## Implementation scenarios and further research priorities regarding forgiving and self-explaining roads

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LIST OF ABBREVIATIONS

A  Activity (e.g. A5.1 : Activity 5.1)
ABS  Anti-lock Braking System
ACC  Advanced Cruise Control
ADAS  Advanced Driver Assistance System
ADVISORS  Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety
AHP  Analytic Hierarchy Process
BASt  Bundesanstalt für Strassenwesen (German Federal Highway Research Institute), Bergisch Gladbach, Germany
C2C  Car to Car communication
C2I  Car to Infrastructure communication
CD  Compact Disk
CDV  Centrum dopravního výzkumu, v.v.i., (Transport Research Centre), Czech Republic
CE  Column Element
CEN  European Committee for Standardization (Comité Européen de Normalisation)
CERTH  Centre for Research and Technology Hellas
CRF  Centro Ricerche Fiat (Fiat Research Centre), Torino, Italy
CVIS  Cooperative Vehicle Infrastructure Systems (EU funded FP6 integrated project)
D  Deliverable (e.g. D1.1 : Deliverable 1.1)
DGPS  differential GPS
DSRC  Dedicated Short Range Communications
DVD  Digital Versatile Disk
EU  European Union
FMCW  Frequency Modulated Continuous Wave
FOR  Forgiving Road
FRE  Forgiving Road Environment
GDR  Group Decision Room
GPS  Global Positioning System
GSM  Global System for Mobile Communications
HIT  Hellenic Institute of Transport
HMI  Human Machine Interface
HUB  Hogeschool-Universiteit Brussel (VLEKHO) (University College Brussels), Brussels, Flemish Community of Belgium
ICT  Information & Communication Technology
IN-SAFETY  INfrastructure and SAFETY
ISA  Intelligent Speed Adaptation
ISO  International Organization for Standardization/ International Standards Organization
ITS  Intelligent Transport Systems
IVIS  In-Vehicle Information System
KfV  Kuratorium für Verkehrssicherheit (Austrian Road Safety Board), Vienna, Austria
KTI  Közlekedéstudományi Intézet Kht (Institute for Transport Sciences, Budapest)
LACOS  Lateral COntrol Support
LAN  Local Area Network
LDWA  Lane Departure Warning Assistant
LDWS  Lane Departure Warning System
MAMCA  Multi-actor multi-criteria analysis
<table>
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<tr>
<td>MCA</td>
<td>Multi-Criteria Analysis</td>
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<tr>
<td>MMI</td>
<td>Man-Machine Interface</td>
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<tr>
<td>OR</td>
<td>Operational Research</td>
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<tr>
<td>POLIS</td>
<td>Promoting Operational Links with Integrated Services, Brussels</td>
</tr>
<tr>
<td>RAI</td>
<td>Rijwiel Automobiel Industrie, Amsterdam, The Netherlands</td>
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<tr>
<td>RDS-TMC</td>
<td>Radio Data System</td>
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<tr>
<td>RE</td>
<td>Row Element</td>
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<td>RVC</td>
<td>Radio Vehicle Communication</td>
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<td>S&amp;G</td>
<td>Stop and Go</td>
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<tr>
<td>SCBA</td>
<td>Social Cost-Benefit Analysis</td>
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<tr>
<td>SER</td>
<td>Self-Explaining Road</td>
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<tr>
<td>SWOV</td>
<td>Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (Dutch Institute for Road Safety Research, The Netherlands)</td>
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<tr>
<td>TMC</td>
<td>Traffic Message Channel</td>
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<tr>
<td>TMIC</td>
<td>Traffic Management and Information Centre</td>
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<tr>
<td>TUDarm</td>
<td>Technische Universität Darmstadt, Germany</td>
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<tr>
<td>TUDelft</td>
<td>Technische Universiteit Delft, The Netherlands</td>
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<tr>
<td>UCalgary</td>
<td>University of Calgary, Canada</td>
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<tr>
<td>USTUTT</td>
<td>Universität Stuttgart, Germany</td>
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<tr>
<td>UWB</td>
<td>Ultra Wide Band</td>
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<tr>
<td>V2I</td>
<td>Vehicle-to-infrastructure</td>
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<tr>
<td>V2V</td>
<td>Vehicle-to-Vehicle</td>
</tr>
<tr>
<td>VLEKHO</td>
<td>Vlaamse Economische Hogeschool (HUB, University College Brussels), Flemish Community of Belgium</td>
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<tr>
<td>VMS</td>
<td>Variable Message Sign</td>
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<td>VRU(s)</td>
<td>Vulnerable Road User(s)</td>
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<td>VTI</td>
<td>Statens väg-och transportforskningsinstitut (Swedish National Road and Transport Research Institute), Linkoping, Sweden</td>
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<tr>
<td>VUB</td>
<td>Vrije Universiteit Brussel (Free University of Brussels), Brussels, Flemish Community of Belgium</td>
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<tr>
<td>WAP</td>
<td>Wireless Application Protocol</td>
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<td>WAVE</td>
<td>Wireless Access for the Vehicular Environment</td>
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<td>WLAN</td>
<td>Wireless LAN</td>
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<tr>
<td>WP</td>
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EXECUTIVE SUMMARY

In this deliverable a multi-actor multi-criteria analysis (MAMCA) is performed for the strategic evaluation of a number of innovative systems contributing to the creation of a more forgiving and self-explaining road environment. This deliverable also formulates a number of guidelines aimed at making the road environment more forgiving and more self-explaining, as well as some specific priorities for further research.

A forgiving road (FOR) environment is a road environment designed and built in such a way as to counteract or block the occurrence of driving errors, and to avoid or mitigate the negative consequences thereof. A self-explaining road (SER) environment is a road environment designed and constructed to elicit correct assessments from road users as to what constitutes appropriate driver behaviour matched to the road environment.

A multi-actor multi-criteria analysis (MAMCA) is a multi-criteria analysis (MCA) whereby the decision tree is structured on the basis of stakeholder criteria. Three stakeholders were identified in this application, namely (1) users, (2) society/public policy makers and (3) manufacturers. Each of these stakeholders attaches importance to a specific set of criteria. The overall relative priorities reflecting the society’s point of view were taken as the starting base for policy purposes. The overall relative priorities of the two other stakeholders (users and manufacturers) make it possible to assess the implementation and market potential of the scenarios.

The approach adopted includes two main phases. First, we performed a preliminary prioritisation of a large number of alternative systems. This was the subject of work package 1 (WP1) in the context of FOR and work package 2 (WP2) in the context of SER. For the purpose of this preliminary prioritisation, 18 potential types of systems were taken into account. These 18 types result from combining the six most important causes of errors identified in accident statistics (excessive speed in unexpected sharp bends, speeding in general, violation of priority rules, wrong use of the road, failure when overtaking and insufficient safety distance), with three dimensions along which systems can be developed (the vehicle, the infrastructure and the coordination between the vehicle and the infrastructure). The 18 types of systems obtained in this way have a preliminary character and should be considered hypothetical. In fact, they merely provide a context within which potential scenarios can be developed. After describing these alternatives, a set of criteria was derived during a number of interactive workshops, attended by a substantial number of policy makers and representatives from the stakeholders (users and manufacturers). Providing preliminary scores for the alternatives was performed by experts coming from consortium partners. Prioritisation of alternatives was done according to the MAMCA methodology, i.e. in terms of stakeholder objectives.

Based on the findings of the preliminary prioritisation performed in WP1 and WP2, together with extensive discussions with experts in two special workshops and taking into account technical feasibility issues, a limited set of six concrete scenarios was selected for final prioritisation in the second phase (i.e. within WP5), namely: (1) in-car variable message signs, dynamic speed limit on motorways, (2) in-car school bus ahead warning, (3) in-car curve speed warning on rural roads, (4) in-car lane departure warning on motorways, (5) overtaking assistant ‘blind spot detection’ (more than one lane per direction), (6) overtaking assistant oncoming vehicle detection (one lane per direction). These scenarios were subject to pilot studies, which took place in WP4. And in WP3, simulation models were developed. The final prioritisation of these (which took place in WP5), was again based on a MAMCA, which was structured according to the same stakeholders and the same set of criteria as in the preliminary prioritisation (WP1 and WP2). In this MAMCA also expert judgments were used to obtain the final priorities, especially when hard data were scarce or non existing.

The most striking conclusion from the final prioritisation of the afore-mentioned six scenarios is that there is a high discrepancy among stakeholder priorities regarding some specific scenarios,

1 Authors: K. De Brucker, C. Macharis, A. Verbeke, E. Gelová, J. Weinberger and J. Vašek.
in particular regarding the scenario ‘overtaking assistant with oncoming vehicle detection’ (scen. no. 6). This scenario is ranked at the top by users and society, but at the bottom by manufacturers. Manufacturers consider that the risk associated with this scenario is too high. In other words, users and society have a high preference for this scenario, but manufacturers do not. Although this scenario has market potential, it is not likely to come on the market in the near future. Further research is, therefore, needed to make this application more reliable and to reduce the risk associated with it.

Another scenario for which the conclusion from comparison of stakeholder priorities is similar to that of the overtaking assistant with oncoming vehicle detection is scenario ‘safe curve speed warning’ (scen. no. 3). It is ranked second from the society’s point of view and third from the users’ point of view, but almost last from the manufacturers’ point of view. Again manufacturers consider the risk associated with this scenario too high. This scenario does have quite some market potential, but it is unlikely to materialize in the near future either. Here also, further research may be needed.

A scenario which receives a good overall priority from various stakeholders is scen. no. 1 (VMS info into vehicle). This scenario will, therefore, more easily be implemented in the market just by letting market forces run their course.

The scenarios ‘blind spot vehicle detection’ (scen. no. 5) and ‘lane departure warning’ (scen. no. 4) do not receive too bad a score from the society’s point of view. However, these scenarios are not viewed particularly favourably, by either users, or manufacturers.

The scenario ‘school bus ahead warning’ (scen. no. 2) is ranked last from the society’s point of view and in fourth position from the users’ point of view. Although children are the most vulnerable road users in society, accidents with children running out of a school bus only represent a small portion of the total number of accidents. School buses usually already have a high visibility in the road environment.

The results obtained in this deliverable are based on a MAMCA and should, therefore, be differentiated from those obtained through a social cost-benefit analysis (SCBA). In the SCBA, which was performed in activity 5.2 (A5.2) of WP5, only safety effects associated with the scenarios were taken into account and compared to the cost of implementing these scenarios. The MAMCA, however, makes it possible to assess the contribution of the various systems to a much larger number of objectives, including, inter alia, driver comfort, travel time duration, network efficiency, environmental effects, liability risk, etc.

As regards the development of guidelines aimed at making the road environment more forgiving and more self-explaining, this deliverable also contains a comprehensive overview of existing, planned and missing guidelines. Based on an extensive description of guidelines, a number of further research priorities were identified in terms of research needs, standardisation needs, education needs, organisational needs and finally legislation needs. As regards research needs, it was noted that guidelines are presently lacking for cooperative systems and that reliable indicators/measurements for the analysis of safety benefits are largely absent in benefit analyses. As regards standardisation needs, the requirement was identified for more standardisation in order to satisfy the long-term commercial interests of manufacturers and operators. As far as educational needs are concerned, guidelines are necessary for (integrated) system operators and drivers. In the realm of organisational needs, making the reporting of accidents more uniform internationally is necessary in order to obtain statistics that are comparable across member states. Finally regarding legislation needs, both systems and drivers must be supervised, but at the same time privacy laws must be respected.
1. INTRODUCTION: APPROACH

1.1 The concepts of forgiving roads and self-explaining roads as related to traffic safety

Although the number of accidents, deaths and injuries in European traffic decreases, still, these numbers are unacceptably high. Evidently, the cause of accidents is to a large extent due to human error. Impairment, errors, or inattention are causes of accidents. Where drivers easily make mistakes, sometimes these lead to accidents, often, fortunately, they do not.

Recently, intelligent driver support systems have started to contribute to the positive macro-level trend, mostly in the form of electronic driving aids that provide relevant information to the driver, or take over parts of the driving task in case the driver is in need. As a complement to the above, the road environment could be developed in such a way as to stimulate correct driving behaviour.

The concept of a sustainable, safe traffic environment has been developed to increase safe driving. This involves issues of road design and issues on driving style. On the one hand, there are opportunities to increase safety by developing a forgiving road (FOR) environment. A forgiving road (FOR) is defined as a road that is designed and built in such a way as to counteract or prevent driving errors and to avoid or mitigate the negative consequences of such errors (Wegman and Aarts, 2005). Forgiving road environments can be considered a basic tool to prevent or mitigate an important percentage of road accidents related to driving errors. More specifically, statistics show that about 25%-30% of fatal accidents involve crashes with fixed roadside objects. Those accidents are mainly caused by driving errors, leading to departure from the road. The existence of a forgiving road environment would prevent accidents of this type (and generally accidents that involve driving errors) or, at least, reduce the seriousness of the consequences of an accident.

A self-explaining road (SER) can be defined as a road designed and constructed to elicit correct assessments from road users on appropriate driving behaviour matched to the road environment (Theeuwes and Godthelp, 1992), thereby reducing the likelihood of driver errors and enhancing driving comfort. A self-explaining road (SER) environment can be facilitated by properly categorizing the road scene according to existing schemata (Dijkstra and Twisk, 1991), i.e., through using a set of standardized “signals” in each road category, easily recognized and acted upon by road users. Drivers have to cope with increasingly complex traffic environments, including different types of road lay-out and all kinds of signposting, many of which are supported by telematics. In some cases, this may lead to an excessive workload imposed on the driver. This workload may include striving to read a VMS (variable message sign), while seeking the correct route in an unfamiliar environment (often in a foreign language and even with unfamiliar signs). It may also include attempts to detect the required, relevant piece of information from an abundance of information sources (including in-car navigation system, traffic management and information centre or radio announcements, VMS signs, road signs, ADAS [advanced driver assistance systems] messages, etc.).

This deliverable is about deriving implementation priorities for a number of systems that have a high potential to contribute to the creation of a FOR and SER environment. This deliverable is the result of the prioritisation activities performed in work packages 1 (WP1), 2 (WP2) and especially 5 (WP5) and also builds upon the work performed in other work packages such as WP3 and WP4. In addition, this deliverable also reports the development of guidelines aimed at making the road environment more forgiving and more self-explaining. It also identifies further research priorities.

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1.2 Approach regarding the prioritisation of scenarios contributing to the creation of a more forgiving and self-explaining road environment

As far as prioritisation of systems is concerned, this deliverable (D5.3) consists of two main parts. The first part (chapter 3) is related to the preliminary prioritisation of systems contributing to the creation of a forgiving road (FOR) and a self-explaining road (SER) environment, which was the subject of WP1 (regarding FOR) and WP2 (regarding SER). Here, a total of 18 systems (called ‘alternatives’) were identified that potentially could contribute to the creation of a more FOR and SER environment. These alternatives were identified in a creative way by combining the six main causes of accidents as identified in accident statistics with three dimensions along which systems can potentially be developed, namely the vehicle, the infrastructure and the vehicle-infrastructure interface. These 18 alternatives were then prioritised using a multi-actor multi-criteria analysis (MAMCA). In this MAMCA, a set of criteria and criterion weights were derived interactively from a couple of workshops in which a substantial number of policy makers and other stakeholders, such as representatives of users and manufacturers participated. In a MAMCA, the criteria are clustered according to the stakeholder (or ‘actor’) group by whom they are considered relevant (Macharis et al., 2008). By doing so, a prioritisation can be obtained from each particular stakeholder point of view. The point of view of society (i.e. the public policy point of view) is one very important point of view in the MAMCA. The other two points of view (the users and manufacturers’ points of view) are also important, especially to check the extent to which the priorities obtained from the societal point of view are consonant with those from users and manufacturers. In case they are consonant, systems may easily be implemented as the result of market forces. In case they are not, government incentives may be necessary to stimulate demand or supply, or both.

The second part of this deliverable (D5.3) (chapter 4) is related to the final prioritisation of systems. Here, a selected set of six systems (called ‘scenarios’ in this chapter) were identified taking into account the results from the initial prioritisation and extensive discussions with experts. These six ‘scenarios’ were then also prioritised using the MAMCA methodology so as to derive priorities in terms of each particular stakeholder point of view. The point of view of society is one very important point of view in the MAMCA. The other two points of view (the users and manufacturers’ points of view) are also important, especially to check the extent to which the priorities obtained from the societal point of view are consonant with those from users and manufacturers. In case they are consonant, systems may easily be implemented as the result of market forces. In case they are not, government incentives may be necessary to stimulate demand or supply, or both.

Before starting, however, a brief and general overview of the multi-criteria analysis (MCA) and the multi-actor MCA (MAMCA) is provided in chapter 2, especially for those readers who are not yet familiar with that methodology. This chapter can be skipped by those readers who feel they are sufficiently familiar with the methodology. The fifth and last chapter contains the general conclusions.

It is important to note that the terminology adopted to name the various systems studied in this deliverable changes from chapter 3 to chapter 4. In the introduction and chapter 2 the general term ‘systems’ or ‘tools’ is used (or even the term ‘actions’ when referring to the general theory of MCA). In chapter 3, however, these systems are (mostly) denoted as ‘alternatives’, whereas in chapter 4 they are denoted as ‘scenarios’. The reason is that in chapter 3 the systems are not yet very concrete, and represent only potential approaches to designing alternative types of systems (i.e. by combining one of six typical errors with one of the three dimensions as described above). In chapter 4, however, the systems to be prioritised become more concrete and the situation in which they are used (road type, penetration rate, etc.) becomes more specified. Therefore, these systems are called ‘scenarios’ or ‘implementation scenarios’ in chapter 4.
1.3 Approach regarding the development of guidelines and identification of research priorities

In parallel with the prioritisation of scenarios, a number of guidelines were developed in order to create a more forgiving road (FOR) and self-explaining road (SER) environment. In addition, also a number of research priorities were identified. These are reported in chapter 5 (i.e. the third part) of this deliverable.

In order to complete the above tasks, a large number of existing guidelines targeting the self-explaining and forgiving nature of a road environment were collected. To this end, two questionnaires were created and were sent to the consortium partners of the IN-SAFETY project, for completion. The questionnaires were completed by experts from the various countries involved. They were asked to describe both the national guidelines and the research needs for making roads more forgiving and self-explaining, and to define gaps in knowledge and potential regulation. A complete list of these questionnaires, completed by the consortium partners, is given in Appendix 4A. On the basis of the responses collected, a concluding matrix of guidelines was created, which is shown in Appendix 3A. This concluding matrix is also synthesized and discussed in the main text of this deliverable (chapter 5).

The work performed to prepare this deliverable did not confine itself to collecting information on existing guidelines, but also took on board the most recent information on possible future guidelines. Several inputs were provided by partners, participating in various WPs of the IN-SAFETY project. The design of various specific scenarios was developed as a part of the IN-SAFETY project. Other important inputs were derived from the experience of some of the pilot projects in the IN-SAFETY project. The results of the initial prioritisation exercise reported in chapter 3 of this deliverable (as part of WP1 and WP2) are one example of such inputs. Benefits and economic returns were assessed in WP5 (A5.2). In addition, some results of other projects considered relevant were taken on board, e.g. the results of the ADVISORS project which also included the prioritisation of scenarios and the RIPCORD project, etc.

Beyond the content of the questionnaire survey, a set of further research priorities was identified here in this deliverable. The questionnaires regarding the research needs are given in Appendix 4B and the concluding matrix regarding these research needs is given in Appendix 3B. In addition, this concluding matrix is synthesized and discussed in the main text of this deliverable (chapter 5).

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3 IN-SAFETY is the abbreviation for ‘INfrastructure and SAFETY’.
4 ADVISORS is the abbreviation for ‘Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety’.
5 RIPCORD is the abbreviation for ‘Road Infrastructure safety Protection CORE research and Development’.
2. GENERAL OVERVIEW OF THE METHODOLOGY USED FOR SELECTION AND PRIORITISATION OF SCENARIOS

The methodology that will be used for the selection and prioritisation of systems (‘alternatives’ or ‘scenarios’) contributing to making the road environment more forgiving and more self-explaining is the multi-criteria analysis (MCA). The MCA methodology in general and the method of the analytic hierarchy process (AHP) in particular appear to be especially relevant for the assessment of intelligent transport systems (ITS) (De Brucker et al., 2004) for a number of reasons explained below. The MCA methodology and in particular the AHP method will be discussed very briefly in this chapter in order to enable the readers to fully understand the subsequent chapters where the actual selection and prioritisation of systems or tools contributing to the creation of a more forgiving and self-explaining road environment will be performed. Readers who are familiar with the MCA-AHP methodology can skip this chapter. Readers who would still like to learn more about this methodology can consult one of the good reference works on MCA and AHP, which will be quoted further in this chapter.

The MCA methodology as an evaluation approach has a long tradition and has its roots in operational research (OR) (Charness and Cooper, 1961). More recently, it has been applied in the context of economics-driven project evaluation. This appears useful especially when a neo-institutional approach to project evaluation is adopted and multiple stakeholders become relevant (Macharis, 2004; De Brucker and Verbeke, 2006; De Brucker and Verbeke, 2007). MCA allows comparing a number of actions (e.g., projects or policy measures, ‘alternatives’ or ‘scenarios’) in terms of specific criteria. These criteria represent the operationalization of the objectives and sub-objectives of decision makers and stakeholders participating in the decision-making process.

The MCA methodology is especially useful for the evaluation of ITS, since this method makes it possible to structure complex decision problems according to their constituent parts (objectives, sub-objectives as measured by criteria) and to make comparisons among project alternatives, even when effects cannot be monetised fully, nor even quantified. It is usually possible to link specific stakeholders with specific criteria in the MCA, and by doing so stakeholder management can effectively be implemented.

In general terms, the process-related steps to be followed in an MCA have a structure as shown in Figure 1.

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6 Authors: K. De Brucker, C. Macharis and A. Verbeke.
7 In this chapter the general term ‘systems’ or ‘tools’ is used (or even the term ‘actions’ when referring to the general theory of MCA). Later on, however, these systems will be denoted as ‘alternatives’ (in chapter 3) or ‘scenarios’ (in chapter 4) for reasons that will be explained there.
First, the nature of the problem is identified and analyzed. On the basis of this analysis, actions ('alternatives' or 'scenarios') that may remedy the problem are formulated in the second step. In the third step, criteria are developed relevant to the evaluation of the actions to be studied. A criterion is a function that makes it possible to provide a score (quantitative or qualitative) for each action, measuring the contribution of that action to a relevant specific objective. By giving scores, a partial evaluation is performed (i.e. an evaluation in terms of one or more specific objectives as measured by criteria). The objectives identified in the MCA may correspond to the objectives of specific stakeholders identified in the decision-making process. Alternatively, it is possible to define objectives (and hence criteria) directly on the basis of stakeholder analysis. Criteria may be elicited by performing first a stakeholder analysis. Looking at the different actors that are involved, the criteria then represent the goals and objectives considered relevant by (or important to) these actors or stakeholders. Criteria are then constructed on the basis of these objectives in order to provide an evaluation in terms of specific stakeholder objectives (i.e. a 'partial evaluation'). The second and the third step as shown in Figure 1 can also be reversed. When criteria are developed first and actions thereafter, value-focused thinking is adopted (Keeney 1996:47ff). Values (to be measured by criteria) are made explicit from the outset. Only in the next step does one proactively attempt to identify actions that can contribute to these predefined values. The set of actions is thus 'constructed' instead of being determined externally. This approach contrasts sharply with the method of alternative-focused thinking, which is often applied in practice. According to Keeney (1996:47ff), the latter approach reduces creativity and innovation, because the pre-determined set of alternatives fundamentally constrains the evaluation process. The criteria are then typically selected based on thinking about the alternatives, not about the fundamental objectives (values) to be achieved. A possible way to reconcile these visions is to make the process iterative, as is suggested by the two opposite arrows in Figure 1 (between step 2 and step 3).

The fourth step consists of constructing and completing the evaluation matrix. This is a matrix where all the actions \((a_i)\) are evaluated in terms of all the criteria \((g_j)\) as shown in Table 1 (whereby \(i=1,\ldots,n\) and \(j=1,\ldots,m\)). Within the evaluation matrix however, clusters of criteria can be distinguished. Criteria can be clustered in two ways. First, they can be clustered according to the type of effect or the way in which the effect was measured. Criteria may then be clustered into groups, such as a group that can be expressed in monetary units, another group related to non-monetary environmental or safety effects, still another group related to the non-monetary aspects of comfort, etc. A second way to cluster criteria is according to specific points of view, corresponding to specific stakeholder objectives. This is done on the basis of a stakeholder analysis as explained in the former alinea. Criteria can then be clustered into groups that
represent, e.g. the point of view of the users, the operators, society, etc. By doing so a multi-
actor MCA (MAMCA) can be performed, this is an MCA which makes it possible to evaluate to
which extent the various actions contribute to the objectives of particular stakeholders (or
‘actors’) in the decision-making process (Macharis et al., 2008).

Table 1: Evaluation matrix

<table>
<thead>
<tr>
<th></th>
<th>g₁</th>
<th>g₂</th>
<th>...</th>
<th>gₖ</th>
<th>...</th>
<th>gₘ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a₁</td>
<td>e₁₁</td>
<td>e₁₂</td>
<td>...</td>
<td>e₁ₖ</td>
<td>...</td>
<td>e₁ₘ</td>
</tr>
<tr>
<td>a₂</td>
<td>e₂₁</td>
<td>e₂₂</td>
<td>...</td>
<td>e₂ₖ</td>
<td>...</td>
<td>e₂ₘ</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>aᵢ</td>
<td>eᵢ₁</td>
<td>eᵢ₂</td>
<td>...</td>
<td>eᵢₖ</td>
<td>...</td>
<td>eᵢₘ</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>aₙ</td>
<td>eₙ₁</td>
<td>eₙ₂</td>
<td>...</td>
<td>eₙₖ</td>
<td>...</td>
<td>eₙₘ</td>
</tr>
</tbody>
</table>

Source: Schärlig (1985:60), adapted by the authors

In the fifth step, the information in the evaluation matrix needs to be aggregated. The
information represented in the evaluation matrix seldom makes it possible to select one action in
an unambiguous fashion. In most cases, the scores obtained by the actions on the various
criteria (partial evaluations) are conflicting, which means that they do not unanimously point to a
single ‘best’ action, which would be superior in terms of all criteria. This situation is sometimes
referred to as the ‘multi-criteria imbroglio’ (Schärlig 1985:4). An aggregation method is,
therefore, needed in most cases to synthesize the conflicting information. Each aggregation
method relies on specific assumptions regarding the comparability of the partial evaluations and
the relations between criteria. In most cases, criteria should be given explicit weights by policy
makers. Here, analysts can introduce an interactive tool to help policy makers when reflecting
on relative weights, but ultimately it is the decision makers themselves who must give the policy
weights. Within each aggregation method, several MCA approaches can be used to aggregate
the partial evaluations.

