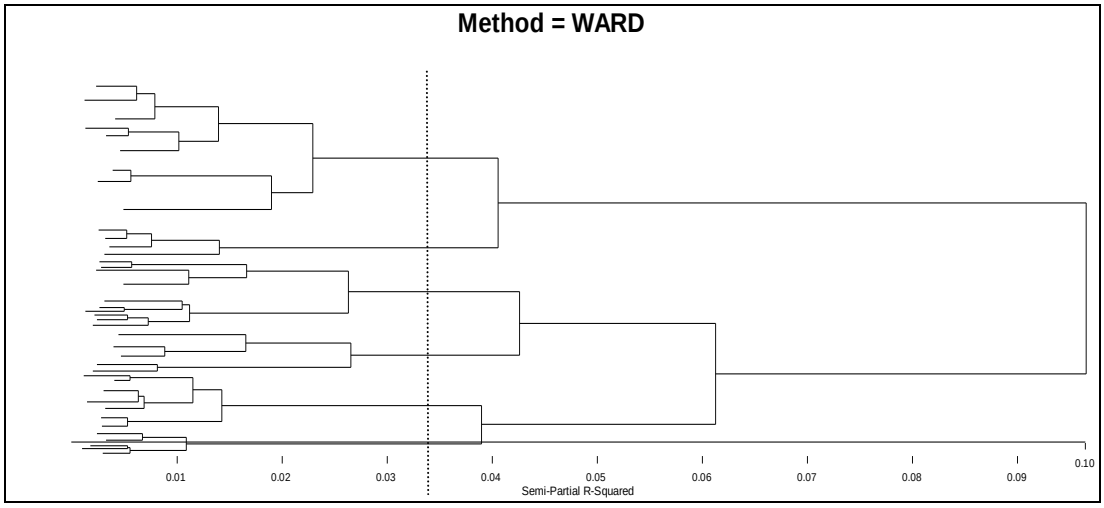


**Figure 3: A classification tree for clusters of stakeholders**

Figure 4 shows the total within sums of squares computed on the basis of k-means clustering, with k running from 1 to 15. Although there is no striking “kink” in the sum of squares curve, the figure also indicates that k=6 is a sensible option.

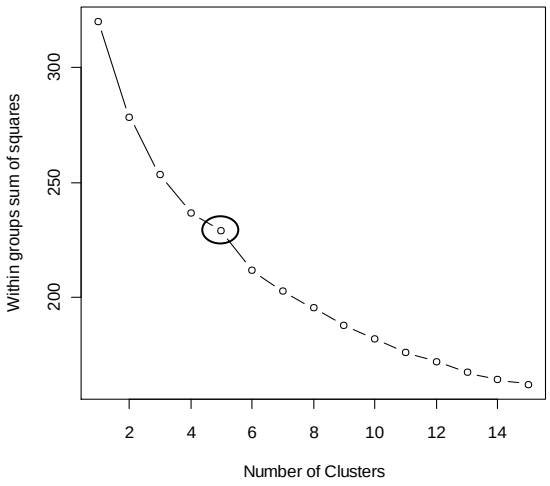


**Figure 4: Selecting the number of clusters using k-means clustering**

The results from the 3-cluster option have nevertheless also been explored in details, in an attempt to gather complementary information about the differences characterizing the stakeholders on the basis of their priority and availability ratings. Comparing the results from the 3 and 6-clusters solutions, one can conclude that fewer clusters do not clarify the differences between the stakeholders. However, when “gathered” into larger groups, the differences that distinguish the smaller

groups of stakeholders tend to cancel each other out. Given that the purpose of this study is to ascertain the differences in the needs for scientific support expressed by the various stakeholders, the 6-clusters solution was adopted for the remainder of the analyses. For the completeness of the information, the results based on the 3-clusters solution are nevertheless described below:

Table 3 provides an overview of the different factor values associated with each of the 3 clusters. Similarly to the 6-clusters solution, lower factor scores indicate higher relevance of the items loaded, meaning a combined estimate of priority and availability with regards the need in these elements for supporting stakeholders' activities. To ease the interpretation of these values, the following colour-coding has been applied:

- Green: high importance of the items loading on the factor. The darker the green, the higher the importance;

- Yellow: medium needs of the items loading on the factor. Dark yellow indicates medium to low importance;

- Red: low needs of the items loading on the factor. Dark red indicates the lowest importance.