Within the limited scope of this contribution, it is not possible to give an overview of the various
MCA methods that have been developed in the recent past. High quality overviews are provided
in Belton and Stewart (2002) or in Figueira, Greco and Ehrgott (2007) (both in English), and De
Brucker et al. (1998) (in Dutch). We shall, however, briefly discuss one specific MCA-method,
namely the analytic hierarchy process (AHP) method of Saaty (1977, 1986, 1988, 1995) for five
reasons. First, this method has actually been applied already in various real life applications,
including other EU funded research projects, such as e.g. the ADVISORS project (De Brucker
et al., 2002; Macharis et al., 2004 and Macharis et al., 2006). Second, it allows to build
(‘construct’) a solution step by step, taking into account conflicting stakeholder objectives. Third,
the AHP method allows to determine policy weights in a very logical way (through a set of
pairwise comparisons). Fourth, the AHP is the most widely used method for the evaluation of
transport projects (Macharis and Ampe, 2007). Fifth, the AHP methodology will also be used in
the next chapters of this deliverable for the selection/prioritisation of actions (‘alternatives’ or
‘scenarios’) in terms of possible future FOR and SER environments. The AHP method is based
on three principles: (1) construction of a hierarchy, (2) priority setting and (3) logical
consistency.

A hierarchy (as shown in Figure 2) is a complex system in which the constituent parts are
hierarchically structured. The top of the hierarchy consists of a single element, which represents

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ADVISORS is the abbreviation for ‘Action for advanced Driver assistance and Vehicle control systems Implement-
ation, Standardisation, Optimum use of the Road network and Safety’.
the overall objective or focus. The intermediate levels represent sub-objectives and their constituent parts (if possible, measured by operational criteria, i.e. g₁…g₇ in Figure 2). The lowest level consists of the final actions considered (a₁, a₂ and a₃ in Figure 2). The arrows represent causal relationships within the hierarchy. Hierarchies can be constructed top-down or bottom-up. Hierarchies can also be structured according to stakeholder groups or actors in the decision-making process as is the case in the MAMCA (which will be explained and applied in further chapters of this deliverable).

Figure 2 : Example of a hierarchy in the AHP

![Hierarchy in the AHP](image)

Source: designed by the authors, based on Saaty (1995)

The relative priorities given to each element in the hierarchy are determined by comparing all the elements at a lower level in pairs, in terms of contribution to the elements at a higher level with which a causal relationship exists, as illustrated in Table 2.

Table 2 : Pairwise comparison matrix in the AHP

<table>
<thead>
<tr>
<th>g</th>
<th>a₁</th>
<th>...</th>
<th>...</th>
<th>a_i</th>
<th>...</th>
<th>a_n</th>
</tr>
</thead>
<tbody>
<tr>
<td>a₁</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td>[1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_i</td>
<td>[1]</td>
<td>Pg(a_i,a_i)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td>[1]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td>[1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a_n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Source: designed by the authors, based on Saaty (1995)

Pg(a_i,a_i) represents the preference intensity for a specific pair of typical elements ([sub]-objectives, criteria or actions [a_i, a_i]) in terms of the higher level element (objective or criteria [g]) with which a causal relationship exists. This preference intensity, Pg(a_i,a_i), is measured on a scale from 1 to 9 as illustrated in Table 3. A similar approach is followed for the constituent components within each objective and sub-objective (criterion). For instance when the value of Pg(a_i,a_i) is equal to 3, this means that the element mentioned at the extreme left of that row (i.e. the 'row element' a_i) is considered to be of moderately higher importance than the element.
mentioned at the top of that column (i.e. the column element \(a_i\)). The elements on the diagonal line of that matrix are all equal to 1, since any element is always considered as important as itself.

### Table 3: Pairwise comparison scale in the AHP

<table>
<thead>
<tr>
<th>Intensity of importance (P_{ij}(a_i,a_i))</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Both elements have equal importance</td>
<td>Both elements contribute equally to the criterion considered</td>
<td></td>
</tr>
<tr>
<td>3 Moderately higher importance of row element (RE) as compared to column element (CE)</td>
<td>Experience and judgment reveal a slight preference of row element (RE) over column element (CE)</td>
<td></td>
</tr>
<tr>
<td>5 Higher importance of RE as compared to CE</td>
<td>Experience and judgment reveal a strong preference of RE over CE</td>
<td></td>
</tr>
<tr>
<td>7 Much higher importance of RE as compared to CE</td>
<td>RE is very strongly favoured over CE, and its dominance has been demonstrated in practice</td>
<td></td>
</tr>
<tr>
<td>9 Complete dominance in terms of importance of RE over CE</td>
<td>The evidence favouring RE over CE is of the highest possible order</td>
<td></td>
</tr>
<tr>
<td>2, 4, 6, 8 (Intermediate values)</td>
<td>An intermediate position between two assessments</td>
<td></td>
</tr>
<tr>
<td>1/2, 1/3, 1/4, ... 1/9 (reciprocals)</td>
<td>When CE is compared with RE, it receives the reciprocal value of the RE/CE comparison</td>
<td></td>
</tr>
</tbody>
</table>

**Rationals**

- Ratios arising from the scale
- For tied activities

Source: Saaty (1988:73), adapted by the authors

Within each subsystem of the hierarchy, the relative priorities of the elements are determined through the pairwise comparison mechanism described above (Table 2 and Table 3). The relative priorities (weights) are given by the right eigenvector \((W)\) corresponding to the highest eigenvalue \((\lambda_{max})\) as shown in formula 1. The pairwise comparison matrix is represented by the letter \(A\). Its standard element is \(P_{ij}(a_i,a_i)\) (mentioned in Table 2).

\[A.W = \lambda_{max}.W\]

Since in each pairwise comparison matrix, a number of pairwise comparisons are redundant, it is possible to neutralize possible estimation errors that may have occurred in the other pairwise comparisons of the same matrix on the one hand and to obtain a measure of consistency for the pairwise comparisons of the same matrix on the other hand. The latter is done using a mathematical technique based on the theory of eigenvectors and eigenvalues.\(^9\)

In order to synthesize all local priorities, the various priority vectors are weighted by the global priorities of the parent criteria and synthesized. One starts this process at the top of the hierarchy.

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\(^9\) In case the pairwise comparison matrix is completely consistent, then all eigenvalues are equal to zero, except one, because all rows and columns of the matrix are linearly dependent (the rank of the matrix is equal to 1) in that case. The only eigenvalue different from zero \((\lambda_{max})\) should then be equal to \(n\) (this is the number of rows and columns in the matrix), since the sum of all the eigenvalues in a square matrix is always equal to the ‘spur’ of the matrix (this is the sum of the elements on its diagonal line). In case of a limited amount of inconsistency in the pairwise comparison matrix, \(\lambda_{max}\) will slightly differ from \(n\). Hence, this difference \((\lambda_{max} - n)\) can be used as the basis for a measure of inconsistency.
hierarchy. By doing so, the final or global relative priorities for the lowest level elements (i.e. the actions) are obtained. These final relative priorities indicate the degree to which the actions contribute to the focus. These global priorities form a synthesis of the local priorities, and thereby integrate the various inputs into the decision-making process. In that way, the various points of view of the different stakeholders are integrated into the final or global priorities, measuring the contribution of each action in terms of the overall objective or focus. In addition, one may as well perform a partial analysis (and synthesis) by doing the pairwise comparisons only from one specific point of view, i.e. taking into account only one sub-objective (or one stakeholder’s point of view) (e.g., sub-objective 1 in Figure 2). In addition, sensitivity analysis may play an important role in this type of MCA. Sensitivity analysis can be performed for each criterion separately, which means testing whether the final ranking would be different from the one obtained in the basic scenario when the weight of one specific criterion is increased or decreased. Sensitivity analysis can also take the form of scenario analysis or stakeholder analysis. In the latter two types of sensitivity analysis, the weights of several criteria are modified at the same time. These criteria are chosen to give special emphasis to specific policy scenarios or specific stakeholder interests. At that stage, it is possible to assess whether the ranking based on a specific point of view, corresponding to a specific stakeholder, is different from the ranking obtained in the basic scenario.

The AHP is a powerful decision-making tool. This method makes it possible to decompose decision-making problems into their constituent parts. According to a carefully designed decision-making process, a decision is constructed step by step, by making pairwise comparisons. This step-by-step process eventually results in a synthesis in the form of overall or global relative priorities for the final actions. In spite of the very structured process, there is ample room for learning, creativity and interactions among the analyst, the decision maker and the stakeholders. In addition, it also allows for integrating qualitative data (e.g. obtained through expert judgment) and quantitative data (including monetized values), and the degree of conflict between various objectives or stakeholders can be analyzed through sensitivity analysis. The MCA-AHP makes it possible to take into account information that cannot easily be monetized or quantified. Expert judgments and opinions expressed by different experts may be synthesized using the pairwise comparison mechanism. By doing so, a final consensus on priorities and future research needs may be obtained, even when hard data are rather scarce.

10 Indeed, Forman and Selly (2001) quoting Einstein synthesize this idea very well in the following statement: ‘Not everything that counts can be counted and not everything that can be counted, counts’.
3. DEVELOPMENT, SELECTION AND INITIAL PRIORITISATION OF A SET OF ALTERNATIVE SCENARIOS FOR CREATING A FORGIVING AND A SELF-EXPLAINING ROAD ENVIRONMENT\textsuperscript{11}

3.1 Introduction

In this chapter, the methodology of multi-criteria analysis (MCA), analytic hierarchy process (AHP) and multi-actor MCA (MAMCA) as described in chapter 2 will be applied to the selection/prioritisation of potential alternative systems describing alternative forgiving road (FOR) and self-explaining road (SER) environments that could potentially materialize in the future and that merit in-depth assessment. The alternatives developed here in this chapter have a preliminary character, since they are rather hypothetical. In fact the scenarios developed here merely constitute alternative ways of developing potential scenarios. The aim of the MCA here is to select (and prioritise) these alternative and potential ways for the development of FOR and SER scenarios. This particular step of the approach can be considered as a type of system design. Only in the next chapter a careful selection of these alternative and potential ways will be made on the basis of specific arguments and considerations. The fundamental difference between both steps/chapters is that in this chapter the MCA is applied mainly in order to select a number of potential alternatives that could materialize in the future and that merit in-depth assessment, whereas in the next chapter the MCA is applied in order to prioritise a number of more concrete implementation scenarios.\textsuperscript{12} That prioritisation is then done on the basis of extensive pilot studies.

Since the concepts of forgiving roads (FOR) and self-explaining roads (SER) turned out to be interdependent, the prioritisation was done in parallel in the same MCA application, both in terms of FOR and SER environments, in this chapter as well as in the next chapter. The future states of these two environments are interdependent because a number of parameters/conditions instrumental to creating a particular state for either of these two environments will also affect the state of the other.

The structure of this section follows more or less the subsequent steps of the methodology as presented in Figure 1 (chapter 2). For the first step, the problem analysis, we refer to chapter one of this deliverable as well as to the other deliverables produced within the IN-SAFETY project.

3.2 Generation of a set of alternatives

An extensive set of alternatives or ‘scenarios’ has been identified based on an exploration of the error structure designed by the Bundesanstalt für Strassenwezen (BAST), i.e. the German Federal Highway Research Institute. This error structure was described more in detail in Deliverable D1.1 (chapter 2) (Wiethoff et al., 2006). In that error structure, four levels of errors were identified:

- Level 1 errors and accidents refer to the type of accident (e.g. single vehicle accident, frontal collision, lateral collision, chain/rear collision, collision with parked vehicle, collision with animal).

\textsuperscript{11} Authors: K. De Brucker, C. Macharis and A. Verbeke.
\textsuperscript{12} This is also the reason why the terminology is different in this chapter from that used in the next chapter. Here, in this chapter the term ‘alternatives’ is mostly used, whereas in the next chapter the term ‘scenarios’ will be used. The latter term refers to more concrete systems ready for implementation, whereas the former refers to merely potential or alternative ways of developing innovative systems or tools.
• Level 2 errors and accidents can be described by the accident causes that are due to failure of the driver (e.g. speeding, wrong use of the road, violation against priority rules, failure when overtaking, etc.), whereby one accident can have more than one cause.

• Level 3 errors and accidents refer to human errors (e.g. information error, diagnostic error and performance error).

• Level 4 accidents refer to the physiological condition of the driver (e.g. exhaustion, fatigue, disorders, intoxication, etc.).

In addition, other conditions that also influence road safety, besides errors can be identified, such as weather conditions (e.g. fog, rain, wind, etc.), road surface conditions (ice, oil, etc.), road conditions (grooves, etc.), technical or maintenance faults, improper behaviour of pedestrians, obstacles, etc.

As regards the identification of a set of tools or ‘alternatives’ that have the potential to improve road safety by creating a forgiving road (FOR) or a self-explaining road (SER) environment, it was decided to start by analysing the so-called ‘level 2 errors and accidents’ described above, i.e. the errors and accidents that are related to a failure of the driver. The aim of the tools or alternatives to be developed is to assist the driver in her/his complex driving task so as to create a safer driver environment.

The set of alternatives was finally developed by analysing and expanding on the six most important causes for accidents (‘level 2 errors’) identified in the German and European accident statistics, namely:

1. too fast in unexpected sharp bends,
2. speeding,
3. violation of priority rules,
4. wrong use of the road,
5. failure when overtaking and
6. insufficient safety distance

The above mentioned six most important causes for accidents are shown in the first column of Table 4. For these six accident types some typical examples of innovative systems were identified that could remedy these errors and reduce the number of accidents. The innovative systems were designed by combining the former six errors with three dimensions along which tools can be developed, namely:

1. the vehicle (‘autonomous in-vehicle tools’, i.e. systems that work with information from in-vehicle sensors only and that do not need any data communication with off-vehicle devices such as other vehicles or infrastructure),
2. the infrastructure (‘autonomous infrastructure-based measures’, i.e. measures that create or change road infrastructure elements) and
3. a co-operative tool (i.e. systems that exchange data between in-vehicle and off-vehicle devices, such as the infrastructure; these systems are considered to be examples of so-called ‘ambient intelligence’).

A systematic overview of these systems is given in Table 4. The first row contains the three dimensions (vehicle, infrastructure and the cooperative version); the first column contains the six top errors in the category ‘level 2 errors’ and the remaining cells as such represent the 18 (i.e. 6x3) alternative ways of developing potential alternative systems. Within these cells themselves, some typical examples of innovative systems are listed.
Table 4: Generation of a set of alternative ways for the design of scenarios contributing to a forgiving and a self-explaining road environment

<table>
<thead>
<tr>
<th>Dimension</th>
<th>In-vehicle tool</th>
<th>Infrastructure-based tool</th>
<th>Cooperative tool vehicle-infrastructure (‘ambient intelligence’)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too fast in unexpected sharp bends</td>
<td>Unexpected sharp bends are registered red in a digital map of the navigation-system and presented to the driver</td>
<td>Vehicle is ‘analysed’ (e.g. speed), VMS signals the danger of the bend depending on the actual speed</td>
<td>Electronic beacons (special reflection posts) give additional information on displays in the vehicle about the road (e.g. warning: sharp bend)</td>
</tr>
<tr>
<td>Speeding</td>
<td>Speed alert system functioning by recognition of traffic signs</td>
<td>Speed limit is presented to the driver by VMS under consideration of special environmental circumstances</td>
<td>Speed alert system, based on digital maps containing legal speed limits with additional info on recommended safe speed</td>
</tr>
<tr>
<td>Wrong use of the road</td>
<td>LDWA (Lane Departure Warning Assistant)</td>
<td>Audible delineation</td>
<td>Adaptive LDWA; Sensitivity of LDWA is adapted in special conditions e.g. road works tunnels</td>
</tr>
<tr>
<td>Violation of priority rules</td>
<td>Traffic sign recognition</td>
<td>Traffic signs</td>
<td>Traffic light status information emission to car</td>
</tr>
<tr>
<td>Failure when overtaking</td>
<td>Blind spot detection system warning driver if a vehicle is approaching from behind</td>
<td>Separation of lanes by rumble strips where overtaking is forbidden</td>
<td>Cooperative system warning of oncoming vehicles by vehicle-to-vehicle communication</td>
</tr>
<tr>
<td>Insufficient safety distance</td>
<td>Advanced Cruise Control (ACC)</td>
<td>Fog detection warning system; VMS warning</td>
<td>ACC set by local (on-site) weather system: Dynamic ACC</td>
</tr>
</tbody>
</table>

Source: IN-SAFETY project team

A more detailed description of these systems is given in Table 5. This description also includes parameters such as the type of drivers (e.g. young drivers, old drivers, etc.), the type of vehicle (e.g. passenger car, heavy vehicle, etc.) and the environmental preference in terms of traffic conditions, road type, special road section, lighting and weather. The term ‘scenarios’ is used in Table 4, instead of ‘measures’, ‘alternatives’, ‘projects’ or ‘systems’, because the description of these ‘measures’ is already rather concrete in Table 4 and is done taking into account a number of very specific parameters and conditions, such as e.g. type of the road, type of vehicle, specific traffic conditions, weather conditions, etc.
Table 5: Overview of scenarios contributing to the concepts of forgiving and self-explaining roads

Source: IN-SAFETY consortium partners (TUDelft, USTUTT, TUDarm)

3.3 Generation of a set of criteria

The next phase in the MCA methodology is the construction of a set of criteria for the evaluation and selection/prioritisation of alternative scenarios for the design of systems contributing to forgiving road (FOR) and self-explaining road (SER) environments. In order to construct such a set, a two-step procedure was followed.

First, a workshop was organised in which experts from all partners from work package 1 (WP1) and work package 2 (WP2) participated. This workshop took place at the Technical University of Delft (TUDelft), on 6 and 7 February 2006. The aim of that workshop was to construct a decision tree with objectives, sub-objectives (to be measured by criteria) and finally alternatives / scenarios similar to the structure presented in Figure 2 (chapter 2) for a generic case. Based on
experience with previous research projects related to road safety (e.g. the ADVISORS\textsuperscript{13} project, De Brucker et al. 2002 and Macharis et al., 2004) and by analysing the objectives and criteria that policy makers consider to be relevant in other, similar decision-making problems, all the experts, by the end of that workshop, agreed on a draft decision tree as presented in Error! Reference source not found..

The top level of the decision tree shown in Error! Reference source not found. represents the focus or overall objective, namely creating benefits by making the road environment more forgiving and more self-explaining. At the second level, three groups of main stakeholders are shown, namely (1) the users, (2) society/authorities and (3) manufacturers. Within each group of stakeholders, a number of subcategories could be identified such as drivers, fleet owners and emergency centres (for the main category ‘users’), road managers and authorities (for the main category ‘authorities’) and vehicle manufacturers, equipment manufacturers, system providers and content providers (for the main category ‘manufacturers’). As regards these subcategories, it turned out that it was not necessary to include them as separate groups, since the preferences of these subgroups were not substantially different from each other and since some of these subgroups were not organised in such a way so as to exert a substantial influence on policy making. At the third level, the criteria are listed that these main stakeholders consider relevant. At the lowest level, the alternatives / scenarios are shown that need to be prioritised. A total of 18 alternatives were identified by combining typical errors (speeding, violation of priority rules, etc.) with the dimensions along which alternatives could be developed (i.e., vehicle, infrastructure, ambient intelligence), as described in section 3.2.

\textsuperscript{13} ADVISORS is the abbreviation for ‘Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety’.
It should be noted that the second stakeholder (at level 2) in Error! Reference source not found. represents the point of view of public policy in general. The subsystem that is formed by this stakeholder and all its lower level elements is the most important subsystem from a public policy point of view, since it represents the overall societal point of view. The two remaining subsystems, formed by the users (i.e. the demand side of the market), respectively the manufacturers (this is the supply side) and their lower level elements, are also important but in another context, since successful implementation of alternatives by public policy makers (i.e. the middle subsystem in Error! Reference source not found.) is indeed only possible when the decisions made or the options chosen by these public policy makers are consonant, at least to a certain extent, with the interests of the other stakeholders. If this is the case, then the public policy objective will be facilitated by the actions taken by the other stakeholders and it will be easier for public policy makers to have their policies implemented. This way of using stakeholder management as facilitating (or hindering) public policy implementation is fully in line with the actual definition of the concept of ‘stakeholder’ by Freeman (1984) who defined a stakeholder as any individual or group who can affect an organization’s performance or who is affected by the achievement of this organization’s objectives. Mitchell et al. (1997) classified stakeholders based upon three attributes, namely power, legitimacy, and urgency. In their model, stakeholder salience, as perceived by decision makers, is positively related to the cumulative impact of these three stakeholder attributes. It should, therefore, be clear that the MCA procedure followed here, this means building up on stakeholder interests, is not merely a tool for assessing the potential of new product development, but that, in essence, it serves public policy making, especially as regards road safety in this case. The MCA that will be performed in the following sections, therefore, needs to be designed in such a way so as to be able to investigate to which extent the solutions chosen within the second subsystem (public policy view) are consonant with the solutions preferred by the users and the manufacturers. In a perfect market (which is the standard assumption in neo-classical economics), the priorities derived at the demand side of the market would be expected to be fully consistent with the ones derived at the supply side, and government or public policy intervention (this is the middle subsystem in Figure 2) would not be an important issue (what would be good for users would also be good for society). This is definitely not the case here and several reasons can be identified for this. First, there are a number of external effects (such as effects on safety, including third party safety effects such as effects on pedestrians and cyclists, environmental effects, etc.), which are also relevant for EU transport policy making. Second, infrastructure and also safety have the character of a public good, which can only be financed with government funds to be provided by public policy makers. Third, there may be bounded rationality and consumer preferences may be inconsistent over time (consumers often prefer to consume goods which result in an immediate, but temporary award, but which may result in a large cost or sacrifice in the future, for instance road accidents, often underestimated at the time the decision is made). This means that intervention in the market by public policy makers is highly necessary here. Fourth, the tools or systems analysed are highly innovative and the market still has to be developed. In such case, government incentives or an active supply policy by government may be instrumental to stimulating and structuring the institutional structures of this evolving market. The decision problem which public policy makers are confronted with here is, therefore, not a simple one but a complex one and the decision tree developed here (Error! Reference source not found.) should be viewed as an attempt to order this complexity.

In the second step, the draft decision tree presented in Error! Reference source not found. was presented to a forum of policy makers, users and manufacturers for validation purposes. This forum was organised at the premises of the Intertraffic Conference that took place in Amsterdam at the RAI14 Congress and Exhibition Center from 4 to 7 April 2006. A special workshop with representatives from policy makers, users and manufacturers was organised on 6 April 2006 in order to validate the decision tree and to derive policy weights. A total of about 80 participants (consortium members included) took part in this workshop. All the participants

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14 RAI is the abbreviation for ‘Rijwiel Automobiel Industrie’.
were invited by POLIS\textsuperscript{15}, which is a network organisation of leading European cities and regions working together for the development of innovative technologies and policies in local transport. POLIS forms a platform for dialogue and cooperation on current mobility issues for cities and regions across Europe. The way in which that workshop was organised in practice will be described more in detail in section 3.5.2. The participants taking part in the workshop carefully examined the decision tree and made some suggestions for additional criteria.

The representatives of the manufacturers group did not formally add a criterion. Earlier, however, one of the manufacturers did mention ‘market demand’ as an extra criterion, since the term ‘investment risk’ was seen as too complex a construct. In fact ‘market demand’ and ‘investment risk’ are highly correlated. The investment risk is indeed determined by volatility and unpredictability of market demand. Liability risk was also considered very important and manufacturers stated that public authorities should set standards in order to reduce the liability risk for the manufacturers.

The users added the criteria ‘integration of function on board’ and ‘harmonisation’. The former criterion refers to the fact that the different functions should be integrated into one concise and well-designed box instead of a multitude of different appliances, not well integrated together. As regards the latter criterion, ‘harmonisation across countries’ was considered very important (e.g. speed limits, infrastructural solutions). Some initiatives have already been initiated (e.g. regarding tunnels).

The authorities and society added a number of criteria, among others ‘accessibility of the transport system’ and ‘accessibility of different locations’. The latter criterion refers to the fact that everyone (including the elderly) should be able to go to places, even when dependent on public transport. The former criterion refers to the fact that personalised information should be given to the drivers (e.g. regarding his/her specific limitations and goals).

The criteria added by the participants, especially the users (‘integration of functions on board and harmonisation’) and the authorities (‘accessibility of the transport system’ and ‘accessibility of different locations’) were not of a nature that the decision tree presented in Error! Reference source not found. needed to be modified substantially. In fact, the criteria described above should rather be seen as ‘musts’ instead of ‘wants’. Musts are minimal (or satisfying) levels that must be achieved, as a ‘conditio sine qua non’, for a project to be considered acceptable to all stakeholders. The analysis of the musts can be done in a so-called pre-MCA test (De Brucker, 2000:205ff,321ff and De Brucker et al., 1998:505ff). As soon as the projects pass this so-called pre-MCA test, an analysis in terms of ‘wants’\textsuperscript{16} (i.e. ‘aspiration levels’ or objectives to be maximised) is applied in a second stage. It is the wants (objectives to be maximised) that are shown in Error! Reference source not found..

Before concluding this section on the construction of a set of criteria, it is worth mentioning that the procedure followed here is indeed a form of value-focused thinking (as described in chapter 2) instead of alternative-focused thinking. Although the generation of alternatives (section 3.2) was described in this deliverable before the generation of a set of criteria (section 3.3), both activities were indeed performed in parallel. When constructing the set of alternatives, a special procedure was followed, by combining six types of main errors (the so-called ‘level 2 errors’), with three dimensions along which systems or tools could be developed. The six types of main errors were all related to safety. Indeed, safety is considered the main objective (or the main criterion) in this study and was made explicit from the outset. The workshop of 6 February 2006 was set up in such a way so as to proactively find innovative solutions (i.e. systems or tools)

\textsuperscript{15} Initially POLIS was the abbreviation for ‘Promoting Operational Links with Integrated Services’, but at present only the word POLIS is used to denote that organisation.

\textsuperscript{16} The idea of ‘musts’ and ‘wants’ was developed by Kepner and Tregoe (1965:173ff and 1981:87-88,181) and is similar to the ‘elimination-by-aspects method’, an MCA method developed by Tversky (1972:281-299) and Noorderhaven (1995:32). Forman (1996:48) and Forman and Selly (2001:111) also acknowledge the distinction between ‘musts’ and ‘wants’. The idea of a pre-MCA based on ‘musts’ was also used by De Brucker (2000:205ff,321ff) and De Brucker, Verbeke and Winkelmans (1998:505ff).
that can contribute to the predefined objective, namely increasing safety by creating more FOR and SER environments.

### 3.4 Completion of the evaluation matrix: scoring of alternatives on each criterion

After having identified the criteria and the alternatives, the next step is then to perform a partial evaluation, i.e. an evaluation in terms of each specific criterion. Therefore, for each alternative a score \( (e_i) \) should be derived expressing the contribution of that alternative to that specific criterion, as presented in Table 1.

Since the alternatives developed in section 3.2 are mostly very innovative and since some of the technologies associated with these alternatives have not yet been commercialised in the marketplace, it is not possible at present to derive a quantitative score directly on a ratio or interval scale for each alternative and for each criterion. It was, therefore, decided to use an ordinal scale in the first stage, i.e. a scale expressing the ranking of the alternatives with respect to one another. It is only in a second stage, when these scores (partial evaluations) have to be aggregated into an overall score (overall evaluation) that the transformation of the ordinal scores to a ratio scale based score will take place. This will be described in more detail in section 3.5.

The scores that are necessary here, in this first stage, have to be determined taking into account the results of the existing research. In deliverable D1.1 (chapters 2, 3, 4 and 5) (Wiethoff et al., 2006), a number of models describing the possible impact of forgiving road scenarios and self-explaining road scenarios are described. The scoring that is needed here, in this stage of the prioritisation process, was given by the experts who developed the scenarios, but taking into account the insights from the models presented in D1.1. The experts who took part in this scoring exercise were leading researchers from the consortium partners, namely the German Federal Highway Research Institute (Bundesanstalt für Strassenwezen, BAST), the University of Stuttgart (USTUTT), the Technical University of Darmstadt (TUD) and the Technical University of Delft (TUDelft).

The ordinal scale that was used to perform the scoring in this stage, is presented in Table 6 below.

<table>
<thead>
<tr>
<th>Ordinal score</th>
<th>Meaning of the ordinal score</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + +</td>
<td>very high positive impact</td>
</tr>
<tr>
<td>+ +</td>
<td>high positive impact</td>
</tr>
<tr>
<td>+</td>
<td>moderate positive impact</td>
</tr>
<tr>
<td>0</td>
<td>no impact</td>
</tr>
<tr>
<td>–</td>
<td>moderate negative impact</td>
</tr>
<tr>
<td>– –</td>
<td>high negative impact</td>
</tr>
<tr>
<td>– – –</td>
<td>very high negative impact</td>
</tr>
</tbody>
</table>

Source : designed by the authors

The 18 alternatives developed in section 3.2 were scored by experts, on the basis of expert judgment. Since the scores given (such as the one presented in Table 6) are relative scores and may partly be determined or biased by the characteristics of the specific expert who performs the partial evaluation of that specific scenario, it was decided to take the expert judgments of one specific expert as a starting base for discussion among experts. The expert judgments
given by the TUDelft were, therefore, taken as the starting base and after discussion with the other experts, a consensus regarding the final score to be given, was obtained. These final scores are presented in Table 7 using the ordinal scale presented in Table 6.
<table>
<thead>
<tr>
<th>Code</th>
<th>Origin</th>
<th>Addressed level 2 error</th>
<th>System type</th>
<th>Scenario description</th>
<th>Driver Comfort</th>
<th>Full user cost</th>
<th>Driver Safety</th>
<th>Travel time</th>
<th>Network efficiency</th>
<th>Overall safety</th>
<th>Socio political acceptance</th>
<th>Public expenditure</th>
<th>Investment risk</th>
<th>Liability risk</th>
<th>Technical feasibility</th>
<th>Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>TUDelft</td>
<td>Too fast in unexpected sharp bends on rural roads</td>
<td>Automated vehicle</td>
<td>Unexpected sharp bends are recognized in a digital map of the navigation system and presented to the driver</td>
<td>+++++</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>1.2</td>
<td>TUDelft</td>
<td>Too fast in unexpected sharp bends on urban roads</td>
<td>Automated vehicle</td>
<td>Vehicle is &quot;analyzed&quot; (e.g., speed, AMS) signals the danger of the bend depending on the actual speed</td>
<td>+++++</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>(TUDelft)</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>TUDelft</td>
<td>Too fast in unexpected sharp bends on urban roads</td>
<td>Automated vehicle</td>
<td>Additional information (e.g., speed limit) is provided to the driver</td>
<td>++++</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>(TUDelft)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>BAST, USTUTT</td>
<td>Speeding</td>
<td>Automated vehicle</td>
<td>Speed Alert System functioning in a digital map of the navigation system</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>BAST, USTUTT</td>
<td>Speeding</td>
<td>Automated vehicle</td>
<td>Speed limit is presented to the driver</td>
<td>++++</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2.3</td>
<td>BAST, USTUTT</td>
<td>Speeding</td>
<td>Automated vehicle</td>
<td>Speed Alert System based on digital maps containing legal speed times with additional information on recommended safe speed</td>
<td>++++</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3.1</td>
<td>TUDelft</td>
<td>Wrong use of road</td>
<td>Automated vehicle</td>
<td>LDWA (Lane Departure Warning Assistant)</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>TUDelft</td>
<td>Wrong use of road</td>
<td>Automated vehicle</td>
<td>Audible stimulation</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3.3</td>
<td>TUDelft</td>
<td>Wrong use of road</td>
<td>Automated vehicle</td>
<td>LDWA (Lane Departure Warning Assistant)</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.1</td>
<td>TUDelft</td>
<td>Violation of priority rules</td>
<td>Automated vehicle</td>
<td>Traffic Sign recognition</td>
<td>++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.2</td>
<td>TUDelft</td>
<td>Violation of priority rules</td>
<td>Automated vehicle</td>
<td>Traffic light status information</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.3</td>
<td>TUDelft</td>
<td>Violation of priority rules</td>
<td>Automated vehicle</td>
<td>Traffic light status information</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5.1</td>
<td>BAST, USTUTT</td>
<td>Parking where overheight</td>
<td>Automated vehicle</td>
<td>On-board detection system warning the driver if a vehicle is overheight</td>
<td>+++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5.2</td>
<td>BAST, USTUTT</td>
<td>Parking where overheight</td>
<td>Automated vehicle</td>
<td>Separation of lanes by rumble strips where overheight is forbidden</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5.3</td>
<td>BAST, USTUTT</td>
<td>Parking where overheight</td>
<td>Automated vehicle</td>
<td>Cooperative system warning of oncoming vehicles by vehicle-to-vehicle communication</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.1</td>
<td>TUDelft</td>
<td>Unintended safety deviation</td>
<td>Automated vehicle</td>
<td>Advanced Cruise Control ACC</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.2</td>
<td>TUDelft</td>
<td>Unintended safety deviation</td>
<td>Automated vehicle</td>
<td>Traffic detection warning system</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.3</td>
<td>TUDelft</td>
<td>Unintended safety deviation</td>
<td>Automated vehicle</td>
<td>ACC by local (steady) weather system &quot;Dynamic ACC&quot;</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Source: IN-SAFETY consortium partners (TUDelft, USTUTT, TUDarm)
3.5 Overall evaluation of the alternatives: deriving priorities

The overall evaluation of alternatives was performed using the AHP MCA methodology. Applied to the case of FOR scenarios and SER scenarios, the starting base for this exercise was the decision tree (Error! Reference source not found.).

The AHP methodology requires two types of inputs. First, the impact of the scenarios on the criteria should be evaluated and second the relative importance of these criteria for each stakeholder should be known.

3.5.1 Prioritisation of scenarios in terms of criteria

As regards the first step, prioritisation of alternatives in terms of specific criteria, the evaluation table constructed in section 3.4 (Table 3) was used as the starting base. The scale used in that table is an ordinal scale, i.e. a scale expressing the ranking of the alternatives with respect to one another. The concordance between the scores of that table and the ratio inputs that are necessary for the AHP model as described in Table 2 and Table 3 is shown in Table 8.

Table 8: Concordance between ordinal scores included in scoring table and preference intensities in pairwise comparison matrices

<table>
<thead>
<tr>
<th>very high pos. impact</th>
<th>high. pos. impact</th>
<th>moderate pos. impact</th>
<th>neutral impact</th>
<th>moderate neg. impact</th>
<th>high neg. impact</th>
<th>very high neg. impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>+++++</td>
<td>+ +</td>
<td>+</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>high. pos. impact</td>
<td>+</td>
<td>+</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>moderate pos. impact</td>
<td></td>
<td>+</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>neutral impact</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>moderate neg. impact</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>high neg. impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>very high neg. impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Inconsistency ratio: 0.02

Source: designed by the authors

The meaning of the numbers in the cells of Table 8 was described in greater detail in chapter 2. For instance, the value 3 (dark cell in Table 8) means that the row element (++++) is

17 When two extreme ordinal scores are compared (namely ‘––’ and ‘++++’), the value 9 (‘absolute dominance’) is given. When this difference is rather small (for instance for the comparison between ‘O’ and ‘+’), the value 2 is given and for a comparison between for instance ‘O’ and ‘++’, the value 3 is given. But when ordinal scores of the order ‘+++’ or ‘––’ are compared with the neutral score ‘O’, the value 5 is given (in stead of 4), since comparisons where the ordinal score ‘+++’ (or ‘––’) is involved are really considered to be associated with a large difference. This is the reason why the scores in Table 8 do not follow an arithmetic progression with progression factor 1, why not all values from the pairwise comparison scale (1-9) are included in the table and why there is a very small inconsistency (0,02).
considered to be three times more preferred than (or to have a ‘weak dominance’ over) the column element (+). A value 5 corresponds to a ‘strong dominance’, a value 7 to a ‘very strong dominance’ and a value 9 to an ‘extreme dominance’. The intermediate values (2, 4, 6, 8) correspond to compromise or intermediate positions between the other two assessments. When the column element is compared with the row element, it receives the reciprocal value of the comparison between the row element and the column element. The ‘concordance table’ that was constructed (Table 8) was used for all the criteria. The computer program ExpertChoice™ applied below, made it possible to define such a concordance table only once and then to use it for all the criteria.

3.5.2 Deriving weights for the criteria: prioritising the criteria

The next step in the AHP methodology is to derive weights for the criteria. Three main stakeholders were identified in the decision tree (Error! Reference source not found.), namely users, society/authorities and manufacturers, which each have their own specific criteria.

In order to obtain the inputs necessary for these pairwise comparison matrices, a forum of policy makers and representatives of the users and manufacturers was created. As said before, this forum was organised at the premises of the Intertraffic Conference.

For the workshop to elicit weights, the room was rearranged to facilitate a Group Decision Room (GDR) session. A GDR consists of a network of computers running Group Systems software, which enables the participants in the session to express their opinion anonymously, and to be heard without having to draw the attention to themselves.

A total of 27 participants actively participated in the GDR session. Table 9 shows the number of participants for each stakeholder group. The complete list of participants is given in Appendix no. 1.

Table 9: GDR session participants

<table>
<thead>
<tr>
<th>Stakeholder group</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>7 vehicle drivers</td>
</tr>
<tr>
<td></td>
<td>1 fleet owner</td>
</tr>
<tr>
<td></td>
<td>1 other</td>
</tr>
<tr>
<td></td>
<td>Total: 9</td>
</tr>
<tr>
<td>Society/authorities</td>
<td>5 road managers</td>
</tr>
<tr>
<td></td>
<td>3 policy makers</td>
</tr>
<tr>
<td></td>
<td>1 enforcement</td>
</tr>
<tr>
<td></td>
<td>2 other</td>
</tr>
<tr>
<td></td>
<td>Total: 11</td>
</tr>
<tr>
<td>Industry</td>
<td>3 equipment manufacturers</td>
</tr>
<tr>
<td></td>
<td>3 system providers</td>
</tr>
<tr>
<td></td>
<td>1 vehicle manufacturer</td>
</tr>
<tr>
<td></td>
<td>Total: 7</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: Own computation

All these stakeholder representatives had to compare the importance of the criteria in pairs, using the pairwise comparison scale. In order to synthesize the various pairwise comparisons given by each representative, the geometric mean was calculated. The geometric mean (and not the arithmetic mean) is the statistical measure that is relevant in this case (Saaty, 1995:265), since the average of ratios is to be calculated here. Also the spread was calculated using the traditional statistical variables such as mean, mode, highest
and lowest score and standard deviation. In Appendix no. 2, an example is given of the results that came out of the GDR session in terms of pairwise comparison scores for one specific pair of criteria, namely ‘driver safety’ and ‘travel time duration’ (shaded cell in Table 10).

The final results of all these pairwise comparisons made by each representative of the various stakeholders and synthesised using the GDR software are shown in Table 10, Table 11 and Table 12. Part A of these tables shows the synthesis (i.e. the geometric mean) of the various pairwise comparisons and Part B contains the final relative priorities for the criteria (i.e. the criterion weights) calculated on the basis of these pairwise comparisons.

Table 10: Pairwise comparison matrix and relative priorities for the criteria from the point of view of the stakeholder ‘users’

<table>
<thead>
<tr>
<th>stakeholder ‘users’</th>
<th>Part A: Pairwise comparisons</th>
<th>Part B: Relat. prior.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>driver comfort</td>
<td>full user cost</td>
</tr>
<tr>
<td>driver comfort</td>
<td>1</td>
<td>1/3</td>
</tr>
<tr>
<td>full user cost</td>
<td>1/3</td>
<td>1</td>
</tr>
<tr>
<td>driver safety</td>
<td>1/5</td>
<td>1</td>
</tr>
<tr>
<td>travel time duration</td>
<td>1/2</td>
<td>1</td>
</tr>
</tbody>
</table>

Inconsistency ratio: 0,06

Source: designed by the authors

Table 11: Pairwise comparison matrix and relative priorities for the criteria from the point of view of the ‘society/public policy makers’

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>network efficiency</td>
<td>network efficiency</td>
<td>overall safety</td>
</tr>
<tr>
<td>network efficiency</td>
<td>1</td>
<td>1/5</td>
</tr>
<tr>
<td>overall safety</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>socio-pol. accept.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>public expenditure</td>
<td>1</td>
<td>1/3</td>
</tr>
<tr>
<td>environm. effects</td>
<td>1</td>
<td>0,170</td>
</tr>
</tbody>
</table>

Inconsistency ratio: 0,04

Source: designed by the authors
Table 12: Pairwise comparison matrix and relative priorities for the criteria from the point of view of the ‘manufacturers’

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>stakeholder</td>
<td>investment risk</td>
<td>liability risk</td>
</tr>
<tr>
<td>investment risk</td>
<td>1</td>
<td>1/2</td>
</tr>
<tr>
<td>liability risk</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>technical feasibility</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Inconsistency ratio: 0,01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: designed by the authors

Table 10, Table 11, and Table 12 represent the relative priorities of the criteria, i.e. the priorities in terms of the overall objective of one specific stakeholder, resp. ‘users’, ‘society/authorities’ and ‘manufacturers’. 18

The users gave the highest weight to the criterion ‘driver safety’ (45,2%), followed by ‘full user cost’ (17,9%). They gave less weight to ‘travel time duration’ (17,9%) and still less to ‘driver comfort’ (8,7%).

Manufacturers gave the highest weight to the criterion ‘liability risk’ (59,5%), then ‘investment risk’ (27,6%) and technical feasibility received a much lower priority (12,8%).

From the societal point of view, the criterion ‘overall safety’ turned out to be the most important criterion (50,9%). The criteria ‘network efficiency’ and ‘environmental effects’ received a lower weight, but nearly ex aequo (resp. 17,1% and 17,0%). The criteria ‘socio-political acceptance’ and ‘public expenditure’, received the lowest weight (resp. 8,2% and 6,8%).

3.5.3 Deriving overall relative priorities for the scenarios from each stakeholder’s point of view

The last step in the overall evaluation phase consists of deriving overall relative priorities for the alternatives in terms of each stakeholder’s point of view. These final relative priorities indicate the degree to which the alternatives contribute to the overall objective or focus of that specific stakeholder.

It should be noted, however, that the actor ‘society/authorities’ is in fact not a stakeholder sensu stricto, since that actor represents the societal point of view. The two other actors or stakeholders, namely the ‘users’ and the ‘manufacturers’ are indeed stakeholders sensu stricto, since they reflect the objectives of only one specific group of people in society. The overall relative priorities in terms of the society’s point of view (middle part in Error! Reference source not found.), therefore, correspond to the policy point of view. These are

18 These relative priorities or weights were calculated on the basis of the eigenvector method. The vector of the weights (W) is given as the right eigenvector corresponding to the highest eigenvalue ($\lambda_{max}$), as described in chapter 2 (formula 1). The matrix of the pairwise comparisons corresponds to the matrix A in formula 1 (in chapter 2). This vector (W) was calculated using the computer program ExpertChoice. The same computer program makes it possible to calculate the consistency ratios. These ratios are shown at the bottom of each pairwise comparison table here.
the overall relative priorities that should be taken as a starting base for policy purposes. The overall relative priorities for the two other stakeholders (users and manufacturers) are indeed also very relevant, esp. for implementation issues, since these priorities make it possible to test to which extent the policy-based ranking of alternatives is sustained by these stakeholders. The success of the implementation of specific alternatives indeed largely depends on the degree to which the stakeholders find these alternatives good or acceptable.

The overall or global relative priorities of the various scenarios for each stakeholder are presented in Error! Reference source not found., Error! Reference source not found., and Error! Reference source not found.

Figure 4: Global priorities of alternatives from the point of view of the stakeholder ‘users’

Figure 5: Global priorities of alternatives from the point of view of the stakeholder ‘society/authorities’
3.6 Results: comparison of stakeholder priorities

Table 13 shows the top five priority alternatives of the stakeholder group ‘society’, as compared to the priorities of the other two stakeholder groups. It appears that VMS speed warning and priority traffic signs are also given a relatively high priority by both the users and the manufacturers, which implies that these alternatives will be accepted by these stakeholders. However, speed alert by signal recognition and speed alert by digital map are not given such a high priority by either of the other stakeholders, meaning that government regulation may be necessary to implement these systems. Blind spot detection is given a high priority by the users as well, but not by the manufacturers. The main barrier perceived by the manufacturers is the liability risk of this system.

Table 13: Top 5 priorities of society as compared to other stakeholders

<table>
<thead>
<tr>
<th>Society</th>
<th>Alternative</th>
<th>User</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VMS speed warning</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Speed alert by signal recognition</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Blind spot detection</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Speed alert by digital map</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Priority traffic signs</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Own computation

The priorities of society in Table 13, when compared with those of the two other stakeholder groups, suggest where government policy may be required to achieve effective implementation of safety systems, namely where a strong discrepancy can be observed in prioritisation among stakeholder groups. In some cases, safety systems may also be introduced autonomously by the market. This will occur when the systems have a high market potential, as expressed by their perceived contribution to both user and manufacturer objectives. In Table 14, therefore, the priority alternatives of the users are compared with those of the manufacturers. The user is chosen as a starting point, as user demand is a major market driver. We should note that VMS sharp bend warning and rumble strips for...
overtaking are infrastructure alternatives and cannot be simply implemented through the mechanism of market forces, because the user has no decision power in the implementation process. For beacon transmitting sharp bend warning, the situation could be even more complex. Digital map sharp bend warning may have market potential, and blind spot detection as well, but only if critical liability problems can be solved.

Table 14: Top 5 priorities of users as compared to manufacturers

<table>
<thead>
<tr>
<th>User</th>
<th>Alternative</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VMS sharp bend warning</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Rumble strips for overtaking</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Digital map sharp bend warning</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Blind spot detection</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>Beacon transmitting sharp bend warning</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: Own computation

3.7 Conclusion

A preliminary selection and prioritisation of alternative ways for the design of innovative alternatives contributing to a forgiving road (FOR) environment and a self-explaining road (SER) environment was performed in this chapter. A total of 18 alternative ways for developing these systems were studied in this chapter. These 18 alternatives were obtained by combining six typical errors, namely: (1) excessive speed in unexpected sharp bends, (2) excessive speed in general, (3) violation of priority rules, (4) wrong use of the road, (5) failure when overtaking and (6) insufficient safety distance, with three dimensions along which scenarios can be developed namely. These three dimensions include: (1) the vehicle, (2) the infrastructure and (3) the vehicle-infrastructure interface. For each of these 18 alternative ways for the design of innovative systems some typical examples were identified.

The findings obtained in this chapter (which are the result of WP1 and WP2) can serve as a starting base for discussion among experts regarding the selection of concrete scenarios to be retained in further research and pilot studies (WP4). This discussion will be described in the next chapter (i.e. chapter 4), where a final selection and prioritisation of concrete scenarios will also be performed. The general conclusions from the initial selection and prioritisation performed in this third chapter are the following.

- There are substantial differences in the rankings of alternatives depending on the point of view of the stakeholder groups ‘society/public policy makers’, ‘users’, and ‘manufacturers’.
- From the societal point of view, alternatives focused on speeding (e.g. speed limit presented to the driver by VMS, speed alert system by recognition of traffic signs, etc.) are considered the most desirable.
- Speeding related alternatives are not considered desirable from the point of view of the manufacturers or users. When the three alternatives regarding speeding are compared with each other, it turns out that the autonomous infrastructure alternative (e.g. speed limit presented to the driver by VMS) is less undesirable than the autonomous in-vehicle alternative (e.g. speed alert system by recognition of traffic signs), or the cooperative alternative (e.g. speed alert system based on digital maps containing legal speed limits with additional info on recommended safe speed).
- Manufacturers consider the autonomous, infrastructure based alternatives (e.g. traffic signs, separation of lanes by rumble strips where overtaking is forbidden, VMS signaling the danger of the bend depending on actual speed and type of vehicle approaching, audible delineation) to be the most desirable, not only with regard to the speeding related alternatives, but regarding all alternatives. This is mainly caused by
the liability problems involved in vehicle alternatives, which is the most important
criterion for the manufacturers. However, not all alternatives belong to the feasible set
of alternatives for each type of manufacturer: vehicle system suppliers are not directly
involved in infrastructure alternatives and vice versa. This should be taken into
account when judging the results of the prioritisation.

- Users most often rank the vehicle related alternatives (e.g. advanced cruise control,
lane departure warning assistant) at the bottom (with the exception of alternatives
regarding bends and failure while overtaking). To a large extent, this is caused by the
costs accruing to the user, and also to the relatively smaller effects on driver safety,
as these are the most important criteria for the user.
4. SELECTION AND FINAL PRIORITISATION OF IMPLEMENTATION SCENARIOS CONTRIBUTING TO A FORGIVING AND A SELF-EXPLAINING ROAD ENVIRONMENT

4.1 Introduction: generation of implementation scenarios

The priorities obtained in the previous chapter were the result of two specific work packages (WP1 and WP2) of the IN-SAFETY project. In these WPs only a preliminary ranking of general types of scenarios, was performed. These general categories were obtained by combining six typical errors, namely (1) excessive speed in unexpected sharp bends, (2) speeding in general, (3) violation of priority rules, (4) wrong use of the road, (5) failure when overtaking and (6) insufficient safety distance, with three dimensions along which scenarios can be developed namely: (1) the vehicle, (2) the infrastructure and (3) the vehicle-infrastructure interface. By doing so, a total of 18 potential scenarios were obtained. These should be considered as alternative venues for the design of innovative systems. For each category, some typical examples were identified, as shown in Table 4 (chapter 4). The prioritisation was done from three different points of view, namely from (1) a society’s point of view, (2) a users’ point of view, and (3) a manufacturers’ point of view. The alternatives studied in WP1 and WP2 were prioritised in terms of their contribution to the objectives of these actors.

In this fourth chapter, however, a limited set of more concrete scenarios should be selected for further in-depth study and final prioritisation. The in-depth study took the form of extensive pilot studies as part of WP4. These pilot studies were conducted by experts and took place at several locations in Europe, namely in Germany (at the University of Stuttgart), Italy (at the Research Centre Fiat in Turin), in Greece (at the Centre for Research and Technology Hellas – Hellenic Institute of Transport in Thessaloniki) and in Sweden (at the National Road and Transport Research Institute in Linköping).

The set of concrete scenarios, called ‘implementation scenarios’, to be subjected to the above mentioned pilot studies was selected on the basis of the results obtained in WP1 and WP2 as reported in the previous chapter, as well as extensive discussions with experts in two special workshops, and taking into account technical feasibilities. The first workshop took place at the German Federal Highway Research Institute in Bergisch-Gladbach (Germany) on 4 Sept. 2006 and the second one at the Danube University of Krems in Austria on 5 March 2007. The idea that came out of these workshops was to firstly focus on the society’s priorities, especially in terms of general safety. The idea being that the IN-SAFETY project wishes to cater to the entire society’s interests, rather than those of only one party. Furthermore, users’ comfort was also considered important, since users will still be the consumers, and must be willing to pay. Such willingness to pay is critical to the manufacturers’ investment risks. Manufacturers’ objectives were also considered important, but in this reasoning a third priority. Final prioritisation should, therefore, at least involve the alternatives ranked within the top three by the stakeholder representatives from society/public policy makers and from the stakeholder ‘users’. The alternatives that were ranked at the top from the society’s point of view were related to speed warning and blind spot detection. The alternatives that were ranked at the top (in WP1 and WP2) from a users’ point of view were related to sharp bend warning and blind spot detection. Based on this information, combined with discussion among experts and taking into account technical feasibilities, it was decided to select a set of six implementation scenarios as presented in Table 15. These scenarios were subject to pilot tests (in WP4) and it is these scenarios that were prioritised in WP5. A more detailed description of each of these scenarios will be given in the next section (section 4.2).