As with the 6 clusters solution (see Section 4.2.3), yellow appears to be the prevailing colour across factors and clusters. This implies that most of the respondents have assigned medium importance to most of the items in the survey. There are only three cells of Table 3 whose colour is either green or red (high and low importance, respectively).

| Factors | Cluster1 | Cluster2 | Cluster3 | Standard deviation |
|---|---|---|---|---|
| Factor1: Implementation of measures | -0.03 | -0.22 | 0.37 | 0.91 |
| Factor2: Accident and infrastructure analysis for implementation of measures | 0.89 | -0.38 | -0.02 | 0.89 |
| Factor3: Statistical models | -0.11 | -0.58 This cell is light green | 1.00 | 0.96 |
| Factor4: Exploring implementation frameworks | 0.43 | -0.17 | -0.03 | 0.88 |
| Factor5: Crash causation | 0.37 | -0.13 | -0.05 | 0.88 |
| Factor6: Evaluation of measures | 0.30 | -0.13 | 0.00 | 0.87 |
| Factor7: Common definitions | 0.22 | -0.14 | 0.07 | 0.88 |
| Factor8: Information on safety impacts | 0.40 | -0.06 | -0.19 | 0.85 |
| Factor9: Improving data collection | 0.19 | -0.07 | -0.02 | 0.82 |
| Number of respondents | 86 | 196 | 123 | Total: 405 |
| % of respondents | 21% | 48% | 30% | Total: 100% |

**Table 3: Exploring the results: mean factor scores of each cluster in the three-cluster solution**

Some differences can be identified between the clusters, however. For example, Cluster 1 (with 21% of the respondents) is characterized by medium to low needs in the majority of the items, especially concerning the analysis of accident and infrastructure for the implementation of measures; while respondents in Cluster 2 (the

largest one with 48% of the respondents) reported moderate needs for all items, with a clearer interest in statistical models. Finally, Cluster 3 (30% of the respondents) did not express any needs in statistical models, low needs in implementation of measures, but moderate interest in the safety impacts of measures and accident causation.

# APPENDIX 5: WITHIN-COUNTRY COMPARISONS

The preceding chapters give an overview of the needs for data and tools in Europe. There are however variations between individual countries' needs and the answers for respondents within these countries. The following sections present some overview tables for Austria, Poland, Spain and the UK to give an indication of the variation between respondents' answers within these countries. For each country the different organisation types represented by the respondents are presented. This is followed by examples of the data/tools items that are considered of great need by a majority of respondents and those items that divide respondents in terms of their views on data/tools needs.

The organisation types described here are the same as those defined in Section 2.2.1:

- ***Associations, Interest Groups*** which includes Association, Automobile club, Consumer association, European (umbrella) organization, Interest Group;
- ***Research*** which includes Research institute (Private), Research institute (Public), University;
- ***National/regional administrations*** which includes Ministry, National Government, Public enterprise, Regional/local authority, Road Administration, Statistics bureau;
- ***Industry*** which includes Automotive industry supplier, Automotive manufacturer, Haulier, Insurance industry, Consultancy;
- ***Road safety organisations***;
- ***European administration*** including European Commission, European Parliament;
- ***Services*** including Health, Emergency services (excluding police);
- ***Media***
- ***Police***
- ***Other***

'Need' is calculated based on the combined priority/availability values as described in Section 2.2.2. These were here further condensed into 3 groups as follows:

1. Medium/high priority, limited/no availability
2. Medium/high priority, already available
3. Low priority/not relevant

Category 1 represents "great need" and Category 3 "little need". Category 2 represents high importance but the data/tool need has already been met (availability).

## 1. Austria (AT)

17 respondents were from Austria. The following tables show the distribution of organisation types (Table 10), the 7 data/tool items that were indicated as having the greatest need (Table 11)and 4 of the data/tool items that divided opinion among respondents as to whether the need is high or low (Table 12).

| Organisation Type | Number of Respondents |
|---|---|
| Association/interest group | 2 |
| Research | 1 |
| National/regional admin | 5 |
| Industry | 1 |
| Road safety organisations | 7 |
| Other | 1 |
| Total | 17 |