19 Authors: K. De Brucker, C. Macharis and A. Verbeke.
<table>
<thead>
<tr>
<th>No./ Name</th>
<th>Description</th>
<th>Type of system</th>
<th>Data needed for operation</th>
<th>Data collection for operation</th>
<th>Condition requirement</th>
<th>Reference scenario for evaluation</th>
<th>Main contrib. factor in target accidents</th>
<th>Pilot studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 In-car Variable mess. signs (VMS) dynamic speed limit (motorways)</td>
<td>Self-explaining system Dynamic speed limit based on weather and traffic conditions</td>
<td>Roadside VMS Warning into vehicle</td>
<td>Current speed, environmental data, traffic volume / flow</td>
<td>Vehicle sensors, roadside sensors</td>
<td>Reliable detection systems, algorithms for calculating safe speed</td>
<td>(A) Current state (B) Roadside VMS, dynamic speed limit (no info into vehicles)</td>
<td>Inappropriate speed on motorways</td>
<td>Greek Pilot Italian Pilot German Pilot</td>
</tr>
<tr>
<td>2 In-car school bus ahead warning</td>
<td>Self-explaining system Warning when school bus stops ahead</td>
<td>Warning from bus into vehicle</td>
<td>Vehicle location, school bus location</td>
<td>Vehicle equipment for vehicle-to-vehicle communication</td>
<td>Reliable detection systems, reliable radio transmitter and receiver</td>
<td>No in-vehicle warning</td>
<td>Not detecting school children crossing road after leaving or before entering school bus</td>
<td>Swedish Pilot</td>
</tr>
<tr>
<td>3 In-car curve speed warning (rural roads)</td>
<td>Self-explaining system Safe curve speed calculated based on curve geometry and weather conditions</td>
<td>Vehicle autonomous</td>
<td>Current speed, curve geometry, environmental data, vehicle characteristics</td>
<td>Digital maps, vehicle sensors</td>
<td>Reliable updated data basis for infrastructure conditions, algorithms for calculation of safe speed</td>
<td>No in-vehicle warning</td>
<td>Inappropriate speed in curves on rural roads</td>
<td></td>
</tr>
<tr>
<td>4 In-car lane departure warnings (motorways)</td>
<td>Forgiving system Lane departure warnings based on lane markings and road side beacons in road work zones</td>
<td>Warning into vehicle</td>
<td>Lane markings, speed, local conditions (e.g. roadwork)</td>
<td>Vehicle sensors (LDWA) Road side beacons (adaptive LDWA)</td>
<td>Lane markings, reliable detection systems</td>
<td>(A) No lane departure warning (B) Rumble strips; no measures at road works</td>
<td>Lane departure on motorways</td>
<td>Swedish, German, Greek pilots</td>
</tr>
<tr>
<td>5 Overtaking ass. ‘blind spot vehicle detection’ (more than 1 lane per direction)</td>
<td>Forgiving system Warning when overtaking while vehicle approaching from behind</td>
<td>Vehicle autonomous</td>
<td>Position and speed of vehicle approaching in blind spot, current speed</td>
<td>Vehicle sensors for detection of vehicles behind</td>
<td>Reliable detection systems</td>
<td>No overtaking assistance</td>
<td>Overseeing vehicle approaching from behind while overtaking</td>
<td></td>
</tr>
<tr>
<td>6 Overtaking ass. oncoming vehicle detection (1 lane per direct.)</td>
<td>Forgiving system Warning when overtaking with oncoming traffic</td>
<td>Vehicle to vehicle communication</td>
<td>Location and speed of own vehicle and oncoming traffic</td>
<td>Vehicle sensors, equipment for vehicle-to-vehicle communication</td>
<td>Reliable detection and communication systems</td>
<td>No overtaking assistance</td>
<td>Overseeing oncoming traffic while overtaking</td>
<td></td>
</tr>
</tbody>
</table>

Source : IN-SAFETY partners
4.2 Presentation of the set of implementation scenarios to be prioritised

4.2.1 Discussion of the implementation schemes for the scenarios

The scenarios that were introduced in section 4.1 can be implemented in different ways. The implementation of these scenarios includes installation of infrastructure equipment (e.g. measuring equipment, variable message signs [VMS], roadside beacons, etc.) and vehicle equipment (e.g. radio receivers, devices for giving information or warnings to the driver, measurement equipment, vehicle-to-vehicle communication, etc.). For some scenarios, only vehicle equipment is required. As regards vehicle components, three possible implementation schemes are possible, namely:

- **Implementation scheme A**: Full scale implementation from day one. Installation in all vehicles (both new and old ones) at the same time as the infrastructure equipment. The market penetration is 100% from day 1. This implementation scheme is probably unrealistic because installation in old vehicles is mostly very expensive and it would be difficult to obtain acceptance.

- **Implementation scheme B**: Market trend. Installation in all new vehicles from day 1 is obligatory. The market penetration will develop as estimated by trend analysis of the numbers of new cars entering the market each year. In the calculation of the effects of the scenarios on the numbers of fatalities and injuries it is taken into account that new vehicles usually have a larger annual mileage than older cars.

- **Implementation scheme C**: Voluntary (not taken into account).

Implementation scheme C will not be taken into account because the penetration rates are impossible to estimate. These rates are dependent, inter alia, on costs for vehicle owners, marketing strategies of manufacturers and public acceptance. Implementation scheme B is the most realistic one. The evaluation (i.e. scoring) of the scenarios in terms of the various criteria, which will be performed in section 4.4.4, will therefore mainly build upon implementation scheme B.

4.2.2 Scenario no. 1: In-car Variable message signs (VMS) info into vehicle, dynamic legal speed limit on motorways

A. Presentation of the scenario

This scenario is implemented on all motorways. It aims at avoiding accidents that are caused by inappropriate speed, as illustrated in Figure 7. The system consists of existing roadside variable message signs (VMS) displaying a dynamically calculated legal speed limit and beacons that emit this information to an on-board unit in the vehicle. The installation of new VMS is not part of this scenario. Old VMS will be completed with an additional emitting unit.

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20 It was decided by consortium members to take into account implementation scheme B only. The aim of the prioritisation is to assess the degree to which the scenarios contribute to stakeholder objectives. If the tools which obtain a high priority from societal perspective also receive a good score in terms of user acceptance and manufacturers’ objectives, then government intervention may be less needed. Hence, drivers may decide voluntary to have these tools installed in their cars. When the user acceptance is rather weak, then government intervention may be necessary (e.g. by making installation in all new vehicles compulsory). Hence the difference between both implementation schemes would not make that much difference in terms of the users’ and the manufacturers’ point of view. As far as the societal perspective is concerned, however, the context may be slightly different if implementation scheme C would be used as the basis for comparison. This will be discussed later.
This means that the cost of this scenario will be substantially lower as compared to a scenario whereby new VMS would be necessary.

The dynamic speed limit is calculated based on current traffic and weather conditions. Information about the current speed limit is provided to the driver via a display in the vehicle at all times. The vehicle on-board unit gives additional warning when the current speed limit is exceeded. An automatic adaptation of driving speed is not included in the scenario. Types of accidents that may be affected by scenario no. 1, besides rear-end collisions, include, for example, overtaking accidents, loss of control, and lane departure.

The VMS may show additional information, e.g. about fog, congestion, accidents ahead, etc. However, effects of such information on appropriate speed are not taken into account in the present analysis.

Figure 7: Referred accident situation for scenario no. 1 (VMS info into vehicle, dynamic speed limit)

![Diagram of referred accident situation for scenario no. 1](source: IN-SAFETY partners)

Figure 8: Variable speed limit sign

![Variable speed limit sign](source: IN-SAFETY partners)
Implementation of this scenario includes the installation of infrastructure and vehicle equipment. Implementation schemes are as described in section 4.2.1. As regards infrastructure equipment, the following equipment will be necessary:

- Measurement equipment (rain sensors, traffic counting etc.) and algorithms for calculating dynamic legal speed limits.
- VMS showing the current speed limit.
- Equipment for communication between the VMS in order to harmonize speed limits over longer distances.
- Devices for sending information to the vehicle on-board units.

In addition, the following infrastructure equipment is necessary:

- Devices for sending information to the vehicle on-board units

As regards vehicle equipment, the following equipment will be necessary:

- On-board units that receive information from the VMS (hardware and software).
- A display and / or other device that notifies the driver of the actual speed limit.
- A display and / or other device that notifies the driver if the actual speed exceeds the speed limit.

B. Presentation of the reference scenarios

For the evaluation of this system or scenario (i.e. for comparison with other systems/scenarios) two reference scenarios (i.e. reference situations or briefly ‘references’) are defined.

Reference no. 21 is the current situation. On most motorways there are only static speed limits. In Germany there are no speed limits on large parts of the motorways. On some motorways VMS are installed on which dynamically calculated speed limits are shown. These speed limits are equal to the static speed limit under normal conditions, and lower for example in fog, snow, or when there is congestion. The proportion of motorway kilometres where VMS with dynamically calculated speed limits are installed is not very large. There are no costs associated with this reference. The number of accidents and injuries is the same as in the current situation, i.e. accident data from current motorways are applicable.

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21 It is this reference scenario that will be used as the implicit reference for pairwise comparison purposes (i.e. for scoring of scenarios) in section 4.4.4, except for scenario no. 6 (i.e. overtaking assistant oncoming vehicle detection, 1 lane per direction).
Safety impacts of this scenario (i.e. scenario no. 1) and number of prevented accidents and injuries (as compared to the references) can be estimated using an error-based approach or an empirical effect approach. As regards the former, estimates for Germany are reported in Erke et al. (2007). Since this scenario only works on those parts of the motorway network where VMS are already installed, target accidents and safety effects will be lower compared to a scenario whereby VMS would be installed all over the motorway network. As regards the error-based approach, reference can be made to a Finnish study by Rämä, Raitio, Anttila and Schyriokoff, s.d. as well as to the Italian, German and Greek pilots where applications of scenario no. 1 were tested.

4.2.3 Scenario no 2: In-car School bus ahead warning

A. Presentation of the scenario

Scenario no. 2 aims at avoiding accidents in which the driver of a car overlooks a school bus which is stopping ahead of the car, and runs over school children getting on or off the bus. It is mainly related to inappropriate speed near school buses.

This scenario involves the installation of vehicle-to-vehicle communication between school buses and cars / all other vehicles. Data about the location of school buses is needed for system operation. Radio transmitter and receiver can be used to handle the communication between both vehicles; these are the so-called Dedicated Short-Range Communications (DSRC). In case of a school bus stopping ahead, drivers will receive a message on a display about 300 m before the school bus appears ahead as illustrated in Error! Reference source not found.

Figure 10 : Warning given in scenario no. 2 (School bus ahead warning)

Source : IN-SAFETY partners

Implementation schemes are as described in section 4.2.1. Equipment in buses is installed in full scale in year 1 of implementation.

Implementation of this scenario only includes the installation of vehicle equipment, namely :

- Senders and receivers for vehicle-to-vehicle communication between school buses and cars.
- A display and / or other device that notifies the driver in case of a school bus stopping ahead.
B. Presentation of the reference scenario

The reference scenario (i.e. the reference situation or briefly the ‘reference’) is the current situation in which no warning is given if a school bus is stopping ahead. No costs are associated with this reference situation. The number of accidents and injuries are the same as in the current situation.

Safety impacts of this scenario (i.e. scenario no. 2) and number of prevented accidents and injuries (as compared to the reference) can be estimated using an error-based approach or an empirical effect approach. As regards the former, a study of accidents related to school transport and in which school children have been killed or injured was conducted in Sweden (Anund et al., 2003) and is also reported in Erke et al. (2007). As regards the latter, pilot studies were conducted in Sweden (VTI) and are briefly reported in Erke et al. (2007).

4.2.4 Scenario no 3: In-car safe curve speed warning

A. Presentation of the scenario

This scenario is a vehicle autonomous system that aims at avoiding inappropriate speed in curves on rural roads (not on motorways), as illustrated in Error! Reference source not found.. Inappropriate speed in curves can lead to road departure, roll-over or head-on-collisions.

Vehicles are equipped with on-board units, that detect if the driver is driving inappropriately fast in the approaches to curves or in curves. Safe speed is calculated based on geometric characteristics of the curve, and current driving conditions (weather, road conditions). Vehicles are also equipped with GPS systems and digital maps with information on curve radius, other relevant curve characteristics and the legal speed limit. Speed limit and infrastructure data are updated with the release of a new digital map on CD or DVD, or by air interface if the on board equipment has a communication stack. The update cycle of static speed limits and infrastructure data by CD or DVD needs a long time. Therefore technologies operated by service providers and road operators like radio broadcast, cellular mobile radio or short-range communication might be used for an update.

The vehicle is also equipped with measurement equipment for external conditions like temperature, rain etc. For calculating safe speed in curves a valid model is necessary that describes safe speed as a function of road and environmental conditions. The calculated safe speed will at maximum be the legal speed limit. Characteristics of the vehicle and driver may be incorporated into this model as well.

When inappropriate speed while approaching a curve on a rural road is detected, the on-board unit gives a warning message to the driver. The system does not actively influence the speed choice of the driver.

Speed warnings are given only in curves which have a radius below 1000 m and on roads with a defined minimum standard. On gravel roads for example no safe speed is calculated. Factors like pavement type and condition are not taken into account in calculating safe speed.
Implementation schemes are as described in section 4.2.1. Only vehicle equipment is needed for the implementation of this scenario, namely:

- GPS, digital map with geometric and speed limit information.
- Model of safe curve speed.
- Measurement equipment for road and weather conditions.
- A display and/or other device that notifies the driver if the actual speed exceeds the calculated safe speed.

B. Presentation of the reference scenario

The reference scenario (i.e. the reference situation or briefly the ‘reference’) is the current situation where no warning is given to the driver when safe speed is exceeded. The reference is based on existing accident data. No costs are associated with the reference. The numbers of accidents and injuries are the same as in the current situation.

Safety impacts of this scenario (i.e. scenario no. 3) and number of prevented accidents and injuries (as compared to the reference) can be estimated using an error-based approach or an empirical effect approach. As regards the former, only target accidents are identified for Germany and reported in Erke et al. (2007). As regards the latter, no pilot studies were conducted for this scenario up till now.

4.2.5 Scenario no 4: In-car Lane Departure Warning (Motorways)

A. Presentation of the scenario

Scenario no. 4 aims at avoiding road departure or lane departure on motorways, as illustrated in Error! Reference source not found. An in-vehicle system warns the driver if it is forecasted that the vehicle might leave the road unintentionally. The in-vehicle system receives information from detectors (optical systems) which identify lane markings. This implies high requirements for lane markings, and the system has to be able to deal with different types of lane markings and with gaps in markings.
Additionally, information is received from roadside beacons at road works and other road sections without (reliable) lane markings. A processor in the vehicle calculates the forecasted vehicle position, using additionally information of speed and steering wheel movements.

Figure 12: Effects of scenario no. 4 (lane departure warning system)

Implementation of this scenario includes the installation of infrastructure and vehicle equipment. Implementation schemes are as described in section 4.2.1. As regards infrastructure equipment, the following equipment will be necessary:

- Lane markings on all motorways (no rumble strips).
- Roadside beacons in road work zones and other areas without standard lane markings.

As regards vehicle equipment, the following equipment will be necessary:

- Detection system for lane markings.
- On-board units that receives information from the road side beacons.
- A display and / or other device that notifies the driver in case of threatening lane departure.
B. Presentation of the reference scenario

For the evaluation of this system or scenario (i.e. for comparison with other systems / scenarios) two reference scenarios (i.e. reference situations or briefly 'references') are defined.

Reference no. I is the current situation\(^\text{22}\) whereby no warning is given to the driver and whereby rumble strips are installed only on few kilometres of motorway. Most motorways have broad (ca. 3m) paved shoulders, and all motorways have a median barrier with guardrails, as well as guardrails at both sides. Beside the motorways there are for the most part no trees, poles or other objects. There are no costs associated with this reference scenario. The numbers of accident and injuries are the same as the current numbers of accidents and injuries on motorways where at least one car is involved.

Reference no. II is the current situation as described in reference situation no. I, but additionally centre line and shoulder rumble strips are installed on all motorways, including ramps. No rumble strips are installed in road work zones. In this reference situation costs occur for installation and maintenance of rumble strips on all motorways. Installation costs per meter vary between €0.30 and €2.38 dependent of the length of the rumble strips (Perrillo, 1998) or ca. € 2.13 (Statens vegvesen, 2004). Maintenance costs are incurred every 2 to 6 years and amount to ca. 50% of the installation cost (Mason, 1999).

The number of accidents and injuries in this second reference situation is equal to the current numbers of accidents and injuries on motorways whereby at least one car is involved (i.e. the number of accidents and injuries under reference scenario no. I) minus the number of accidents and injuries that would be prevented by the installation of rumble strips.

Safety impacts of this scenario (i.e. scenario no. 4) and number of prevented accidents and injuries (as compared to both references) can be estimated using an error-based approach or an empirical effect approach. As regards the former, estimates for Germany are reported in Erke et al. (2007). As regards the latter, pilot studies were conducted in Sweden, Greece and Germany.

\(^{22}\) It is this reference scenario that will be used as the implicit reference for pairwise comparison purposes in chapter 4.
4.2.6 Scenario no 5: Overtaking Assistant on roads with lane separation (‘Blind spot vehicle detection’) (more than one line per direction)

A. Presentation of the scenario

Scenario no. 5 aims at avoiding accidents on motorways and other roads with more than one driving lane per direction (mostly motorways), in which a vehicle overtakes in spite of approaching traffic from behind, as illustrated in Error! Reference source not found.

Cars are equipped with sensors that detect traffic approaching from behind, and with equipment that identifies situations in which the driver intends to overtake (signalling, steering wheel movements) in spite of approaching traffic from behind. The vehicle also has to be equipped with GPS and a digital map in order to identify whether the vehicle is driving on a road with more than one lane per direction. In case of identified dangerous overtaking manoeuvres a (visual, haptic, or acoustic) warning is given to the driver. A warning is also given in situations where the system (and the driver) could not detect any vehicle approaching from behind because of horizontal or vertical curvature of the road or sight obstacles. Geometric information is therefore also included in the digital map. This scenario does not involve vehicle-to-vehicle communication. Speed limit information also might be included in order to determine the maximum tolerable sight and detection distance which has to be clear of vehicles approaching from behind.

Figure 13: Referred accident situation of scenario no. 5
(Overtaking assistant, ‘blind spot’, more than 1 lane per direction)
Implementation schemes are as described in section 4.2.1. Implementation of this scenario includes the installation of vehicle equipment, namely:

- Device that detects vehicles approaching from behind.
- GPS, digital map with geometric and speed limit information.
- A display and/or other device that notifies the driver in case of detected dangerous overtaking situations.

B. Presentation of the reference scenario

The reference scenario (i.e. the reference situation or briefly the ‘reference’) is the current situation whereby no warning is given to the driver in case of dangerous overtaking with traffic approaching from behind. No costs are associated with this reference scenario. The number of accidents and injuries in this reference scenario is equal to the current numbers of accidents and injuries on motorways where at least one car is involved.

Safety impacts of this scenario (i.e. scenario no. 5) and number of prevented accidents and injuries (as compared to the reference scenario) can be estimated using an error-based approach or an empirical effect approach. As regards the former, estimates for Germany are reported in Erke et al. (2007). As regards the latter, pilot studies are being conducted in Germany.

4.2.7 Scenario no 6: Overtaking Assistant Oncoming Vehicle Detection (1 lane per direction)

A. Presentation of the scenario

Scenario no. 6 aims at avoiding accidents on rural roads with one driving lane per direction and no median barrier, in which a vehicle overtakes in spite of approaching traffic from the front, as illustrated in Error! Reference source not found.

Cars are equipped with sensors that detect traffic approaching from the front, and with vehicle-to-vehicle communication that enables vehicles to detect approaching vehicles also if these are not (yet) within sight distance. This system requires information on speed and location of all vehicles, and a digital map with information on infrastructure (number of lanes, road curvature) and speed limits. In case of identified dangerous overtaking manoeuvres a (visual, haptic, or acoustic) warning is given to the driver.

The system must be designed so as to avoid the interpretation of ‘no warning’ as ‘nothing in front’. This includes approaching vehicles that were not detected (e.g. all motor vehicles without functioning vehicle-to-vehicle equipment), cyclists, pedestrians or other road users, and objects or other barriers on the way.

Implementation of this scenario only makes sense if it is installed in all vehicles simultaneously because of the vehicle-to-vehicle communication involved.
Implementation schemes could theoretically be as described in section 4.2.1, but in this scenario, however, vehicle equipment is installed in all vehicles simultaneously (full scale implementation from year 1). Only implementation scheme A is considered here. Gradual implementation (i.e. implementation scheme B or C) is not considered. Implementation of the scenario includes the installation of vehicle equipment, namely:

- Device that detects vehicles approaching from in front.
- GPS, digital map with geometric information.
- Senders and receivers for vehicle-to-vehicle communication.
- A display and/or other device that notifies the driver in case of detected dangerous overtaking situations

B. Presentation of the reference scenario

The reference scenario (i.e. the reference situation or briefly the ‘reference’) for this scenario is the current situation whereby no warnings are given to drivers that are overtaking in spite of oncoming traffic. No costs are associated with this scenario. The numbers of accidents and injuries for this reference are the current numbers of accidents and injuries on motorways where at least one car is involved.

Safety impacts of this scenario (i.e. scenario no. 6) and number of prevented accidents and injuries (as compared to both reference scenarios) can be estimated using an error-based approach or an empirical effect approach. As regards the former, estimates for Germany are reported in Erke et al. (2007).
4.3 Definition of a set of criteria for the prioritisation of concrete scenarios

As regards the criteria and their respective weights to be used for the evaluation of the implementation scenarios described above (in section 4.2), the same approach and the same set of criteria can be used as for the preliminary prioritisation (WP1 and WP2). This set was developed after several discussion workshops with experts and representatives from policy makers, as was described in section 3.3. In addition, an extra pan European workshop was organised within WP5, by POLIS\(^{23}\) on 24 October 2007 in Brussels. The set of criteria is shown in Error! Reference source not found., (third level of the decision tree). That decision tree is structured along three stakeholders, namely (1) society/public policy makers, (2) users, and (3) manufacturers. Each of these stakeholder groups has its own set of criteria (and associated weights) that it considers relevant. The criteria of the stakeholder ‘society/public policy’ are considered to represent the general, i.e. societal point of view and should be taken as a starting base for policy purposes. The two other points of view (users and manufacturers), are also important, particularly in order to assess to which extent the options and preferences of society/public policy are consonant with those of the other stakeholders, as explained in section 3.3.

4.4 Scoring of scenarios on each criterion

4.4.1 Introduction

After having defined a set of criteria and criterion weights in section 4.3, scenarios now need to be evaluated on each criterion separately. By doing so, a partial evaluation is obtained. This should be done by experts, on the basis of the information which is available to them. For some criteria hard data are available and these should of course be used. Some scenarios were subject to pilot studies which were conducted by consortium partners (see section 4.2). The partial evaluations to be performed by experts in fact amount to assessing a cardinal value function for the criterion studied.

In the next section (section 4.4.2) three possible ways to construct such a value function will be discussed. In the subsequent section (section 4.4.3), the capabilities of the pairwise comparison mechanism to implicitly derive such a value function will be described briefly. The actual scores of the scenarios will be reported in section 4.4.4.

4.4.2 Three ways of constructing a cardinal value function

A. Case no. 1 : The hard data describe a cardinal value function: no further operations are necessary

When the scores associated with the scenarios in terms of one specific attribute or criterion describe a cardinal value function, then these scores can be used for prioritisation without any further operations or calculations. A cardinal value function makes it possible to argue that a score of e.g. 2X is considered to be twice as good/bad as a score of X for each value of X. For instance, as regards the criterion or attribute ‘public expenditure’ estimates of levels

\(^{23}\) Initially POLIS was the abbreviation for ‘Promoting Operational Links with Integrated Services’, but at present only the word POLIS is used to denominate that organisation.
of expenditure expressed in euros are available e.g. from the social cost-benefit analysis performed in A5.2 (Erke et al., 2007). This information is expressed on a ratio scale. It is quite natural to assume that a tool associated with a public expenditure of 200,000 euro (such as tool B) is twice as bad compared to a tool with a public expenditure of only 100,000 euro (such as tool A), in terms of the criterion ‘public expenditure’ (i.e. in terms of a societal point of view). In this case, the scores obtained on the criterion or attribute ‘public expenditure’ need no further computations. In fact, the value function transforming the attribute scale \((z_j)\) into a value scale \((v_j)\) is a linear one in this case (for the criterion \(j\)), as illustrated by the straight line in Figure 15: Deriving a value function.

**Figure 15: Deriving a value function**

![Figure 15: Deriving a value function](source: designed by the authors)

B. Case no. 2: The hard data is presented on a ratio scale, but it does not describe a cardinal value function

The fact that the scores obtained e.g. from pilot studies are expressed on a ratio scale does not automatically imply that these scores describe a cardinal value function. The relation between the attribute scale \((z_j)\) and the cardinal value scale \((v_j)\) is not necessarily a linear one. For instance, as regards income for a private person, it is generally accepted that the marginal utility of income is decreasing. A job that pays twice the salary of another job is not necessarily considered to be twice as good in terms of the criterion salary. In case the salary is low, the job with the double salary may be considered close to two times better than the other job. In case the salary is high, it may be considered e.g. only 1.5 times better. The underlying value function transforming the attribute scale into a value scale is a logarithmic one in this case. A value of 0.5 on attribute scale then corresponds to a score of e.g. 0.8 on value score (as shown in Figure 15: Deriving a value function).

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24 A ratio scale is a scale which not only consists of equidistant points, but which has also a meaningful zero point. For instance cost, revenue and profit are ratio scales. The distance between two adjacent points is always the same (it is always one euro) and there is a meaningful zero point (a revenue of zero signifies the absence of revenue). Hence, it makes sense to argue that a project which generates a revenue of 100 million euro per year generates twice as much revenue compared to a project which generates a revenue of only 50 million euro per year. When there is no meaningful zero point, but the distance between two adjacent points is always the same, then the scale is called an interval scale. For instance the temperature scale of Celsius is an interval scale. The differences between two adjacent points (e.g. 5°C and 6°C versus 10°C and 11°C) is always the same, but one can not argue that with a temperature of 10°C it is twice as hot as compared to a temperature of 5°C.
accidents) are studied in terms of society as a whole that this relationship may be assumed to be a linear one.

C. Case no. 3: The hard data can only be expressed on an ordinal scale

For some criteria it will not be possible to obtain scores expressed on a ratio scale, but only scores on an ordinal scale. For instance, as regards the criterion ‘driver comfort’ the highest or most sophisticated measurement scale that is possible will in principle be an ordinal scale. This means that the scenarios can only be classified and ranked in terms of their contribution to this criterion (‘driver comfort’). It is possible to construct a scale like e.g. − − − / − − / − / 0 / + / + + / + + + for the scoring on this criterion. Although this scale can be considered as a value function, it is purely an ordinal one. In this case, further operations in order to obtain a cardinal value function will be necessary. One technique to derive such a cardinal value function is the pairwise comparison mechanism described below.

4.4.3 The use of the pairwise comparison mechanism as a tool to construct a cardinal value function

The pairwise comparison mechanism of the analytic hierarchy process (AHP) (Saaty, 1995) makes it possible to obtain a cardinal value scale for the prioritisation of scenarios in terms of specific criteria. This will be especially useful in the cases B and C described above (in section 4.4.2).

The use of the pairwise comparison mechanism of the AHP was described in detail in chapter 2. The relative priorities of the scenarios in terms of contribution to a specific criterion (g) (e.g. ‘driver comfort’) are determined by comparing these scenarios in pairs in terms of their contribution to that criterion. The values that may be used for making this comparison were presented in Table 3. It is these values or scores that should be used to fill in the typical pairwise comparison matrices of the AHP, an example of which was given in Table 2. These values \[ P_{g}(a_i,a_{i'}) \] represent the preference intensity for a specific pair of scenarios (e.g. the pair \[ a_i-a_{i'} \] in Table 2) in terms of the criterion studied (g). In the next section a concrete example of such a pairwise comparison matrix is given as applied to the IN-SAFETY project, for one specific criterion namely ‘driver comfort’ and for one specific expert (see Table 16).

It is these values \[ P_{g}(a_i,a_{i'}) \] that are used to construct the cardinal value function. This will be done using the standard procedures of the AHP methodology, which are based on the theory of eigenvalues and eigenvectors of matrices. An explanation of these techniques would lead too far here. One can refer to chapter 2 and to Saaty (1995).

\[ P_{g}(a_i,a_{i'}) \] For instance the value 5 (shadowed cell in Table 16) expresses that scenario no. 1 (which is the so-called ‘row element’ or ‘row scenario’) is considered to have a ‘higher importance’ (value 5) over scenario no. 5 (which is the so-called ‘column element’ or ‘column scenario’) in terms of contribution to the criterion studied (namely ‘driver comfort’). Scenario no. 1 can then be considered to be 5 times better than scenario no. 5 in terms of contribution to the criterion ‘driver comfort’.

25
4.4.4 Scoring of scenarios on each criterion separately

The scoring of scenarios on the various criteria was done by a number of experts coming from IN-SAFETY consortium partners participating in WP5 (BASt\textsuperscript{26}, CRF\textsuperscript{27}, HIT\textsuperscript{28}, KfV\textsuperscript{29}). The scoring was done by these partners taking into account as much as possible the hard data available to them, on the basis of results from pilot studies or other relevant studies (mentioned in section 4.2) or relying on their expert judgments. Within each partner, however, several internal experts were consulted in order assist with this scoring exercise. The whole scoring exercise was coordinated by VUB\textsuperscript{30} within A5.1 of WP5 following a specific procedure described below.

A first and preliminary step in this procedure was that the scoring procedure was briefly explained to the experts who were present in the periodic meetings of the IN-SAFETY consortium, e.g. the meeting in Krems (Austria) on 5 and 6 March 2007 (and later on also at the meeting in Thessaloniki, Greece, on 28 and 29 June 2007).

The second step was that an extensive scoring document was submitted to the experts. This document contained among other elements a detailed description of the scenarios to be prioritised, a clear specification of the criteria considered relevant and their exact meaning, as well as a clear explanation of the various ways of constructing a cardinal value function (as described in section 4.4.2), including the role of the pairwise comparison mechanism of the AHP in this procedure (as described in section 4.4.3). The main part of this scoring document was, however, a list of scoring tables to be filled in by the experts. Experts had the choice to give their scores in a pairwise fashion, i.e. as described in chapter 2 (Table 2, using the values presented in Table 3) and already applied in chapter 3 (Table 8, Table 10, Table 11 and Table 12) or to give their scores using direct ratings on a ratio scale. Most experts preferred to give their ratings in a pairwise fashion. An example of such a scoring table filled in by one expert for one specific criterion (namely ‘driver comfort’) is given in Table 16 as an example. The remaining pairwise comparison matrices are not shown here in this deliverable, but they were made in the same way. Such pairwise comparison matrices had to be filled in for each individual criterion (12 criteria in total) and for each individual expert.

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\textsuperscript{26} BASt : Bundesanstalt für Strassenwesen (i.e. the German Federal Highway Research Institute), Bergisch-Gladbach, Germany.

\textsuperscript{27} CRF : Centro Ricerche Fiat (Fiat Research Centre), Turin, Italy.

\textsuperscript{28} HIT : Hellenic Institute of Transport, Thessaloniki, Greece.

\textsuperscript{29} KfV : Kuratorium für Verkehrssicherheit (Austrian Road Safety Board), Vienna, Austria.

\textsuperscript{30} VUB : Vrije Universiteit Brussel (Free University of Brussels), Flemish Community of Belgium.
### Table 16: Example of one pairwise comparison matrix as filled in by one expert for the criterion driver comfort

<table>
<thead>
<tr>
<th>Crit. Driver comfort</th>
<th>Scen. 1 VMS info into vehicle</th>
<th>Scen. 2 School bus ahead warn.</th>
<th>Scen. 3 Safe curve speed warn.</th>
<th>Scen. 4 Lane depart. warning</th>
<th>Scen. 5 Overtak. ass. with lane sep.</th>
<th>Scen. 6 Overtak. ass. without la.sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scen. 1 VMS info into vehicle</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1/2</td>
</tr>
<tr>
<td>Scen. 2 School bus ahead warn.</td>
<td>1/7</td>
<td>1</td>
<td>1/4</td>
<td>1/5</td>
<td>1/2</td>
<td>1/9</td>
</tr>
<tr>
<td>Scen. 3 Safe curve speed warn.</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1/2</td>
<td>3</td>
<td>1/3</td>
</tr>
<tr>
<td>Scen. 4 Lane depart. warning</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1/2</td>
</tr>
<tr>
<td>Scen. 5 Overtak. ass. with lane sep.</td>
<td>1/5</td>
<td>2</td>
<td>1/3</td>
<td>1/3</td>
<td>1</td>
<td>1/8</td>
</tr>
<tr>
<td>Scen. 6 Overtak. ass. without la.sep</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Overall inconsistency: 0.02

Source: KfV

In Table 16 the scenarios are compared in pairs in terms of their contribution to one specific criterion, namely ‘driver comfort’. The scenarios are listed horizontally on the first row of the matrix, as well as vertically in the first column of the matrix (shaded in both cases). The criterion in terms of which the pairwise comparison is made is mentioned in the first cell in the first row of the matrix. The remaining cells contain the values of the actual pairwise comparisons made by the expert. For instance the value 5 in the shaded cell of the upper right triangle of this matrix (on row 2) expresses that scenario no. 1 (which is the so-called ‘row element’ or ‘row scenario’) is considered to have a ‘higher importance’ (value 5) over scenario no. 5 (which is the so-called ‘column element’ or ‘column scenario’) in terms of contribution to the criterion driver comfort. Scenario no. 1 is then considered to be 5 times better than scenario no. 5 in terms of contribution to the criterion studied (‘driver comfort’). When the opposite comparison is made, i.e. when scenario no. 5 is compared with scenario no. 1, then this comparison should receive the reciprocal value of the initial comparison, i.e. the value 1/5 as shown in the shaded cell in the lower left triangle of the matrix (on row 6 of the matrix).

Then, in a third step, the results from this first scoring exercise were analysed by the coordinating team and presented at the plenary meeting in Thessaloniki (Greece) on 28 and 29 June 2007. Some tables still needed to be filled in at that time, as all pilot studies were not finalised yet. But a constructive discussion took place among experts and it was decided to submit a (revised) scoring document to the experts so that they could fill in the remaining tables, taking into account the information becoming available from pilot studies.

Then, in a fourth step, this revised document was (re-)submitted to the experts by the end of July 2007. The experts had to complete this document (i.e. filling in the remaining scoring tables an example of which was given in Table 16) and send it back to the coordinating team (VUB) by the end of September 2007.

The fifth and most conclusive step in this scoring procedure was that all the information provided by the experts (i.e. all scoring tables an example of which was given in Table 16) was compared and analysed in depth by the coordinating team and then presented to a committee of experts during a special workshop which took place in Brussels on 22 October 2007.
2007. This committee consisted of at least one representative (i.e., an expert) from each of the partners involved in the scoring exercise (BASt, CRF, HIT and KfV), as well as some representatives and experts from other consortium partners (TUDarm\textsuperscript{31}, TUDelft\textsuperscript{32}, USTUTT\textsuperscript{33}, and other partners). The aim of this workshop was to obtain a consensus scoring.

Within each consortium partner, the internal experts that had been consulted internally, had already obtained a consensus at the time the scoring document was submitted to the coordinating team. In other words the scoring tables (an example of which is given in Table 16) were already the result of a consensus among internal experts, i.e., among experts within the organisation of the consortium partner. Among the four consortium partners themselves, however, scores were still slightly diverging as far as some specific criteria are concerned. Such divergences are quite natural when applying the AHP methodology and may indeed be due to several elements, the most important ones being different expert opinions, different assumptions, but also a simple clerical error or a misunderstanding of the sequences of the pairwise comparison mechanism may be at the basis of the divergence of scores. The aim of the AHP methodology is precisely to confront the divergent expert opinions and to obtain a consensus, as is the case in traditional Delphi techniques. There are several techniques to address the issue of divergent scores as suggested by Saaty (1995:265). One of these techniques could be to calculate the geometric mean\textsuperscript{34} of the scores given. Another technique is to have a vote on the proposed values or scores and still another technique could be to present the final solution as a range of values representing the range of judgments. In order to obtain a consensus that is really supported by all experts, it was decided, in this project, to have a constructive discussion among experts and to obtain a consensus by confronting the different points of view.

Finally, by discussing these issues and with the help of the other partners present in the workshop, a consensus scoring was finally obtained at the end of the workshop. These consensus scores are represented in Table 17, Table 18 and Error! Reference source not found.. These results can also be visualised graphically as shown in the corresponding figures (Error! Reference source not found., Error! Reference source not found., and Error! Reference source not found.).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Criterion (weight)</th>
<th>Driver comfort (0,087)</th>
<th>Full user cost (0,282)</th>
<th>Driver safety (0,452)</th>
<th>Travel time sav. (0,179)</th>
<th>Overall (Users) (1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scen. 1 : In-car VMS dynamic speed limit</td>
<td>0,150</td>
<td>0,277</td>
<td>0,125</td>
<td>0,190</td>
<td>0,182</td>
<td></td>
</tr>
<tr>
<td>Scen. 2 : School bus ahead warning</td>
<td>0,100</td>
<td>0,403</td>
<td>0,025</td>
<td>0,040</td>
<td>0,141</td>
<td></td>
</tr>
<tr>
<td>Scen. 3 : In-car curve speed warning</td>
<td>0,150</td>
<td>0,043</td>
<td>0,250</td>
<td>0,090</td>
<td>0,154</td>
<td></td>
</tr>
<tr>
<td>Scen. 4 : In-car lane departure warning (motorways)</td>
<td>0,150</td>
<td>0,124</td>
<td>0,100</td>
<td>0,040</td>
<td>0,100</td>
<td></td>
</tr>
<tr>
<td>Scen. 5 : Overtaking assistant (blind spot vehicle detection)</td>
<td>0,150</td>
<td>0,115</td>
<td>0,175</td>
<td>0,040</td>
<td>0,132</td>
<td></td>
</tr>
<tr>
<td>Scen. 6 : Overtaking assistant oncoming vehicle detection</td>
<td>0,300</td>
<td>0,038</td>
<td>0,325</td>
<td>0,600</td>
<td>0,291</td>
<td></td>
</tr>
</tbody>
</table>

Overall inconsistency ratio : 0,06

\textsuperscript{31} TUDarm : Technische Universität Darmstadt (Darmstadt Technical University), Germany.

\textsuperscript{32} Technische Universität Delft (Delft University of Technology), The Netherlands.

\textsuperscript{33} Universität Stuttgart (Stuttgart University), Germany.

\textsuperscript{34} The geometric mean (and not the arithmetic mean) is the statistical measure that would be relevant in such a case, since the average of ratios is to be calculated here.
Table 17 shows the relative priorities of the six scenarios studied in terms of the criteria considered relevant by the users. The scenarios are listed in the first column and the criteria (together with their respective weights) are listed in the first row. The relative priorities are mentioned in the remaining cells of that table (last column excluded). The last column contains the overall or global relative priorities of the scenarios from the point of view of the stakeholder ‘users’. The way in which these were obtained will be explained in the next section.

Error! Reference source not found. shows the same information, but in a graphical way. The criteria are mentioned on the horizontal axis. The height of the vertical bars represents the criterion weights. On the right vertical axis are shown the global relative priorities from the users’ point of view. The intersection of the various curves (i.e. the quasi horizontal lines) with the vertical lines starting at the criterion name represents the relative priority of the scenario for that specific criterion. For instance, the high peak of the curve related to scenario 6 when it intersects with the vertical line starting at the criterion ‘travel time’ means that scenario 6 has a very high (i.e. a very good) score for the criterion reducing ‘travel time’.

Table 18 and Error! Reference source not found., as well as Error! Reference source not found., and Error! Reference source not found., are structured in the same way as Table 17 and Error! Reference source not found., and contain the same information, but in terms of the criteria for the stakeholder society/public policy and the stakeholder users.

Figure 16 : Priorities of scenarios in terms of criteria for stakeholder ‘users’

35 Please note that all the criteria are conceived as benefit criteria. A higher score of a scenario on e.g. the criterion travel time (or full user cost) means that this scenario is associated with lower travel times (or lower full user cost) as compared to the other scenarios. And of course a higher score of a scenario on a criterion like driver safety means that this scenario is associated with higher levels of safety (less accidents).
### Table 18: Relative priorities of scenarios in terms of criteria from society’s point of view

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Network Effic. (0,171)</th>
<th>Overall Safety (0,509)</th>
<th>Soc-pol Accept. (0,082)</th>
<th>Public Expendit. (0,068)</th>
<th>Envir. Effects (0,170)</th>
<th>Overall (Society) (1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scen. 1: In-car VMS dynamic speed limit</td>
<td>0,240</td>
<td>0,033</td>
<td>0,255</td>
<td>0,051</td>
<td>0,513</td>
<td>0,170</td>
</tr>
<tr>
<td>Scen. 2: School bus ahead warning</td>
<td>0,187</td>
<td>0,066</td>
<td>0,327</td>
<td>0,154</td>
<td>0,154</td>
<td>0,120</td>
</tr>
<tr>
<td>Scen. 3: In-car curve speed warning</td>
<td>0,187</td>
<td>0,220</td>
<td>0,120</td>
<td>0,205</td>
<td>0,077</td>
<td>0,181</td>
</tr>
<tr>
<td>Scen. 4: In-car lane departure warning (motorways)</td>
<td>0,075</td>
<td>0,200</td>
<td>0,212</td>
<td>0,179</td>
<td>0,103</td>
<td>0,162</td>
</tr>
<tr>
<td>Scen. 5: Overtaking assistant (blind spot vehicle detection)</td>
<td>0,236</td>
<td>0,180</td>
<td>0,052</td>
<td>0,205</td>
<td>0,103</td>
<td>0,168</td>
</tr>
<tr>
<td>Scen. 6: Overtaking assistant oncoming vehicle detection</td>
<td>0,075</td>
<td>0,301</td>
<td>0,033</td>
<td>0,205</td>
<td>0,103</td>
<td>0,200</td>
</tr>
</tbody>
</table>

Overall inconsistency ratio: 0,04

Source: Own computation using ExpertChoice™

### Figure 17: Priorities of scenarios in terms of criteria for stakeholder ‘society/public policy’

Source: Own computation using ExpertChoice™
Table 19: Relative priorities of scenarios in terms of criteria from the manufacturers' point of view

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Criterion weight</th>
<th>Investm. Risk (0,276)</th>
<th>Liability Risk (0,595)</th>
<th>Technic. Feasib. (0,128)</th>
<th>Overall (Manufact.) (1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scen. 1: In-car VMS dynamic speed limit</td>
<td></td>
<td>0,245</td>
<td>0,332</td>
<td>0,284</td>
<td>0,302</td>
</tr>
<tr>
<td>Scen. 2: School bus ahead warning</td>
<td></td>
<td>0,120</td>
<td>0,377</td>
<td>0,140</td>
<td>0,276</td>
</tr>
<tr>
<td>Scen. 3: In-car curve speed warning</td>
<td></td>
<td>0,112</td>
<td>0,053</td>
<td>0,077</td>
<td>0,072</td>
</tr>
<tr>
<td>Scen. 4: In-car lane departure warning (motorways)</td>
<td></td>
<td>0,169</td>
<td>0,160</td>
<td>0,249</td>
<td>0,174</td>
</tr>
<tr>
<td>Scen. 5: Overtaking assistant (blind spot vehicle detection)</td>
<td></td>
<td>0,241</td>
<td>0,057</td>
<td>0,219</td>
<td>0,129</td>
</tr>
<tr>
<td>Scen. 6: Overtaking assistant oncoming vehicle detection</td>
<td></td>
<td>0,112</td>
<td>0,021</td>
<td>0,030</td>
<td>0,047</td>
</tr>
</tbody>
</table>

Overall inconsistency ratio: 0,01

Source: Own computation using ExpertChoice™

Figure 18: Priorities of scenarios in terms of criteria for stakeholder ‘manufacturers’

Source: Own computation using ExpertChoice™
4.5 Overall evaluation of the scenarios: deriving overall priorities per stakeholder

In order to derive the overall relative priorities for each stakeholder, the scores of the scenario on the individual criteria (shown in Table 17, Table 18 and Error! Reference source not found.) have to be combined with the respective criterion weights. To this end, the scores on each individual criterion are added after being multiplied by the weight of each individual criterion. These weights were derived in section 4.3 and section 3.5.2 and are shown on the first row of the aforementioned tables. The results of combining scores with weights give the overall or global relative priorities, which are shown in the last column of Table 17, Table 18 and Error! Reference source not found., for each individual stakeholder.

In Error! Reference source not found., Error! Reference source not found., and Error! Reference source not found., these global relative priorities are represented graphically for the respective stakeholders, namely society, users and manufacturers. In these figures the scenarios are ranked in decreasing order of priority.

Figure 19: Global priorities of scenarios from the point of view of the stakeholder 'users'

<table>
<thead>
<tr>
<th>Synthesis with respect to: Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: Improving road safe &gt; Users [L..333 G..333]</td>
</tr>
<tr>
<td>Overall Inconsistency = 0.06</td>
</tr>
<tr>
<td>Scene 6: Overtaking assistant on rural roads without L..</td>
</tr>
<tr>
<td>Scene 1: VMS info into vehicle</td>
</tr>
<tr>
<td>Scene 3: Safe curve speed warning</td>
</tr>
<tr>
<td>Scene 2: School bus ahead warning</td>
</tr>
<tr>
<td>Scene 5: Overtaking assistant with lane separation [Bl..</td>
</tr>
<tr>
<td>Scene 4: Lane departure warning</td>
</tr>
</tbody>
</table>

Source: Own computation, using ExpertChoice™

Figure 20: Global priorities of scenarios from the point of view of the stakeholder 'society'

<table>
<thead>
<tr>
<th>Synthesis with respect to: Society/Authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: Improving road safe &gt; Society/Authorities [L..3]</td>
</tr>
<tr>
<td>Overall Inconsistency = 0.04</td>
</tr>
<tr>
<td>Scene 6: Overtaking assistant on rural roads without L..</td>
</tr>
<tr>
<td>Scene 3: Safe curve speed warning</td>
</tr>
<tr>
<td>Scene 1: VMS info into vehicle</td>
</tr>
<tr>
<td>Scene 5: Overtaking assistant with lane separation [Bl..</td>
</tr>
<tr>
<td>Scene 4: Lane departure warning</td>
</tr>
<tr>
<td>Scene 2: School bus ahead warning</td>
</tr>
</tbody>
</table>

Source: Own computation, using ExpertChoice™

Figure 21: Global priorities of scenarios from the point of view of the stakeholder 'manufacturers'

<table>
<thead>
<tr>
<th>Synthesis with respect to: Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal: Improving road safe &gt; Manufacturers [L..333 G..]</td>
</tr>
<tr>
<td>Overall Inconsistency = 0.01</td>
</tr>
<tr>
<td>Scene 1: VMS info into vehicle</td>
</tr>
<tr>
<td>Scene 2: School bus ahead warning</td>
</tr>
<tr>
<td>Scene 4: Lane departure warning</td>
</tr>
<tr>
<td>Scene 5: Overtaking assistant with lane separation [Bl..</td>
</tr>
<tr>
<td>Scene 3: Safe curve speed warning</td>
</tr>
<tr>
<td>Scene 6: Overtaking assistant on rural roads without L..</td>
</tr>
</tbody>
</table>

Source: Own computation, using ExpertChoice™
4.6 Discussion of results

4.6.1 Discussion of results per stakeholder

The relative priorities derived in the former section and discussed below were obtained through the application of MAMCA and express the degree to which the various scenarios are expected to contribute to the stakeholders’ objectives. For a number of criteria, however, hard data regarding the scenarios performance was rather scarce or non-existing. Relying on expert judgment was, therefore, necessary. Indeed, the MCA-AHP is a decision tool which allows various experts to express their opinions regarding the contribution of scenarios to a number of stakeholder objectives (as measured by criteria) and these expert opinions are then synthesized using the pairwise comparison mechanism of the AHP. By confronting the various expert judgments (and making all the pairwise comparisons) subjectivity in the decision-making process is limited or made objective. The final synthesis, i.e. the result in terms of final relative priorities, express a consensus of the various experts’ opinions (just like in Delphi-poll techniques) and may be used as a basis to identify further research needs, even when hard data are rather scarce.

From society’s point of view, the final overall relative priorities of the six scenarios studied do not differ from each other substantially as can be concluded from Error! Reference source not found. and Error! Reference source not found. However there are two small exceptions. The scenario that is ranked first from society’s point of view is the scenario no. 6 namely the overtaking assistant on rural roads (i.e. oncoming vehicle detection), which obtains an overall relative priority of 0.200. This is due to a very good score on the criterion ‘overall safety’, which received a very high weight. The scenario with the lowest priority from society’s point of view is the scenario related to ‘school bus ahead warning’. This scenario obtains an overall priority of 0.120, mainly due to its very low score on the criterion ‘overall safety’. Although the socio-political acceptability related to this scenario is very high (school children are the most vulnerable road users), the actual number of accidents with children running out of a school bus is, however, relatively small compared to the other types of accidents. School buses usually already have a high visibility in the road environment. The four remaining scenarios obtain overall relative priorities close to each other, i.e. ranging between 0.162 and 0.181.

From a users’s point of view (see Error! Reference source not found. and Error! Reference source not found.), the most desirable scenario is definitely scenario no. 6 (i.e. the overtaking assistant on rural roads or oncoming vehicle detection), which obtains an overall relative priority of 0.291, mainly due to its high score on driver safety (which is the most important criterion), travel time and driver comfort. The second most desirable scenario is the scenario no. 1, namely the scenario VMS info into the vehicle, which obtains an overall priority of 0.182, because of its relatively good score on the criteria ‘full user cost’, ‘travel time’ and ‘driver comfort’. The least desirable scenario from the users’ point of view is the lane departure warning scenario (scenario no. 4) with an overall priority of 0.100. This is due to the fact that the score of this scenario, as compared to the other scenarios, is not so good for the criteria ‘travel time’ and ‘driver safety’. The intermediate scenarios, i.e. the scenario no. 3 (in-car curve speed warning), no. 2 (school bus ahead warning) and no. 5 (blind spot detection) obtain priorities close to each other, i.e. between 0.132 and 0.154.

From the manufacturers’ point of view (see Error! Reference source not found. or Error! Reference source not found.), the overall relative priorities are quite dispersed. However, two top scenarios can be distinguished, namely scenario no. 1 (VMS info into vehicle) and no. 2 (school bus ahead warning), as well as two bottom scenarios, namely scenario no. 3 (safe curve speed warning) and no. 6 (overtaking assistant with oncoming vehicles) and two
intermediate scenarios, namely scenario no. 4 (lane departure warning) and no. 5 (blind spot detection). The two top scenarios obtain overall relative priorities of 0.302 respectively 0.276, mainly due to their good scores on the criteria ‘investment risk’ and ‘liability risk’. The two bottom scenarios obtain low scores on all three criteria.