**Table 1: Number of respondents per organisation type (AT)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | Missing data | |
|---|---|---|---|---|---|---|---|---|
| | Count | **%** | Count | % | Count | % | Count | % |
| Information on crash causation factors | 16 | **94%** | 0 | 0% | 0 | 0% | 1 | 6% |
| Information on the safety impacts of combined road safety measures | 16 | **94%** | 0 | 0% | 1 | 6% | 0 | 0% |
| Standardised procedures and methods for carrying out evaluations of road safety measures | 15 | **88%** | 1 | 6% | 1 | 6% | 0 | 0% |
| Information on road user behaviour and attitudes | 15 | **88%** | 0 | 0% | 1 | 6% | 1 | 6% |
| Statistical methods for priority setting | 15 | **88%** | 0 | 0% | 1 | 6% | 1 | 6% |
| Information on the public acceptance of a road safety measure | 15 | **88%** | 0 | 0% | 1 | 6% | 1 | 6% |
| Common methodology for in-depth crash analysis | 15 | **88%** | 0 | 0% | 1 | 6% | 1 | 6% |

**Table 2: Data/tools with the greatest need (AT)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | Missing data | |
|---|---|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % | Count | % |
| Long term forecast models (up to 10 years) | 8 | 47% | 2 | 12% | 7 | 41% | 0 | 0% |
| Results from driving simulator studies | 8 | 47% | 0 | 0% | 8 | 47% | 1 | 6% |
| Statistical methods for following trends | 6 | 35% | 5 | 29% | 6 | 35% | 0 | 0% |

**Table 3: Data/Tools items for which opinion is divided (AT)**

# 2. Poland (PL)

19 respondents were from Poland. The following tables show the distribution of organisation types (Table 10), the 8 data/tool items that were indicated as having the greatest need (Table 11)and 6 of the data/tool items that divided opinion among respondents as to whether the need is high or low (Table 12).

| Organisation Type | Number of Respondents |
|---|---|
| Association/interest group | 3 |
| Research | 3 |
| National/regional admin | 3 |
| Industry | 3 |
| Road safety organisations | 2 |
| Other | 4 |
| No answer | 1 |
| Total | 19 |

**Table 4: Number of respondents per organisation type (PL)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | Missing data | |
|---|---|---|---|---|---|---|---|---|
| | Count | **%** | Count | % | Count | % | Count | % |
| Good practice catalogue of measures -- including implementation conditions | 12 | **63%** | 0 | 0% | 5 | 26% | 2 | 11% |
| Comparisons of driver training programmes across Europe | 12 | **63%** | 0 | 0% | 5 | 26% | 2 | 11% |
| The use of GPS and/or GIS technologies in accident data collection | 11 | **58%** | 2 | 11% | 4 | 21% | 2 | 11% |
| Information on the effect of external factors on the number of road traffic crashes | 11 | **58%** | 2 | 11% | 4 | 21% | 2 | 11% |
| Crash databases that link police and hospital data | 11 | **58%** | 1 | 5% | 5 | 26% | 2 | 11% |
| Information on frequent crash scenarios and patterns | 11 | **58%** | 1 | 5% | 5 | 26% | 2 | 11% |
| Common methodology for in-depth crash analysis | 11 | **58%** | 1 | 5% | 5 | 26% | 2 | 11% |
| Common methodology for the evaluation of costs and benefits of road safety measures | 11 | **58%** | 1 | 5% | 5 | 26% | 2 | 11% |

**Table 5: Data/tools with the greatest need (PL)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | No answer | |
|---|---|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % | Count | % |
| Statistical methods for isolating effects of specific policies or measures | 9 | 47% | 0 | 0% | 8 | 42% | 2 | 11% |
| Methods to assess the training needs of individuals involved in road safety implementation processes | 8 | 42% | 1 | 5% | 7 | 37% | 3 | 16% |
| Information on the public acceptance of a road safety measure | 8 | 42% | 1 | 5% | 8 | 42% | 2 | 11% |
| Data on the under-reporting of road traffic crashes | 7 | 37% | 4 | 21% | 6 | 32% | 2 | 11% |
| Focusing on seriously injured counts, in addition to fatality counts | 7 | 37% | 4 | 21% | 6 | 32% | 2 | 11% |
| Statistical models and tools for target setting | 7 | 37% | 3 | 16% | 6 | 32% | 3 | 16% |
| User-friendly interfaces to assist new users in finding road safety materials on the internet | 7 | 37% | 3 | 16% | 7 | 37% | 2 | 11% |
| Comparisons of the frameworks in which road safety policies and measures are implemented | 7 | 37% | 2 | 11% | 7 | 37% | 3 | 16% |
| Detailed information from road safety audits and road safety inspections | 7 | 37% | 2 | 11% | 8 | 42% | 2 | 11% |
| Long term forecast models (up to 10 years) | 7 | 37% | 2 | 11% | 8 | 42% | 2 | 11% |