4.6.2 Comparison of stakeholder priorities

In Table 20 the scenarios for the stakeholder ‘society’ are compared to the priorities of the other two stakeholder groups.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Society</th>
<th>User</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scen. 6 (Overtaking assistant on rural roads without lane separation: oncoming vehicle detection)</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Scen. 3 (Safe curve speed warning)</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Scen. 1 (VMS info into vehicle)</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Scen. 5 (Overtaking assistant with lane separation: blind spot detection)</td>
<td>5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Scen 4 (Lane departure warning)</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Scen. 2 (School bus ahead warning)</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

The priorities of society in Table 20, when compared with those of the two other stakeholder groups, suggest where government policy may be required to achieve effective implementation of safety systems, namely where a strong discrepancy can be observed in prioritisation among stakeholder groups. In some cases, safety systems may also be introduced autonomously by the market. This will occur when the systems have a high market potential, as expressed by their perceived contribution to both user and manufacturer objectives. In Table 21, therefore, the priority alternatives of the users are compared with those of the manufacturers. The user is chosen as a starting point, as user demand is a major market driver.

<table>
<thead>
<tr>
<th>User</th>
<th>Scenario</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scen. 6 (Overtaking assistant on rural roads without lane separation: oncoming vehicle detection)</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Scen. 1 (VMS info into vehicle)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Scen. 3 (Safe curve speed warning)</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Scen. 2 (School bus ahead warning)</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Scen. 5 (Overtaking assistant with lane separation: blind spot detection)</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Scen 4 (Lane departure warning)</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Own computation
The most striking conclusion from Table 20 and Table 21 is the high discrepancy among stakeholder priorities as regards the scenario no. 6 (overtaking assistant with oncoming vehicle detection). This scenario is ranked at the top by users and society, but completely at the bottom by manufacturers. Manufacturers consider the risk associated with this scenario too high, in particular the liability risk, but also the investment risk and the risk of technical non-feasibility. In other words, users and society have a high preference for this scenario, but manufacturers do not. Although this scenario has some market potential, it is not likely to hit the market in the near future. Further research is, therefore, needed to make this application more reliable and to reduce the risks associated with it.

Another scenario for which the conclusion from comparison of stakeholder priorities is similar to that of the overtaking assistant with oncoming vehicle detection is scenario no. 3 (Safe curve speed warning). This scenario is ranked second from society’s point of view and third from the users’ point of view, but only second last from the manufacturers’ point of view. Again, manufacturers consider the risks associated with this scenario as too high. This scenario also has quite some market potential, but it is not likely to materialize in the near future either. Here again, further research may be needed to make this application more reliable and to reduce the risks associated with it.

A scenario receiving a good overall priority from the various stakeholders is scenario no. 1 (VMS info into vehicle). This scenario receives a good score from users and from manufacturers (and a relatively good one from the society’s point of view). This scenario will, therefore, more easily be implemented in the market solely as the result of market forces.

Scenario no. 5 (blind spot vehicle detection) and no. 4 (lane departure warning) do not receive too bad a score from society’s point of view. Although they are ranked fourth and fifth, the difference with the scenarios ranked just ahead is, indeed, rather small. However, these scenarios are not very much preferred by users, nor by manufacturers.

Scenario no. 2 (school bus ahead warning) is ranked last from society’s point of view and is in fourth position from the users’ point of view. Although children are the most vulnerable road users in society, accidents with children running out of a school bus only represent a small portion of the total number of accidents. School buses usually already have a high visibility in the road environment. Manufacturers, however, consider this scenario as being low risk in terms of reliability, technical feasibility and investment risk.

It should be noted that the relative priorities derived above were obtained assuming an implementation scheme called ‘market trend’ whereby installation would be compulsory in all new vehicles (i.e. implementation scheme B in section 4.2.1). If the starting base would be implementation scheme called ‘voluntary’ (i.e. voluntary installation in all new vehicles or implementation scheme C), then results may be different, especially from the society’s point of view. Scenarios that do not require vehicle-to-vehicle communication may in that case obtain a higher priority as compared to scenarios that do not need this type of communication.
5. DEVELOPMENT OF GUIDELINES CONTRIBUTING TO THE CREATION OF A MORE FORGIVING AND SELF-EXPLAINING ROAD ENVIRONMENT AND IDENTIFICATION OF FURTHER RESEARCH PRIORITIES\(^{36}\)

5.1 Development of a set of guidelines contributing to the creation of a more forgiving and self-explaining road environment

5.1.1 Introduction

In parallel with the prioritisation of scenarios reported in chapter 3 and chapter 4 of this deliverable, a number of guidelines were formulated in order to create a more forgiving road (FOR) and self-explaining road (SER) environment. In addition, also a number of research priorities have been identified. In order to complete these tasks, information on a large number of existing guidelines targeting the self-explaining and forgiving nature of a road environment was collected. To this end, two questionnaires were created and sent to the consortium partners of the IN-SAFETY\(^{37}\) project, for completion. The questionnaires were completed by experts from various countries. They were asked to describe briefly both national guidelines and research needs for making roads more forgiving and self-explaining, and to define gaps in knowledge and potential regulation. A complete list of these questionnaires, completed by the consortium partners, is given in Appendix 4A. On the basis of the responses collected, a concluding matrix of guidelines was created, which is shown in Appendix 3A.

The work performed for this deliverable did not confine itself to collecting information on existing guidelines, but also took on board the most recent information on possible future guidelines. Several inputs came from partners participating in various WPs of the IN-SAFETY project. The design of various specific scenarios was performed as part of the IN-SAFETY project. Other important inputs were derived from the experience of some of the pilot projects in the IN-SAFETY project. The results of the initial prioritisation exercise reported in chapter 3 of this deliverable (as part of WP1 and WP2) represent one example of such inputs. Benefits and economic returns were investigated in WP5 (A5.2). The results of other projects considered relevant were also included, e.g. the results of the ADVISORS\(^{38}\) project, which was also related to the prioritisation of scenarios and those of the RIPCORD\(^{39}\) project, etc.

5.1.2 Description of the approach followed

The various types of guidelines that were studied are the following:
- National guidelines, already existing
- International guidelines or standards (CEN\(^{40}\), ISO\(^{41}\)), already existing
- International guidelines, planned

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\(^{36}\) Authors: E. Gelová, J. Weinberger and J. Vašek.

\(^{37}\) IN-SAFETY is the abbreviation for ‘INfrastructure and SAFETY’

\(^{38}\) ADVISORS is the abbreviation for ‘Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety’.

\(^{39}\) RIPCORD is the abbreviation for ‘Road Infrastructure safety Protection CORe research and Development’.

\(^{40}\) CEN is the abbreviation for ‘Comité Européen de Normalisation’ (European Committee for Standardization).

\(^{41}\) ISO is the abbreviation for ‘International Standards Organization’
Projects outputs – best practices, recommendations, guidelines
Guidelines used in the industry (car manufacturers, system manufacturers)

The possible phases in which these guidelines may be used for defining technical specifications are the following:
- Project/design,
- Technical specifications for implementation or
- Operation rules.

Three main organizational levels on which these guidelines may be implemented can be distinguished, namely:

- **General level**:
  - Political decisions
  - Organizational handbooks or guidelines
  - Commonly used agreements

- **Middle level**:
  - Technical standards already used - like VMS (variable message signs) technical specifications
  - Legal requirements and binding directives

- **Specific level**:
  - Guidelines regarding specific systems and communication
  - Guidelines based on scenarios from IN-SAFETY and other projects
  - Guidelines based on pilots from IN-SAFETY and other projects
  - Methodologies for assessment/evaluation of measures/systems

Each of the guidelines were investigated from various points of view, whereby in each case specific aspects of these guidelines were focused at, namely:

- **Technical aspects**
  - Definitions of functional, environmental and regulatory requirements have been used. These include, for example, the systems’ primary and secondary functions, system constraints, acceptable and unacceptable performance, etc.

- **Behavioural aspects**
  - Human sense addressed
  - Influencing driver’s mental capacity
  - Decreasing drivers workload
  - Changing driver’s driving skill and experience
  - Increasing knowledge
  - Information comprehension (incl. comprehension of traffic signs/roadside/other traffic information, prevention of information misunderstanding)
  - Optimization of system design (resulting in e.g. decreased driver’s workload, prevention of driver’s distraction, increase of driver’s control over situation)
  - Drivers comprehension of in-vehicle information systems (IVIS) / advanced driver assistance systems (ADAS) functionality and limitations
  - Driver’s attitude to IVIS/ADAS and its acceptance
  - Increasing users compliance to an information provided by a system
  - Increasing drivers comfort
  - Informational transfer
  - Facilitation of decision-making process of drivers/decision-makers/authorities
  - Increasing road safety and efficiency of traffic flow
Timing and intelligence of the IVIS/ADAS activity
Monitoring/Influencing of investment efficiency
None/standardization-optimization instructions
At the individual driver’s level, ADAS use can lead to different types of behavioural changes (problems in risk analysis mainly). These changes can be divided into:
- Perceptive changes (seeing, hearing, feeling)
- Cognitive changes (comprehending, interpreting, prioritizing, selecting, deciding)
- Performance changes (driving, system handling, error, behavioural adaptation)
- Driver state changes (attentiveness/awareness, workload, stress, drowsiness)
- Attitudinal changes (acceptance, rejection, overtrust, mistrust)

• Legal aspects, focused on various types of liability, namely:
  - Driver’s liability
  - Vehicle owner’s liability
  - ADAS manufacturer liability
  - Car manufacturer liability
  - Traffic Authorities’ liability
  - Local Authorities
  - Etc.

• Organizational aspects, which include all the measures related to the functioning of organizations/institutions/manufacturers etc. Issues involved here may be related to e.g.:
  - Properly adapted national manuals
  - Set proper implementation priorities
  - Changes in skills/knowledge workers/operators/drivers

5.1.3 Conclusions regarding the study of guidelines

In Table 22 a synthetic statistical overview of all the guidelines defined in this deliverable is given. The complete list of these guidelines can be found in Appendix 4A and the concluding matrix in Appendix 3A.
Table 22: Statistical overview of the guidelines survey results

<table>
<thead>
<tr>
<th>Guideline target field</th>
<th>Number of guidelines</th>
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<tbody>
<tr>
<td>• Intelligent Transport Systems Generally</td>
<td>2</td>
</tr>
<tr>
<td>➢ Policy Approach</td>
<td>1</td>
</tr>
<tr>
<td>➢ Technical Approach</td>
<td>1</td>
</tr>
<tr>
<td>• Infrastructure</td>
<td>29</td>
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<td>➢ Guidelines for Variable Message Signs</td>
<td>10</td>
</tr>
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<td>➢ Traffic management systems</td>
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<tr>
<td>➢ Roadside information</td>
<td>7</td>
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<tr>
<td>• Autonomous</td>
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<td>➢ Pre-trip information</td>
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<tr>
<td>• Human Machine Interface (HMI)</td>
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<td>• Cooperative</td>
<td>7</td>
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<tr>
<td>• Other</td>
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Source: designed by the authors

5.2 Identification of research priorities

5.2.1 Introduction: description of the approach

On the basis of missing or weakly developed issues within the questionnaire survey, a set of further research priorities has been identified. These research needs are described here in the next section of this deliverable (section 5.2.2). That section describes current needs for future activities in general; this means not only research needs identified by partners in the IN-SAFETY consortium, but also needs identified by other experts. The needs for further activities are built on the experience of these experts, arisen from the IN-SAFETY project as well as other projects.

5.2.2 Conclusions regarding research needs

On the basis of the various topics defined as needs by the experts in the survey, a synthetic table (Table 23) containing a statistical overview of these needs has been prepared. More detailed information about these various types of needs can be found in Appendix 4B (complete list) and Appendix 3B (concluding matrix) to this deliverable.
Table 23: Statistic overview of the survey results on research needs

<table>
<thead>
<tr>
<th>Guideline target field</th>
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<td>Research needs</td>
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<td>- VMS needs</td>
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<td>- IVIS/ADAS needs</td>
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<td>- Users needs</td>
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<td>- Organizational needs</td>
<td>6</td>
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<td>- Legislation needs</td>
<td>3</td>
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</table>

Source: designed by the authors

Based on the recommendations regarding the research needs and other activities needed, the following priorities have been defined:

- **Research needs**: Guidelines for cooperative systems are very poorly developed, compared to the guidelines regarding the other systems. This whole area should be more developed in the future. A possible reason for this could be that the cooperative systems are among the most expensive and complicated systems, both from a technical and an organisational point of view. Also some more methodologies are needed for various ways of assessment.

- **Research needs**: Evaluation and assessment methods like benefits analyses, and other exact indicators/measurements are to be set up and commonly used. Also various VMS needs and categories of traffic participants/drivers needs should be investigated.

- **Standardisation needs**: Directive or standardisation activities should be continued or should be started in this area, in order to overbridge the particular commercial interests of various manufacturers and operators. National practices in signing and using various languages should become more uniform. In order to avoid uneffective solutions, methods against parallel using of various system or isolated company solutions must be set up. Of course, compatibility/interoperability of the various systems is considered to be of the highest importance according to the users point of view. Standardisation needs are indeed another specific topic of WP5 in the IN-SAFETY project.

- **Education needs**: Training tools in the form of guidelines are the other important group. The most important users of such guidelines were identified as:
  - Specific systems operators
  - Integrated systems (like Traffic Management and Information Centres [TMIC], etc.) operators
  - Drivers (various categories)

There are already several manuals for strategy designers and decision makers in the administration.

- **Organisational needs**: A unified way of reporting accidents would be very helpful to obtain accident data that are comparable, esp. for statistics regarding IVIS and ADAS. Cooperation with insurance companies should be stronger with the aim of better motivating car owners to use ADAS. The use of the latter should be encouraged e.g. in the form of bonus as a part of the insurance fee.
- **Legislation needs**: Rules for the supervision of systems/drivers, respecting at the same time the privacy rights of the users/drivers, would be welcome. Regulation and directives would be useful in some harmonisation aims.

The recommendations given above address several stakeholders with a huge interest in decreasing the number of road accidents and fatalities, such as e.g.:

- EU research funding bodies regarding the further research needs.
- National research funding bodies regarding the further research needs.
- EU standardisation body (CEN) regarding the standardisation needs identified.
- Worldwide standardisation body (ISO) regarding the standardisation needs (in cooperation with CEN) identified.
- EU legislation bodies regarding the legislation changes needed.
- National legislation bodies regarding the legislation changes (in cooperation with EU) needed.
- European cooperation with the national education regarding support of various training tools.
- European policy decision makers regarding the organisational and legislation support needed.
- Infrastructure owners and road operators have been identified as important stakeholders regarding the possible cooperation in research, standardisation, education and organisational changes.
- Insurance companies regarding the possible cooperation in research, education, legislation and organisational changes.

All of the above described actors can contribute to the increase of road safety together with other road infrastructure users, mainly drivers, all over Europe. Every type of a small damage avoided can greatly contribute to safety because of its multiple averting, and so reached multiple benefits.
6. GENERAL CONCLUSIONS

In this deliverable, a multi-actor multi-criteria analysis (MAMCA) was performed for the strategic evaluation of a number of innovative systems (called ‘scenarios’) contributing to the creation of a more forgiving road (FOR) and self-explaining road (SER) environment. In addition, this deliverable also reports the development of a set of guidelines aimed at making the road environment more forgiving and more self-explaining. It also identifies some further research priorities.

The MAMCA is a policy instrument which allows various stakeholders with an interest in improving the present state of FOR and SER environments to understand which types of future states command the highest expected ‘value added’ for the community of stakeholders in its entirety. Here, for each scenario, information is uncovered on the probability of successful implementation and its contribution to the improvement of road safety. In this MAMCA, three main actor actors or strategic stakeholders were identified, namely (1) society/public policy makers, (2) users and (3) manufacturers, who each have their own specific set of criteria viewed relevant to assess scenarios. The societal point of view represents the general interest, and should be taken as a starting base for policy purposes. The two other points view, namely those of the users (demand side) and manufacturers (supply side), are also important from an implementation perspective. Successful implementation of scenarios by public policy makers is indeed only possible if the decisions made or the options chosen by these public policy makers are consonant, at least to some extent, with the interests of the other stakeholders. If this is the case, then the public policy objective will be facilitated by the actions taken by the other stakeholders and it will be easier for public policy makers to have their policies implemented. In the case of conflicting interests, achieving the public policy objective may be hindered by the other stakeholders, unless specific government incentives are created, which themselves require resource investments.

As far as prioritisation of systems is concerned, the approach followed in this contribution consists of two main phases. First, a preliminary prioritisation of a large number of alternative systems was performed as part of work packages 1 (WP1) and 2 WP2. For the purpose of this preliminary prioritisation, a total of 18 types of hypothetical or potential systems (called ‘alternatives’) were generated by combining the six most important causes of driver errors identified in accident statistics with three dimensions along which systems can be developed (namely the vehicle, the infrastructure and the interface between both). Then, a set of criteria was established as the result of interactive workshops attended by a substantial number of policy makers and representatives from users and manufacturers. The preliminary scoring was performed by experts from the consortium partners, based on the analytic hierarchy process of T. Saaty.

Based on the findings of this preliminary prioritisation, a limited set of six specific scenarios was selected for final prioritisation in the second phase (as part of WP5), namely: (1) In-car variable message signs, dynamic speed limit on motorways, (2) in-car school bus ahead warning, (3) in-car curve speed warning on rural roads, (4) in-car lane departure warning on motorways, (5) overtaking assistant ‘blind spot detection’ (more than one lane per direction) and (6) overtaking assistant ‘oncoming vehicle detection’ (one lane per direction). These scenarios were subject to pilot studies, which took place in WP4. The final prioritisation of these was again based on a MAMCA, which was structured according to the same stakeholders and the same set of criteria as in the preliminary prioritisation.

The most striking conclusion from the final prioritisation of the afore-mentioned six scenarios is that there is a high discrepancy among stakeholder priorities as regards scenario no. 6.

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(overtaking assistant with oncoming vehicle detection). This scenario is ranked at the top by users and society, but at the bottom by manufacturers. Manufacturers consider the risks associated with this scenario as too high, in particular the liability risk, but also the investment risk and the risk associated with technical (non-)feasibility. In other words, users and society exhibit a strong preference for this scenario, but manufacturers do not. Although this scenario has market potential in terms of demand, it is unlikely to be supplied in the near future. Further research is therefore needed to make this application more reliable and to reduce the risks associated with it.

Another scenario for which the conclusion from comparing stakeholder priorities is similar to that of the overtaking assistant with oncoming vehicle detection is scenario no. 3 (Safe curve speed warning). It is ranked second from society’s point of view and third from the users’ point of view, but second last from the manufacturers’ point of view. Again, manufacturers consider the risk associated with this scenario as too high. This scenario also has quite some market potential, but it is unlikely to hit the market either in the near future. Here again, further research may be needed to make this application more reliable and to reduce the risk associated with it.

A scenario receiving a good overall priority from the various stakeholders is scenario no. 1 (VMS info into vehicle). This scenario receives a good score from the users’ and manufacturers’ point of view (and a relatively good one from society’s point of view). This scenario will, therefore, more easily be implemented in the market by market forces, without the need for substantial government intervention.

Scenario no. 5 (blind spot vehicle detection) and no. 4 (lane departure warning) do not receive too bad a score from society’s point of view. Although they are ranked fourth and fifth, the difference with the scenarios ranked just ahead is indeed rather small. However, these scenarios are not very much preferred by users, nor by manufacturers.

Scenario no. 2 (school bus ahead warning) is ranked last from the society’s point of view and in fourth position from the users’ point of view. Although children are the most vulnerable road users in society, accidents with children running out of a school bus only represent a small portion of the total number of accidents. School buses usually already have a high visibility in the road environment. Manufacturers, however, consider this scenario as being low risk, whether from a reliability, technical feasibility or investment risk perspective.

The results of this deliverable are based on a MAMCA and should, therefore, be differentiated from those obtained through a social cost-benefit analysis (SCBA). In the SCBA, which was performed in activity 5.2 (A5.2) and reported in deliverable 5.2 (D5.2) (Erke et al. 2007), only safety effects associated with the scenarios were taken into account and compared with the cost of implementing these scenarios. The SCBA allowed judging the fundamental desirability of government investment to support these scenarios. One should, however, note that the outcome of the SCBA performed under A5.1 largely depends on (production) cost considerations. Costs represent a parameter that may change substantially over time. In general terms, the production costs of new, innovative systems tend to decrease with time, as market penetration increases, due to economies of scale in production. In contrast, the aim of the MAMCA applied here is much broader. The MAMCA makes it possible to assess the expected contribution of the various systems to a much larger number of objectives, including, inter alia, driver comfort, travel time duration, network efficiency, environmental effects, liability risk, etc. These objectives/criteria were clustered around three groups of stakeholders (users, society and manufacturers). As a result, the MAMCA allows identifying the scenarios preferred over other ones by each stakeholder. Such scenarios are likely more easily introduced in the market, vis-à-vis those that need government action in the form of incentives to stimulate demand (i.e. the users) and/or supply (i.e. the manufacturers).

The relative priorities derived through the use of MAMCA express the degree to which the various scenarios are expected to contribute to the stakeholders’ objectives. For a number of
criteria, however, hard data regarding the scenarios performance was rather scarce or non-existing. Relying on expert judgment was, therefore, necessary. This means that experts had to express their opinions regarding the expected contribution of the scenarios to a number of criteria and these experts' opinions were then synthesized into the final relative priorities. By confronting the various expert judgments subjectivity in the decision-making process was eliminated or made objective. The final synthesis, i.e. the result in terms of final relative priorities, express a consensus of the various experts’ opinions (just like in Delphi-poll techniques) and may be used as a basis to identify further research needs, even when hard data are rather scarce.

As regards the formulation of guidelines aimed at making the road environment more forgiving and more self-explaining, a comprehensive overview of existing, planned and missing guidelines was compiled. The complete overview of these guidelines is listed in Appendix 4A and in the concluding matrix in Appendix 3A. A synthesis of this overview was given in chapter 5 of this deliverable. Based on these overviews, a number of further research priorities were identified. These are listed in Appendix 4B (complete list) and Appendix 3B (concluding matrix). A synthesis of these priorities was also given in chapter 5 of this deliverable. These research priorities were clustered into four main categories. These include: (1) research needs (e.g. in the realm of cooperative systems for which guidelines are not yet well developed, as well as evaluation and assessment methods for the analysis of benefits and other reliable indicators/measurements); (2) standardisation needs, to satisfy the long-term commercial interests of manufacturers and operators, as well as to make national practices in signing more uniform; (3) education needs in the form of guidelines for (integrated) system operators and drivers, (4) organisational needs (e.g. regarding the reporting of accidents so as to make accident data more easily comparable among countries); and (5) legislation needs so as to allow the supervision of systems and drivers, while at the same time respecting privacy laws.

The recommendations involve a variety of stakeholders with an interest in decreasing the number of road accidents and fatalities, such as, e.g.: research funding bodies, standardisation bodies, legislation bodies, policy making bodies, infrastructure owners and road operators, insurance companies, etc.
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IN-SAFETY_WP4_D4.2_Certh_HIT_Pilot paragraph 2.3.1-VMS info into vehicle – GPS with GPRS architecture
TRAVEL-GUIDE D5: T5.5
TRAVEL-GUIDE WP1
TRAVEL-GUIDE Thessaloniki pilot
TROPIC project, Thessaloniki pilot
AWAKE (D9.1)
COST 352 Final report

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APPENDIX 1: LIST OF PARTICIPANTS WORKSHOP AMSTERDAM, 6 APRIL 2006, INTERTRAFFIC CONFERENCE, RAI CONGRESS CENTER

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<tr>
<th>Name</th>
<th>Position</th>
<th>Affiliation</th>
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<tbody>
<tr>
<td>Anund Anna</td>
<td>Researcher</td>
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<tr>
<td>Atsali Aggelili</td>
<td>Civil engineer, task leader road</td>
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<td>Coordinator intelligent vehicles</td>
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<td>ACI – Automobile Club d’Italia</td>
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43 Authors: K. De Brucker, C. Macharis and A. Verbeke.
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<td>Höfs Wolfgang</td>
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<td>Moreira Paulo</td>
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<td>Nawrat Fabienne</td>
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<td>Nussbaumer Cornelia</td>
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<td>Nygårdhs Sara</td>
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<td>Orosz Csaba</td>
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<td>BME, Dpt of Highway and Railway Engineering</td>
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<tr>
<td>Papadimitriou Aristofanis</td>
<td>Head of traffic operations</td>
<td>Attikes Diadromes</td>
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<td>West Sussex County Council</td>
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<td>Prof. Dr. Fachhochschule</td>
<td>Fakultät 03 Informations- &amp; Kommunikationswissenschaften</td>
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<td>Sermpis Dimitris</td>
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<td>Simlinger Peter</td>
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Source: the authors
APPENDIX 2 : EXAMPLE OF THE RESULTS OF THE GDR SESSION FOR THE PAIRWISE COMPARISON OF THE CRITERIA ‘DRIVER SAFETY’ VERSUS ‘TRAVEL TIME DURATION’ (STAKEHOLDER : USERS)\(^{44}\)

**Question n°1 : Is ‘driver safety’ more important to you than ‘travel time duration’ ?**

<table>
<thead>
<tr>
<th>Item</th>
<th>freq</th>
<th>Perc.</th>
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<tr>
<td>Dri Saf &gt; TTD</td>
<td>8</td>
<td>88.9%</td>
</tr>
<tr>
<td>TTD &gt;= Dri Saf</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>9</strong></td>
<td><strong>100%</strong></td>
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</table>

Source : the authors

**Question n°2 : To what extent do you consider ‘driver safety’ more important than ‘travel time duration’ ?**

<table>
<thead>
<tr>
<th>Dri Saf &gt; TTD</th>
<th>freq</th>
<th>score</th>
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</thead>
<tbody>
<tr>
<td>(1) Equal</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(2) Equal to Moderate</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>(3) Moderate</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>(4) Moderate to Strong</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>(5) Strong</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>(6) Strong to Very Strong</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>(7) Very Strong</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>(8) Very Strong to Extreme</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>(9) Extreme</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td><strong>sum</strong></td>
<td><strong>8</strong></td>
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</table>

Source : the authors

**Question n°3 : To what extent do you consider ‘travel time duration’ more important than ‘driver safety’ ?**

<table>
<thead>
<tr>
<th>TTD &gt; Dri Saf</th>
<th>freq</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Equal</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(2) Equal to Moderate</td>
<td>0</td>
<td>1/2</td>
</tr>
<tr>
<td>(3) Moderate</td>
<td>0</td>
<td>1/3</td>
</tr>
<tr>
<td>(4) Moderate to Strong</td>
<td>1</td>
<td>1/4</td>
</tr>
<tr>
<td>(5) Strong</td>
<td>0</td>
<td>1/5</td>
</tr>
<tr>
<td>(6) Strong to Very Strong</td>
<td>0</td>
<td>1/6</td>
</tr>
<tr>
<td>(7) Very Strong</td>
<td>0</td>
<td>1/7</td>
</tr>
<tr>
<td>(8) Very Strong to Extreme</td>
<td>0</td>
<td>1/8</td>
</tr>
<tr>
<td>(9) Extreme</td>
<td>0</td>
<td>1/9</td>
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<tr>
<td><strong>sum</strong></td>
<td><strong>1</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source : the authors

*Geometric mean score Driver Safety > Travel Time Duration : 4.2*

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\(^{44}\) Authors : K. De Brucker, C. Macharis and A. Verbeke, with the help of L. Walta.
## APPENDIX 3A : CONCLUDING MATRIX REGARDING GUIDELINES

<table>
<thead>
<tr>
<th>Guideline categorization</th>
<th>Guideline name</th>
<th>See No.</th>
<th>Technical description</th>
<th>Behavioural</th>
<th>Organizational Policy/Target group(s)</th>
<th>Legal</th>
<th>Level of application</th>
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<tr>
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<td>Intelligent Transport Systems Generally</td>
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<tr>
<td></td>
<td>Strategic Framework for Intelligent Transport Systems (ITS) Standards</td>
<td></td>
<td>ITS standards development on the international level</td>
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<td>Instructions for system manufacturers</td>
<td>Manufacturers</td>
<td>Existing International Europe</td>
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<td>Technical Approach</td>
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<td></td>
<td></td>
<td>Governmental liability</td>
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<tr>
<td></td>
<td>CEN procedures and CEN/TC 278</td>
<td>4A23</td>
<td>Standardization procedures</td>
<td>None</td>
<td>Instructions for manufacturers/traffic authorities</td>
<td>Manufacturers liability</td>
<td>Existing International Europe</td>
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<td></td>
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<td>Traffic authorities liability</td>
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<tr>
<td></td>
<td>Guidelines for Variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Governmental liability</td>
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45 Authors: E. Gelová, J. Weinberger and J. Vašek.
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<th>Legal</th>
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<tr>
<td>Message Signs</td>
<td>(German) Guidelines for Variable Message Signs (B 6738)</td>
<td>4A1</td>
<td>Implementation technical guidelines for VMS</td>
<td>Information transfer and comprehension</td>
<td>Properly adapted national manual</td>
<td>Traffic authorities liability</td>
<td>Existing National Germany</td>
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<td>(German) Guidelines for Variable Message Sign Systems (B 6740)</td>
<td>4A2</td>
<td>Technical details for VMS</td>
<td>Information transfer and comprehension</td>
<td>Properly adapted national manual</td>
<td>Traffic authorities liability</td>
<td>Existing National Germany</td>
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<tr>
<td></td>
<td>(Czech) Principles for Variable Systems of Road Signs and Equipment for Variable Operating Information on the Roads</td>
<td>4A17</td>
<td>Technical specifications for VMS application, placement</td>
<td>Information transfer and comprehension</td>
<td>Properly adapted national instructions</td>
<td>Traffic authorities liability</td>
<td>Existing National Czech</td>
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<tr>
<td></td>
<td>CEN Standards for vertical road traffic signs incl. VMS</td>
<td>4A20</td>
<td>Technical standards for traffic signs and VMS</td>
<td>Information comprehension</td>
<td>Properly adapted national instructions</td>
<td>Traffic authorities liability</td>
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<td></td>
<td>Standardised Information Provided by Variable Message Signs</td>
<td>4A61</td>
<td>Harmonization of icons used for the same messages across Europe</td>
<td>Increasing drivers comprehension of traffic signs across Europe</td>
<td>Information providers Designers</td>
<td>Road operators liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td>Guideline categorization</td>
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<tr>
<td>Evaluation of Full Colour Information Panels (FCIPs)</td>
<td>4A62</td>
<td>Identification of the optimal comprehensibility of screen layout and content of a &quot;Next-generation VMS&quot; - the Full Colour Information Panels (FCIP)</td>
<td>Increasing drivers comprehension of traffic signs</td>
<td>Road authorities Information providers Traffic participants</td>
<td>Road operators liability Road authorities liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td>VMS: Information presentation: Use of two VMS at the same time when traffic and parking info is displayed</td>
<td>4A67</td>
<td>Presenting two information on VMS one dedicated to the present traffic and one to the parking availability</td>
<td>Increasing drivers comfort and information comprehension</td>
<td>Information providers Road operators</td>
<td>Road operators liability Road authorities liability</td>
<td>IN-SAFETY project verified</td>
<td></td>
</tr>
<tr>
<td>VMS: Information presentation: Appropriate roadside system location</td>
<td>4A68</td>
<td>Presenting information on VMS at appropriate location, distance esp. before places where drivers chooses one from various alternatives</td>
<td>Optimization of information system</td>
<td>Information providers Road operators</td>
<td>Road operators liability Road authorities liability</td>
<td>National Greece</td>
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<tr>
<td>VMS: Information timing: Road side systems time interval/information density</td>
<td>4A69</td>
<td>Road side systems must change their screens approximately every 5 seconds respecting the urban speed limit of 50 km/h.</td>
<td>Optimization of information system</td>
<td>Information Providers Road operators</td>
<td>Road operators liability Road authorities liability</td>
<td>National Greece</td>
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<td>VMS: Information presentation: languages, text position and use of pictogram(s)</td>
<td>4A70</td>
<td>If applicable, a good and tested VMS screen template uses left side for local language text, middle for appropriate pictogram, right side for English text version</td>
<td>Information comprehension</td>
<td>Information Providers</td>
<td>Road operators liability</td>
<td>Findings of the TRAVEL-GUIDE IN-SAFETY Thessalonica pilot verified</td>
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<td>Traffic management systems</td>
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<td>Technical Specification for Roadside Stations</td>
<td>4A3</td>
<td>Communication channels/data acquisition to standardize functions and interfaces used in traffic management systems</td>
<td>Increasing knowledge</td>
<td>Properly adapted national instructions</td>
<td>Traffic authorities liability</td>
<td>Existing National Germany</td>
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<tr>
<td>Instructions for the Equipment of Traffic Control Centres and Sub-centres</td>
<td>4A4</td>
<td>Communication channels/data acquisition to standardize functions and interfaces used in traffic control centres</td>
<td>Human sense addressed Increasing knowledge</td>
<td>Properly adapted national instructions</td>
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<td>General administrative regulation of road traffic regulations</td>
<td>4A25</td>
<td>Advices on how to deal with the road traffic regulations</td>
<td>Properly adapted national instructions</td>
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<td>Regular inspection of traffic management systems (TMS)</td>
<td>4A59</td>
<td>TMS should be inspected at least 10 to 25 times a year (ideally permanently) in order to guarantee highly reliable and effective data for efficient traffic management strategies</td>
<td>None</td>
<td>Instructions for traffic management systems operators</td>
<td>Road operators liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td>Accident frequency in the area of Traffic Control Devices with a specific consideration of traffic volume</td>
<td>4A27</td>
<td>Procedures for quantification of safety benefits when using TCD</td>
<td>None</td>
<td>Procedures for traffic management systems operators</td>
<td>Road operators liability</td>
<td>Findings of the German project: Forschungsprojekt FE 03.278 G93F der Bundesanstalt für Straßenwesen</td>
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<td>Guidelines for road design; Part: alignment</td>
<td>4A24</td>
<td>Instructions/standards for design of roads and roads extensions in urban and rural areas</td>
<td>None/standardization-optimization instructions Human sense addressed</td>
<td>Properly adapted national instructions</td>
<td>Traffic authorities liability</td>
<td>Instructions for road authorities</td>
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<td>4A26</td>
<td>Summary of best practices for reducing traffic accidents</td>
<td>Facilitation of decision-making process Increasing knowledge</td>
<td>Instructions for road authorities</td>
<td>Traffic authorities liability</td>
<td>Findings of the SUPREME project</td>
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<td>RANKing for European Roads Safety</td>
<td>4A28</td>
<td>Guidelines for facilitating decision making process of traffic authorities dealing with dangerous road sections</td>
<td>Facilitation of decision making process Increasing knowledge</td>
<td>Instructions for road authorities</td>
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</table>
| Road Infrastructure Safety Management | 4A19 | Safety Handbook for Secondary Roads (rural roads) | Decreasing drivers workload  Increasing drivers comfort | Traffic authorities  Road designers | Road authorities liability | Planned  
To be verified in the RIPCORD project |
| Road Infrastructure Safety Management (ISM) Directive | 4A32 | The directive establishes procedures relating to road safety impact assessments, road safety audits and safety inspections | Increasing knowledge with harmonized legislation | Set of proper implementation priorities for Authorities  Strategy designers  Decision makers | Traffic Authorities liability | Existing  
European Union |
| Guidelines for developing and implementing a safety management system (SMS) for road controlling authorities (RCA) | 4A33 | SMS: construction, maintenance, management and operation of road network | Increasing knowledge; Facilitation of decision-making | Urban authorities  Strategy designers  Decision makers | Advice level  
Local road authorities liability | Existing  
European Union  
Local level |
| Urban Safety Management Guidelines (USM) | 4A34 | USM: strategy integrating safety with other urban strategies | Increasing road safety and efficiency of traffic flow | Urban authorities  Strategy designers  Decision makers | Advice level  
Local road authorities liability | Existing  
National level |
| **Roadside information** | | | | | | |
| Graphical Interface features | 4A41 | Description of graphical interface features used in traffic (letters, contrast, luminance balance, polarity, colour etc.) | Optimization of driver’s information comprehension | System developers | Traffic authorities liability | Existing  
International |
<table>
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<th>Guideline categorization</th>
<th>See No.</th>
<th>Technical description</th>
<th>Behavioural</th>
<th>Organizational Policy/Target group(s)</th>
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<td>Europeanism for making understandability of traffic signs/messages easy</td>
<td>4A21</td>
<td>Facilitating of comprehension of traffic signs/messages</td>
<td>Human sense addressed Traffic signs/messages comprehension</td>
<td>Instructions for road authorities</td>
<td>Traffic authorities liability Governmental authorities liability</td>
<td>Existing and new in IN SAFETY project verified</td>
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<td></td>
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<tr>
<td>Language Independent Information: Graphical Design of Traffic Signs</td>
<td>4A63</td>
<td>Implementation of new traffic pictographic information should not use a modification of well-known traffic signs</td>
<td>Prevention of driver’s misunderstanding of traffic signs; Information comprehension</td>
<td>Guidance for road authorities</td>
<td>Road operators liability Road authorities liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td></td>
</tr>
<tr>
<td>Graphical Information Design of New Features</td>
<td>4A64</td>
<td>To convey information related to new functionalities, a balance has to be found between unambiguous understanding of the meaning (new) and the use of familiar elements (recognition)</td>
<td>Avoidance of misunderstanding</td>
<td>Guidance for road authorities</td>
<td>Road operators liability Road authorities liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td>Information Content: Roadside Traffic Information Systems</td>
<td>4A65</td>
<td>Due to physical and safety restraints the amount of information given should be limited</td>
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<td>On-trip Information providers System designers</td>
<td>System manufacturers liability</td>
<td>Existing GIDS system Findings of the TRAVEL-GUIDE project</td>
</tr>
<tr>
<td>Drivers/systems control of message timing</td>
<td>4A47</td>
<td>Transfer the control of message timing from the system to the user</td>
<td>Informational transfer Decreasing additional workload</td>
<td>On-trip information providers System designers</td>
<td>System manufacturers liability</td>
<td>IN-SAFETY project verified</td>
</tr>
<tr>
<td>Extend ‘yellow page’ services</td>
<td>4A49</td>
<td>On-trip in-vehicle services and information optimization/extension</td>
<td>Increasing drivers comfort Influencing driver’s mental capacity</td>
<td>On-trip information providers System developers</td>
<td>System manufacturers liability</td>
<td>IN-SAFETY project verified</td>
</tr>
<tr>
<td>Effective combination of various routing types in navigation systems</td>
<td>4A50</td>
<td>Dynamic route guidance based on TMC in connection with other user-defined routing preferences</td>
<td>Increasing drivers comfort Informational transfer</td>
<td>On-trip Information providers System developers</td>
<td>System manufacturers liability</td>
<td>IN-SAFETY project verified Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td>Guideline categorization</td>
<td>See No.</td>
<td>Technical description</td>
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<td>Organizational Policy/Target group(s)</td>
<td>Legal</td>
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<tr>
<td>Timing of queue warning messages</td>
<td>4A84</td>
<td>Providing drivers with relevant and timely information in order to increase efficiency of the traffic related message</td>
<td>Increasing drivers comfort</td>
<td>System developers</td>
<td>System manufacturers liability</td>
<td>IN-SAFETY project verified</td>
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<tr>
<td>Provision of complete information for services</td>
<td>4A85</td>
<td>Providing drivers with all relevant information about a specific transport network at the same source</td>
<td>Increasing drivers comfort</td>
<td>Information providers</td>
<td>Information providers liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td>Provision of information with the emphasis on safety restraints</td>
<td>4A55</td>
<td>Providing driver with a personalized information on an optimal channel and at optimal time</td>
<td>Decreasing drivers workload Increasing drivers comfort and safety</td>
<td>Information providers</td>
<td>Information providers liability System manufacturers liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td>SMS: Speed and simplification of use</td>
<td>4A56</td>
<td>Traffic related information provision through SMS containing all the most needed information</td>
<td>Increasing drivers comfort and information</td>
<td>Information Providers</td>
<td>Information providers liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td>Guideline categorization</td>
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<tr>
<td>Radio detailed announcements after a well known and understandable sound / music</td>
<td>4A57</td>
<td>Radio station with many announcements during the day, with a special sound and/or music as an introduction; slow and clear speaking is required</td>
<td>Increasing drivers comfort and information</td>
<td>Information Providers</td>
<td>Information providers liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td>RDS: suggestions and use optimisation</td>
<td>4A58</td>
<td>Providing drivers with information through RDS as an additional (minor) informational channel</td>
<td>Informational transfer</td>
<td>Information Providers</td>
<td>Information providers liability System manufacturers liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<td>Advice to travellers on confirmed events</td>
<td>4A74</td>
<td>Journey related information provided to drivers automatically or on request; automatically generated message has to be confirmed by an operator</td>
<td>Increasing drivers comfort and information</td>
<td>Information providers Road operators</td>
<td>Information providers liability Road operators liability</td>
<td>National</td>
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<td>Expression of the entity of traffic anomalies</td>
<td>4A75</td>
<td>Providing information to drivers with defining indexes based on observed average speed, that help to express the traffic conditions</td>
<td>Increasing drivers comfort and information esp. for foreigners</td>
<td>Information providers Road operators</td>
<td>Information providers liability Road operators liability</td>
<td>National</td>
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<td>Advanced Driver Assistance</td>
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<td>Systems (ADAS)</td>
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<td>Code of practice for ADAS design</td>
<td>4A7</td>
<td>Detailed procedures for optimization of system design specifications and ADAS verification</td>
<td>None/standardization-optimization instructions</td>
<td>Instructions for system manufacturers</td>
<td>IVIS/ADAS manufacturers liability</td>
<td>Existing Optional</td>
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<tr>
<td>Legal rules according to the 6 systems (and other ADAS)</td>
<td>4A10</td>
<td>Measures for systems to meet national regulations</td>
<td>None/standardization-optimization instructions</td>
<td>Instructions for system manufacturers</td>
<td>Manufacturers liability</td>
<td>Existing Legislation approach</td>
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<tr>
<td>Advanced lane departure warning assistant</td>
<td>4A5</td>
<td>ADAS warning and helping the driver when deviating from the intended trajectory</td>
<td>Timing and intelligence of the ADAS activity; Informational transfer; Increasing of road safety</td>
<td>Changes in skills of drivers</td>
<td>ADAS manufacturer liability</td>
<td>IN-SAFETY project verified (scenario)</td>
</tr>
<tr>
<td>Overtaking assistant for rural roads</td>
<td>4A11</td>
<td>Overtaking assistance warning the driver of other vehicle approaching</td>
<td>Drivers comprehension of ADAS functionality and limitations Timing and intelligence of the ADAS activity</td>
<td>Changes of drivers skills</td>
<td>ADAS manufacturer liability</td>
<td>Findings of the ADVISORS project (scenario)</td>
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<tr>
<td>Blind spot detector</td>
<td>4A6</td>
<td>System provides warning of presence of other road users when changing lanes</td>
<td>Drivers comprehension of system functionality and limitations Timing and intelligence of the ADAS activity</td>
<td>Changes of drivers skills</td>
<td>IVIS manufacturer liability Drivers liability</td>
<td>IN-SAFETY project verified</td>
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<tr>
<td>I2V communication (1)</td>
<td>4A30</td>
<td>“School bus ahead” warning</td>
<td>Decrease of approaching vehicle velocity; Increasing knowledge</td>
<td>Support for designers Recommendations for manufacturers</td>
<td>Manufacturer liability Drivers liability</td>
<td>IN-SAFETY Swedish pilot</td>
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<tr>
<td>Guideline categorization</td>
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<tr>
<td>Cooperative</td>
<td>Data exchange between information centres</td>
<td>4A77</td>
<td>Optimal data exchange can improve the effectiveness of management and control of its specific systems</td>
<td>Informational transfer</td>
<td>Researchers, System developers</td>
<td>Information providers liability</td>
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<tr>
<td></td>
<td>Common data exchange protocols and smooth co-operation between the different information providers and operators</td>
<td>4A71</td>
<td>Setting a common way of data exchange between information providers and operators in terms of ease communication and compatibility</td>
<td>Informational transfer</td>
<td>Researchers, Designers, Operators, Information providers</td>
<td>Information providers liability, Road operators liability</td>
</tr>
<tr>
<td></td>
<td>Cooperative Vehicle – Infrastructure (Traffic) Management System (CVIMS)</td>
<td>4A35</td>
<td>A complete integration of all traffic members into an information flow(s) and a cooperative situation</td>
<td>Cooperation C2C, C2I, I2C</td>
<td>End customers: TMC operators, Drivers, Fleet owners, EFC operators</td>
<td>Information providers liability, Road operators liability</td>
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<tr>
<td></td>
<td>I2V communication (2)</td>
<td>4A31</td>
<td>Warning by rumble stripes</td>
<td>Speed, sleepiness, lateral position etc.; Performance and driver state changes; Increasing of road safety</td>
<td>Researchers, Designers, Road operators</td>
<td>Road operators liability, Drivers liability</td>
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<tr>
<td></td>
<td>Speed Limit and VMS into</td>
<td>4A36</td>
<td>Speed warning</td>
<td>Increasing user</td>
<td>Researchers</td>
<td>Road operators</td>
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</table>
| Vehicle information application (GPS + GPRS architecture) | | | Compliance to an information provided by a system | Drivers  
Road operators  
IVIS/ADAS producers | liability | pilot |
| VMS into Vehicle information application (WiFi architecture) | 4A37 | WiFi limitations  
Impacts of speed on the communication reliability | Compliance to an information provided by a system | Researchers  
Drivers  
Road operators  
IVIS/ADAS producers | Road operators liability | IN-SAFETY Greek pilot |
| VMS into Vehicle information application (Bluetooth architecture) | 4A38 | Limitations of Bluetooth  
Compliance to an information provided by a system; Avoidance of Bluetooth communication | Researchers  
Drivers  
Road operators  
IVIS/ADAS producers | Road operators liability | IN-SAFETY Greek pilot |
| Other | | | | | | |
| Interacting of the systems with society and the market | 4A9 | Description of the interaction of various ADAS and society | None/Driver’s attitude to ADAS and its acceptance | Implementation priorities | Manufacturers liability  
Governmental liability | Findings of the ADASE 2 project |
| Support of a Transeuropean traffic | 4A51 | Informational service providing efficient support for drivers travelling on international level | Increasing drivers information and comfort | On-trip Information providers  
System developers | System manufacturers liability  
Road authorities | Findings of the TRAVEL-GUIDE project |
<table>
<thead>
<tr>
<th>Guideline categorization</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Databases including qualitative knowledge about the driver</td>
<td>4A52</td>
<td>Integrate and implement knowledge about drivers’ perceptual and attentional biases in particular situation to guide the drivers’ attention to those road features and traffic elements they are not sufficiently aware of into the intelligent transport systems</td>
<td>Decreasing drivers workload, Increasing drivers comfort and safety</td>
<td>Traffic authorities, Information providers, System designers</td>
<td>System manufacturers liability, Road authorities liability</td>
<td>IN-SAFETY project verified</td>
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<td></td>
<td>Incident prevention has higher priority than incident management</td>
<td>4A60</td>
<td>Incident prevention by traffic forecasts within the traffic management systems</td>
<td>Increasing drivers safety, Increasing drivers comfort</td>
<td>Guidance for road authorities</td>
<td>Road operators liability, Road authorities liability</td>
<td>Findings of the TRAVEL-GUIDE project</td>
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<tr>
<td></td>
<td>Economic Assessment of Safety Benefits</td>
<td>4A29</td>
<td>Methods for economic analysis</td>
<td>Monitoring/influencing of investment efficiency</td>
<td>Assessment of (public) projects</td>
<td>Public authorities liability, Road authorities liability</td>
<td>IN-SAFETY project verified</td>
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<td></td>
<td>Use of national languages</td>
<td>4A76</td>
<td>Provision of the information to drivers in different languages at the same time or also in language independent ways</td>
<td>Human sense addressed, Increasing drivers information and comfort esp. for foreigners</td>
<td>Information providers, Road operators</td>
<td>Information providers liability, Road operators liability</td>
<td>National</td>
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</tbody>
</table>
### APPENDIX 3B : CONCLUDING MATRIX REGARDING RESEARCH NEEDS

<table>
<thead>
<tr>
<th>Guideline categorization</th>
<th>Guideline name</th>
<th>See No.</th>
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<tr>
<td>Research needs</td>
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<tr>
<td>VMS needs</td>
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<tr>
<td>Impacts on visibility of VMS</td>
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<td>4B1</td>
<td>Usage of relevant illumination power</td>
<td>Human sense addressed</td>
<td>Technical guideline</td>
<td>Research liability</td>
<td>Manufacturers liability</td>
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<td>IVIS/ADAS needs</td>
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<tr>
<td>Impacts of IVIS/ADAS</td>
<td></td>
<td>4B2</td>
<td>Exact measuring of systems variations</td>
<td>Human sense addressed</td>
<td>System manufacturers</td>
<td>Manufacturers liability</td>
<td>Research liability</td>
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<tr>
<td>ADAS/IVIS costs definition</td>
<td></td>
<td>4B3</td>
<td>Investigating of specified costs</td>
<td>Exact formulation of costs linked with just one investigated system</td>
<td>Proper manual for costs evaluation</td>
<td>Manufacturers liability</td>
<td>Research liability</td>
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<tr>
<td>Evaluation by cost-benefit analysis</td>
<td></td>
<td>4B4</td>
<td>Acceptable benefits /unacceptable impacts for various actors</td>
<td>Practical impacts of systems instead of theoretical assumptions</td>
<td>Proper manual as a support for strategic decision making</td>
<td>Research liability</td>
<td>Government liability</td>
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<tr>
<td>Guideline categorization</td>
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<td>Users needs</td>
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<tr>
<td>Various categories of systems users (see COST 352)</td>
<td>4B5</td>
<td>Description of needs of various users groups towards IVIS</td>
<td>Novice drivers specific behaviour Elder drivers’ specific behaviour Professional drivers’ specific behaviour</td>
<td>Guidelines for systems design</td>
<td>Research liability</td>
<td>International Europe</td>
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<tr>
<td>Dependence on systems (see COST 352)</td>
<td>4B5</td>
<td>Dependence on system resulting in deterioration of specific drivers skills, inability to react properly on system failure</td>
<td>Changes in driver skills Changes in drivers behaviour Changes in attitudes towards telematic systems</td>
<td>Guidelines preventing dependence on system, preventing deterioration of driver skills</td>
<td>Research liability</td>
<td>International Europe</td>
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<tr>
<td>Misuse of system (see COST 352)</td>
<td>4B5</td>
<td>Misuse of systems is often a neglected issue, which represents a serious threat for road safety</td>
<td>Changes in driver skills Changes in driver behaviour Changes in attitudes towards telematic systems</td>
<td>Guidelines preventing misuse of telematic system endangering road safety</td>
<td>Research liability System manufacturers liability Traffic authorities liability</td>
<td>International Europe</td>
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<tr>
<td>Lane change behaviour in microsimulation models</td>
<td>4B6</td>
<td>Extended relev. models can include parameters relevant to the behaviour of an equipped vehicle</td>
<td>Facilitation of decision-making process of drivers</td>
<td>Drivers with cars having an ADAS</td>
<td>Drivers liability</td>
<td>International Europe</td>
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<td>System for personalized information transmission from VMS into the vehicle</td>
<td>4B7</td>
<td>Informational transfer</td>
<td>Personalized information according to driver needs</td>
<td>Drivers with cars having ADAS for connection VMS and vehicle</td>
<td>Drivers liability</td>
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<td>Standardization needs</td>
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<td>European standardization/(regulation) issues</td>
<td>4B8</td>
<td>ITS standards development on the international level</td>
<td>Standardization activity</td>
<td>Technical standard</td>
<td>Manufacturers liability</td>
<td>International CEN for Europe ISO worldwide</td>
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<td>More Europeanism for traffic signs/messages</td>
<td>4B9</td>
<td>Standards development on the international level</td>
<td>Standardization activity</td>
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<td>Manufacturers liability</td>
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<td>Avoiding of parallel solutions of one problem by more systems</td>
<td>4B11</td>
<td>Standards development on the international level</td>
<td>Standardization activity</td>
<td>Technical standard</td>
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<td>International CEN for Europe</td>
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<tr>
<td>Compatibility/ interoperability of various systems and communication among them</td>
<td>4B12</td>
<td>Standards development on the international level</td>
<td>Standardization activity</td>
<td>Technical standard</td>
<td>Manufacturers liability</td>
<td>International CEN, ISO, IEEE</td>
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<td>Symbols/pictograms</td>
<td>4B15</td>
<td>More items</td>
<td>Information</td>
<td>Technical standard;</td>
<td>Traffic</td>
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<td>Keywords/Europeanisms</td>
<td>4B16</td>
<td>More items</td>
<td>Information comprehension</td>
<td>Technical standard; drivers</td>
<td>Traffic authorities liability</td>
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<td>Content structure</td>
<td>4B17</td>
<td>More items</td>
<td>Information comprehension</td>
<td>Technical standard; drivers</td>
<td>Traffic authorities liability</td>
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<td>Education needs</td>
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<td>Training tools (see Cost 352)</td>
<td>4B5</td>
<td>Business guidelines, manuals and training tools for involved persons</td>
<td>Enhancing familiarity, correctness of usage and reliability of human factor</td>
<td>Specific systems operators Integrated systems (like TMIC etc) operators Drivers (various categ)</td>
<td>Educational institutions liability Driver liability System operator liability</td>
<td>National International Europe</td>
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<td>Unified accident reporting forms for statistical data (see Cost 352)</td>
<td>4B5</td>
<td>Classical and electronic reporting</td>
<td>Authorization, validation and reliability of reached data on incidents/accidents</td>
<td>Directive for harmonization</td>
<td>Research liability Police liability Insurance companies liability</td>
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<td>Cooperation with insurance companies</td>
<td>4B13</td>
<td>Financial incentives for customers</td>
<td>Support by insurance companies for enhancing penetration of ADAS</td>
<td>All actors involved when incidents/accidents and preventing them</td>
<td>Research liability</td>
<td>National International Europe</td>
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</table>

| Aplication of IN-SAFETY pieces of knowledge | 4B14 | Too many dangerous points in urban contest for the In-Safety Application. | Increasing user compliance to an information provide by a system | Set proper implementation priorities | Traffic authorities liability | National International |

<table>
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| Rules for supervision and checking of private users | 4B5 | Intelligent systems and society | Society interests vs. driver/car owner rights (privacy) | Investigative bodies and persons | Vehicle owner liability | National International Europe |

| European (standardization)/regulation issues | 4B8 | Syntax and semantics harmonization of signs Europe-wide | EU of regulation of diverging/conflicting national legislation | Requirements for harmonization | Directives for harmonization | National International Europe |
APPENDIX 4A : QUESTIONNAIRE RESPONSES REGARDING GUIDELINES

### Guideline concerning:
VMS (German)

**Guideline native name:**
B 6738 Richtlinien für Wechselverkehrszeichen (RWVZ), Ausgabe 1997

**Guideline focus – national (country)/international:** national (Germany)

**Guideline name in English translation:** Guidelines for Variable Message Signs

**Guideline reference number:** Document Nr. B 6738 – Vers.05/97

**Valid since (year):** 1997

---

**Completed by:**
Name: Jessica Kleine
Institution: BASt

---

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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</table>

**Type of guideline:**

- [X] Existing
- [] Planned to be implemented
- [] Verified in IN-SAFETY project
- [] Other: .................................................................