**Table 6: Data/Tools items for which opinion is divided (PL)**

# 3. Spain (ES)

23 respondents were from Spain. The following tables show the distribution of organisation types (Table 10), the 5 data/tool items that were indicated as having the greatest need (Table 11)and 3 of the data/tool items that divided opinion among respondents as to whether the need is high or low (Table 12).

| Organisation Type | Number of Respondents |
|---|---|
| Association/interest group | 5 |
| Research | 6 |
| National/regional admin | 5 |
| Industry | 3 |
| Road safety organisations | 1 |
| Other | 3 |
| Total | 23 |

**Table 7: Number of respondents per organisation type (ES)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | Missing data | |
|---|---|---|---|---|---|---|---|---|
| | Count | **%** | Count | % | Count | % | Count | % |
| Information on road user behaviour and attitudes | 20 | **87%** | 0 | 0% | 2 | 9% | 1 | 4% |
| Comparisons of road safety policies and measures regarding specific road user groups | 19 | **83%** | 0 | 0% | 2 | 9% | 2 | 9% |
| Good practice collection on how countries have implemented specific road safety measures | 19 | **83%** | 0 | 0% | 2 | 9% | 2 | 9% |
| Information on crash causation factors | 17 | **74%** | 4 | 17% | 1 | 4% | 1 | 4% |
| Standardised procedures and methods for carrying out evaluations of road safety measures | 17 | **74%** | 2 | 9% | 2 | 9% | 2 | 9% |

**Table 8: Data/tools with the greatest need (ES)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | No answer | |
|---|---|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % | Count | % |
| Results from driving simulator studies | 9 | 39% | 2 | 9% | 10 | 44% | 2 | 9% |
| Collections of video clips and billboards of road safety campaigns | 9 | 39% | 1 | 4% | 9 | 39% | 4 | 17% |
| Long term forecast models (up to 10 years) | 8 | 35% | 2 | 9% | 9 | 39% | 4 | 17% |

**Table 9: Data/Tools items for which opinion is divided (ES)**

# 4. United Kingdom (UK)

54 respondents were from the UK. The following tables show the distribution of organisation types (Table 10), the 5 data/tool items that were indicated as having the greatest need (Table 11)and 8 of the data/tool items that divided opinion among respondents as to whether the need is high or low (Table 12).

| **Organisation Type** | **Number of Respondents** |
|---|---|
| Association/interest group | 5 |
| Research | 3 |
| National/regional admin | 11 |
| Industry | 15 |
| Road safety organisations | 7 |
| Police | 7 |
| Other | 5 |
| No answer | 1 |
| Total | 54 |

**Table 10: Number of respondents per organisation type (UK)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | Missing data | |
|---|---|---|---|---|---|---|---|---|
| | Count | **%** | Count | % | Count | % | Count | % |
| Information on the safety impacts of combined road safety measures | 40 | **74%** | 7 | 13% | 4 | 7% | 3 | 6% |
| Information on frequent crash scenarios and patterns | 36 | **67%** | 11 | 20% | 4 | 7% | 3 | 6% |
| Good practice collection on how countries have implemented specific road safety measures | 36 | **67%** | 5 | 9% | 10 | 19% | 3 | 6% |
| Data on the under-reporting of road traffic crashes | 35 | **65%** | 7 | 13% | 10 | 19% | 2 | 4% |
| Crash databases that link police and hospital data | 33 | **61%** | 6 | 11% | 12 | 22% | 3 | 6% |

**Table 11: Data/tools with the greatest need (UK)**

| | Medium/high priority, limited/no availability | | Medium/high priority, already available | | Low priority/not relevant | | No answer | |
|---|---|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % | Count | % |
| Comprehensive monitoring of implemented measures across Europe | 25 | 46% | 3 | 6% | 23 | 43% | 3 | 6% |
| Detailed data on the costs of road safety measures across Europe | 23 | 43% | 2 | 4% | 25 | 46% | 4 | 7% |
| Short term forecast models (up to 2 years) | 22 | 41% | 7 | 13% | 21 | 39% | 4 | 7% |
| Tools for simulating road user behaviour | 22 | 41% | 7 | 13% | 22 | 41% | 3 | 6% |
| Statistical methods for following trends | 20 | 37% | 13 | 24% | 18 | 33% | 3 | 6% |
| Statistical models and tools for target setting | 20 | 37% | 11 | 20% | 19 | 35% | 4 | 7% |
| Long term forecast models (up to 10 years) | 20 | 37% | 8 | 15% | 21 | 39% | 5 | 9% |

**Table 12: Data/Tools items for which opinion is divided (UK)**