---

46 Authors : E. Gelová, J. Weinberger and J. Vašek.
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other:…………………………………………………………………………..

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☒ Motorway
☐ Highway
☐ Other:…………………………………………………………………………..

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:…………………………………………………………………………..

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☐ Other…………………………………………………………………………..

Infrastructure Traffic Management Systems:
☒ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:…………………………………………………………………………..

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other:…………………………………………………………………………..

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:…………………………………………………………………………..

Operators’ training:
☐ Infrastructure operator training
☐ Drivers’ training
☐ Manual for drivers (non-mandatory)
☐ Other:…………………………………………………………………………..

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☐ Other:…………………………………………………………………………..

…………………………………………………………………………..
### Abstract of the guideline:
This guideline describes how signs (according to road traffic regulations (German Straßenverkehrsordnung StVO) are to be shown on variable message signs. VMS can display speed limits or recommendations on route diversion. The guideline gives information on where to implement VMS on roadside (e.g. range of sight).

### Statistical data or analysis:
No statistical data available.

### Note / Background / Reference / Link etc:
Verkehrsblatt-Verlag, Hohe Straße 39, D-44139 Dortmund, [www.verkehrsblatt.de](http://www.verkehrsblatt.de)
### 4A2 Guideline concerning:
**VMS (German)**

**Guideline native name:**
**B 6740 Richtlinien für Wechselverkehrszeichenanlagen (RWVA), Ausgabe 1997**

**Guideline focus – national (country)/international:** national (Germany)

**Guideline name in English translation:** Guidelines for Variable Message Sign Systems

**Guideline reference number:** Dokument Nr. B 6740 – Vers.05/97

**Valid since (year):** 1997

**Completed by:**
Name: Jessica Kleine
Institution: BASt

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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<td>Policy</td>
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**Type of guideline:**
- ✔️ Existing
- □ Planned to be implemented
- □ Verified in IN-SAFETY project
- □ Other:..........................................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other

Infrastructure generally:
- Communication channels
- Data exchange
- Other

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other

Operators` training:
- Infrastructure operator training
- Drivers` training
- Manual for drivers (non-mandatory)
- Other

Simulation models
- Microscopic
- Macroscopic
- Other

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<table>
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<tr>
<th><strong>Abstract of the guideline:</strong></th>
<th>The guideline describes technical details of the Variable Message Sign systems (adjustment, components) and the design and operation of VMS systems.</th>
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<td><strong>Statistical data or analysis:</strong></td>
<td>No statistical data available.</td>
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<td>Verkehrsblatt-Verlag, Hohe Straße 39, D-44139 Dortmund, <a href="http://www.verkehrsblatt.de">www.verkehrsblatt.de</a></td>
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</table>
4A3 Guideline concerning:
Roadside equipment, architecture, communication
Guideline native name:
Technische Lieferbedingungen für Streckenstationen (TLS),
Ausgabe 2002
Guideline focus – national (country)/international: national (Germany)
Guideline name in English translation: Technical Specification for Roadside Stations
Guideline reference number:
Valid since (year): 2002

Completed by:
Name: Jessica Kleine
Institution: BASt

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:
☒ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:........................................................................................................................................................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other

Infrastructure generally:
- Communication channels
- Data exchange
- Other

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other

Operators’ training:
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other

Simulation models
- Microscopic
- Macroscopic
- Other

Abstract of the guideline:

The basic idea of the TLS is:
- to define functional groups for the roadside equipment,
- to standardise the interfaces and communication protocols,
- to create a common data modelling and
- to define and test performances and quality.

In the TLS standard the requirements regarding
the defined functional groups,
the architecture of the stations,
the internal interfaces and
the OSI 2, 3 and 7 layers of the communication interface between roadside equipment and
the traffic control centres
are defined. Additionally the performance characteristics and quality of traffic and
environmental sensors including test procedures are specified.

The functional groups (FG) include:
FG 1: Traffic data acquisition
FG 2: Weight in motion
FG 3: Environmental data acquisition
FG 4: Variable message sign and variable direction sign control
FG 6: Operational messages and control
FG 7: Control of external systems
FG 8: Enforcement systems
FG 9: Ramp metering

Example of a TLS compatible roadside station
**Statistical data or analysis:**

TLS is intended to standardize functions and interfaces so that devices from different manufacturers can be used in traffic management systems. This leads to more competition and decreasing prices. This notice is not proved by a certain study or statistical analysis but is an indication for the effectiveness of standardized functions and interfaces in Intelligent Traffic Systems.

**Note / Background / Reference / Link etc:**
http://www.bast.de/htdocs/veroeffentlichung/tls.htm
4A4 Guideline concerning:
**TCC equipment, architecture, communication**

**Guideline native name:**
**Merkblatt zur Ausstattung von Verkehrsrechnerzentralen und Unterzentralen (MARZ), Ausgabe 1999**

Guideline focus – national (country)/international: national (Germany)

**Guideline name in English translation:** Instructions for the Equipment of Traffic Control Centres and Sub-centres

Guideline reference number:
Valid since (year): 1999

**Completed by:**
Name: Jessica Kleine
Institution: BASt

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- ✗ Existing
- □ Planned to be implemented
- □ Verified in IN-SAFETY project
- □ Other: ..................................................................................................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other: ............................................................... 

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: .................................................................. 

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: .................................................................. 

Infrastructure generally:
- Communication channels
- Data exchange
- Other: ..................................................................

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: ..................................................................

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: ..................................................................

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: ..................................................................

Operators´ training:
- Infrastructure operator training
- Drivers´ training
- Manual for drivers (non-mandatory)
- Other: ..................................................................

Simulation models
- Microscopic
- Macroscopic
- Other:
- .............................................................................
- .............................................................................
Abstract of the guideline:

These instructions describe all the necessary definitions for sub centres and traffic control centres of the federal highways:
tasks of the centres,
functional specifications and traffic engineering requirements,
system requirements and system architecture,
data communication between the centres,
documentation and acceptance of the systems.

The MARZ comprise instructions for software and hardware units, the interfaces between them and their relevant common features. On this base, guidelines for the design of traffic control centres and sub centres are given, in order to make a co-operating of all components of the traffic control system possible. By the modular architecture of the centres the transfer of software modules between these is enabled without big complexity.

Statistical data or analysis:

MARZ is intended to standardize functions and interfaces so that devices from different manufacturers can be used in traffic control centres. This leads to more competition and decreasing prices. This notice is not proved by a certain study or statistical analysis but is an indication for the effectiveness of standardized functions and interfaces in Intelligent Traffic Systems.

Note / Background / Reference / Link etc:
Buying Source: Fa. Kappich&Kniß, Martin-Luther Str. 14, 52062 Aachen
4A5 Guideline concerning:
**Advanced lane departure warning assistant**

Guideline native name:
**Guideline focus – national (country)/international: scenario**

Guideline name in English translation:

Valid since (year):

Completed by:
Name: Marion Wiethoff
Institution: TU Delft

Guideline reference:

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Type of guideline:
- Existing
- Planned to be implemented
- Verified in IN-SAFETY project
- Other: ........................................................................................................
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other: ...........................................................................................................

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: all roads + tunnels, road works

Communication:
☒ V2V (= C2C) Vehicle (Car) to Vehicle
☒ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other: ...........................................................................................................

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☐ Other: ...........................................................................................................

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other: ...........................................................................................................

Vehicle
☒ HMI (= MMI) – Human (Man) Machine Interface
☒ Design
☐ Other: ...........................................................................................................

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☒ ADAS – Advanced Driver Assistance Systems
☐ Other: ...........................................................................................................

Operators’ training:
☐ Infrastructure operator training
☐ Drivers’ training
☐ Manual for drivers (non-mandatory)
☐ Other: ...........................................................................................................

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☐ ...........................................................................................................
**Abstract of the guideline:**

The system must warn the driver when the vehicle is (potentially) deviating from the intended lane of travel and must provide advice on the appropriate driver steering or braking response to correct the problem. The sensitivity of the system must be adapted if required, through to road surface conditions, road works, tunnels, etc. (ADVISORS 2002)

At least the system consists of:
- Vehicle sensors to derive the distance between the lane marking and the vehicle
- A communication system to warn the driver (seat vibrations, rumble, audible, visible)

The system has to correctly detect the lane markings in all circumstances. Several techniques have been investigated for lane detection and tracking (Bishop 2005 p. 98):
- Embedded magnetic markers in the roadway
- Highly accurate GPS and digital maps
- Image processing

**Statistical data or analysis:**

**Note / Background / Reference / Link etc:**
4A6 Guideline concerning:

**Blind spot detector**

**Guideline native name:**
Guideline focus – national (country)/international: scenario

**Guideline name in English translation:**
Guideline reference number:
Valid since (year):

**Completed by:**
Name: Marion Wiethoff
Institution: TU Delft

**Guideline reference:**

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**Type of guideline:**

☒ Existing
☐ Planned to be implemented
☒ Verified in IN-SAFETY project
☐ Other:..................................................................................................................
Guideline identification:

Road design:
- [ ] Road Risk Assessment
- [ ] Other: .................................................................

Type of road:
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [x] Motorway
- [x] Highway
- [ ] Other: ........................................................................

Communication:
- [ ] V2V (= C2C) Vehicle (Car) to Vehicle
- [ ] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other: .........................................................................

Infrastructure generally:
- [ ] Communication channels
- [ ] Data exchange
- [ ] Other: ........................................................................

Infrastructure Traffic Management Systems:
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other: ........................................................................

Vehicle
- [x] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other: ........................................................................

In-vehicle autonomous systems:
- [x] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other: ........................................................................

Operators’ training:
- [x] Infrastructure operator training
- [x] Drivers’ training
- [x] Manual for drivers (non-mandatory)
- [ ] Other: ........................................................................

Simulation models
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [ ] ..................................................................................
**Abstract of the guideline:**

Users of this system need to have as good view as possible (by using infrared sensors) especially down behind and to the blind spots on his/her vehicle (ADVISORS 2002). A warning must be given to the driver when turning/changing lanes in presence of other vehicles/pedestrians/cyclists in the blind spot of the driver.

| Statistical data or analysis: |

| Note / Background / Reference / Link etc: |
4A7 Guideline concerning:

**All the six systems in question**

Guideline native name:

**Code of practice for ADAS design**

Guideline focus – national (country)/international:

Guideline name in English translation:

Guideline reference number:

Valid since (year):

Completed by:

Name: Marion Wiethoff
Institution: TU Delft

Guideline reference:

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Type of guideline:

- ✗ Existing
- ❑ Planned to be implemented
- ❑ Verified in IN-SAFETY project
- ❑ Other:........................................................................................................
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Abstract of the guideline:

The CoP can be used as a basis by individual companies to create detailed procedures for optimization of system design specifications and ADAS verification. The code could play an extremely important role in ADAS introduction; therefore, it is described in some detail here. An ADAS CoP is needed for both system safety and safety of use.

Design and performance standards would address “reasonable safety” and process standards would address “duty of care”.

To translate the requirements of “reasonable safety” and “duty of care” into actionable processes and requirements, activities are split into 1) defining requirements and characteristics of a reasonably safe product and 2) describing the process to ensure achievement of this safety target (development and validation process requirements).

Design requirements are expected to address the following:
- Suitability of the system to the objective
- Self-descriptiveness
- Conformity with pre-existing customer expectations
- Error tolerance
- Controllability
- Predictability
- Consistency
- Transparency
- Scalability
- Learnability
- Interruptability
- Pace of interaction
- Comprehensibility
- Effectiveness
- Familiarization
- Driver vigilance issues

The process definition will address the following:
- Organizational requirements
- Identification of customer requirements
- Engineering requirements
- Design specifications
- Hazard and safety analysis (integrating both technology and user perspectives)
- Verification procedures for fulfilling specified requirements
- Validation procedures for determining overall system readiness
- Methods of product/crash analysis
- Product monitoring after market introduction

(Bishop 2005)

Statistical data or analysis:

Note / Background / Reference / Link etc:
4A8 Guideline concerning:
**In-car curve speed warning**

**Guideline native name:**
Guideline focus – national (country)/international: scenario

**Guideline name in English translation:**
Guideline reference number:
Valid since (year):

**Completed by:**
Name: Marion Wiethoff
Institution: TU Delft

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- ✗ Existing
- □ Planned to be implemented
- □ Verified in IN-SAFETY project
- ✗ Other: Verified in ADVISORS project
### Guideline identification:

Road design:
- Road Risk Assessment
- Other: .................................................................

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: all types of roads

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: .................................................................

Infrastructure generally:
- Communication channels
- Data exchange
- Other: .................................................................

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: .................................................................

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: .................................................................

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: .................................................................

Operators´ training:
- Infrastructure operator training
- Drivers´ training
- Manual for drivers (non-mandatory)
- Other: .................................................................

Simulation models
- Microscopic
- Macroscopic
- Other:
  - .................................................................
Abstract of the guideline:
The system has to warn the driver when he is approaching a curve too fast. In order to understand, if a dangerous situation occurs, the road curvature is computed, by the data contained in the maps, and then the maximum speed at which it is possible to travel in the particular curve is derived. Comparing this value with the vehicle velocity, it is understandable if it is the case to alert and warn the driver or not.
A system like this, at least, needs these three components:
Digital enhanced maps (ADAS)
Localisation system, including the enhanced vehicle positioning, the GPS antenna and the digital maps survivor
HMI dedicated services → see guidelines according to HMI/In-vehicle displays.

(ADVISORS 2002)

A fully informed curve speed warning system would also incorporate parameters such as surface quality, street width, number of lanes, shoulders, visibility, weather and driving style of the driver

(Bishop 2005, p.106)

Statistical data or analysis:

Note / Background / Reference / Link etc:
4A9 Guidelines concerning:

**All the six systems in question**

Guideline native name:

**Interacting of the systems with society and the market**

Guideline focus – national (country)/international: marketing approach

Guideline name in English translation:

Guideline reference number:

Valid since (year):

Completed by:

Name: Marion Wiethoff
Institution: TU Delft

Guideline reference:

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Type of guideline:

☒ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:...........................................................................................................
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other:………………………………………………………………………………

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: all types

Communication:
☒ V2V (= C2C) Vehicle (Car) to Vehicle
☒ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:………………………………………………………………………………

Infrastructure generally:
☒ Communication channels
☒ Data exchange
☐ Other:………………………………………………………………………………

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other: all……………………………………………………………………………

Vehicle
☒ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other:………………………………………………………………………………

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other: all……………………………………………………………………………

Operators’ training:
☐ Infrastructure operator training
☐ Drivers’ training
☐ Manual for drivers (non-mandatory)
☐ Other:………………………………………………………………………………

Simulation models
☐ Microscopic
☐ Macroscopic
Other:
☐ …………………………………………………………………………………
Abstract of the guideline:

Across the various governments there is broad agreement as to the high-level safety vision, but disagreement as to how to get there. ADASE 2 noted that, generally speaking, ADAS’s will not rise higher on government policy agendas until there is “proof” of their safety benefits.

One effective way car companies build the trust of users and potential users is through identifying “baby steps” in system function, which are less risky in the event of failure.

An item of key concern to drivers is controllability of the system. The driver must both have the control and perceive it that way. Ideally, as the driver gains confidence in the system, override actions decrease. System feedback is also important for gaining confidence, such as the way in which ACC systems provide a display when the system is tracking the vehicle ahead.

User comprehension: System functionality and limits may not be immediately obvious to users, and they are unlikely to actually take the time to read system information. If users have an inaccurate understanding or expectation of the system, they may use it incorrectly or in an environment it is not designed for. This emphasizes the need for intuitive driver interfaces in which functionality and limits are quickly evident.

Public awareness of ADAS and their benefits are key to success. Government activities and programs can be helpful in creating this...

(Bishop 2005)

Statistical data or analysis:

Note / Background / Reference / Link etc:

4A10 Guideline concerning:

**All the six systems in question**

**Guideline native name:**

**Legal rules according to the 6 systems (and other ADAS)**

**Guideline focus – national (country)/international: legislation approach**

**Guideline name in English translation:**

**Guideline reference number:**

**Valid since (year):**

**Completed by:**

Name: Marion Wiethof
Institution: TU Delft

**Guideline reference:**

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☑ Other: a more detailed characteristic depends on a specific system

**Type of guideline:**

☑ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other: ........................................................................................................

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: independent

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other: ........................................................................................................

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☐ Other: ........................................................................................................

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other: ........................................................................................................

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other: ........................................................................................................

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☒ ADAS – Advanced Driver Assistance Systems
☐ Other: ........................................................................................................

Operators’ training:
☐ Infrastructure operator training
☐ Drivers’ training
☐ Manual for drivers (non-mandatory)
☐ Other: ........................................................................................................

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☒ Approval procedures for ADAS
☐ ........................................................................................................
Abstract of the guideline:

Vehicles in Europe must comply with both European union regulations and national regulations. For instance, industry is currently calling for changes in EU headlight regulations so that adaptive front lighting can be offered (Bishop 2005 p.104). If someone would like to introduce a new ADAS on the market, it must be sure that the specific ADAS is not in contrast with existing regulations.

Article 21 wegenverkeerswet (traffic roads): All categories of vehicles, vehicle parts, etc and measures for the protection of passengers and road users (therefore also ADAS), should be approved before admittance to the road. In the Netherlands the approval is performed by the RDW. (van Wees 2004)

In product liability regulations of dpt 6.3.3 BW, the criterion of “failure” (“gebrek”) is the central issue. The issue is defined as follows in art. 6:186 BW (part 1 and 2) (The Netherlands):

A product is "failing" (“gebrekkig”), if it does not provide the safety that one can expect, taking into consideration all circumstances, in particular:
- The presentation of the product
- The use of the product as may be expected within reason, and
- The moment at which the product is introduced in traffic

A product is not considered “failing” only because afterwards a better product is introduced into traffic.

The safety that one may expect of a product (ADAS) should be objectivated to be assessed... (van Wees 2004)

Recall-verplichting: this means that a producer of an ADAS has to take measures for mitigation of the dangers caused by failures in the product that is already introduced in traffic. (van Wees 2004 p. 213)

Statistical data or analysis:

Note / Background / Reference / Link etc:

4A11 Guideline concerning:
Overtaking assistant for rural roads
Guideline native name:
Guideline focus – national (country)/international: scenario
Guideline name in English translation:
Guideline reference number:
Valid since (year):

Completed by:
Name: Marion Wiethof
Institution: TU Delft

Guideline reference:
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Type of guideline:
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☐ Other:..................................................................................................................
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**Road design:**
- [ ] Road Risk Assessment
- [ ] Other: .................................................................

**Type of road:**
- [ ] Urban
- [ ] Peri-urban
- [x] Rural
- [ ] Motorway
- [ ] Highway
- [ ] Other: .................................................................

**Communication:**
- [x] V2V (= C2C) Vehicle (Car) to Vehicle
- [ ] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other: .................................................................

**Infrastructure generally:**
- [ ] Communication channels
- [ ] Data exchange
- [ ] Other: .................................................................

**Infrastructure Traffic Management Systems:**
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other: .................................................................

**Vehicle**
- [ ] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other: .................................................................

**In-vehicle autonomous systems:**
- [ ] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other: .................................................................

**Operators’ training:**
- [ ] Infrastructure operator training
- [ ] Drivers’ training
- [x] Manual for drivers (non-mandatory)
- [ ] Other: .................................................................

**Simulation models**
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [ ] .................................................................
Abstract of the guideline:

The system needs to warn the driver for meeting traffic while starting to overtake.

ADVISORS 2002:
The system shall be able to warn the driver if the host vehicle moves towards a volume of road space that is about to be occupied, or already occupied by an oncoming driver.

The system shall be able to detect the position of oncoming vehicles.

The system shall minimize the risk of an accident due to the impaired alertness of the driver.

Statistical data or analysis:

Note / Background / Reference / Link etc:

ADVISORS. Competitive and sustainable growth programme; Del 1.2 v12.3; inventory of ADAS and user needs. Update 2002.
4A12 Guideline concerning:
Principles/guidelines for safe and efficient in-vehicle information and communication systems (HMI)
In-car curve speed warning, in-car VMS and bus warning systems
**Guideline native name:**
**European Statement of Principles on the Human Machine Interface**
Guideline focus – national (country)/international: international - EU
**Guideline name in English translation: also known as ESOP**
Guideline reference number:
Valid since (year):

**Completed by:**
Name: Marion Wiethoff
Institution: TU Delft
Name: Eva Gelová
Institution: CDV

**Guideline reference:**

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**Type of guideline:**
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☐ Verified in IN-SAFETY project
☐ Other:..................................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other: ..............................................................................................................

Type of road:
- Urban
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- Rural
- Motorway
- Highway
- Other: all types of roads

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: ..............................................................................................................

Infrastructure generally:
- Communication channels
- Data exchange
- Other: ..............................................................................................................

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: ..............................................................................................................

Vehicle:
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: ..............................................................................................................

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: ..............................................................................................................

Operators´ training:
- Infrastructure operator training
- Drivers´ training
- Manual for drivers (non-mandatory)
- Other: ..............................................................................................................

Simulation models:
- Microscopic
- Macroscopic
- Other:
- Basic HMI+design policy for the in-vehicle ITS systems
Abstract of the guideline:
A European Statement of Principles on the Human Machine Interface of in-vehicle information and communication systems is essential to maximise their safety potential. This statement of principles summarises essential safety aspects to be taken into account for the Human Machine Interface (HMI) for in-vehicle information and communication systems. This statement of principles will be of particular use to manufacturers when they have to consider the safety implications of HMI design. The main topics of this statement of principles are overall design, installation, information presentation, interaction with displays and controls, system behaviour and information about the system.

The Principles tackle information and communication systems for usage while driving that are directly or indirectly related to a driving task, both portable and permanently installed systems, produced as OEM or after-market.

The principles are:

Overall design principles:
The system should be designed to support the driver and should not give rise to potentially hazardous behaviour by the driver or other road users.
The system should be designed in such a way so that the allocation of driver attention to the system displays or controls remain compatible with the attentional demand of the driving situation.
The system should be designed so as not to distract or visually entertain the driver.

Installation principles:
The system should be located and fitted in accordance with relevant regulations, standards and manufacturer’s instructions for installing the system in vehicles.
No part of the system should obstruct the driver's view of the road scene.
The system should not obstruct vehicle controls and displays required for the primary driving task.
Visual displays should be positioned as close as practicable to the driver's normal line of sight.
Visual displays should be designed and installed to avoid glare and reflections.

Information installation principles:
Visually displayed information should be such that the driver can assimilate it with a few glances, which are brief enough not to adversely affect driving.
Where available, internationally agreed standards relating to legibility, audibility, icons, symbols, words, acronyms or abbreviations should be used.
Information relevant to the driving task should be timely and accurate.
The system should not present information, which may result in potentially hazardous behaviour by the driver or other road users.
The system should not produce uncontrollable sound levels liable to mask warnings from within the vehicle or outside.

Principles on interaction with displays and control:
The driver should always be able to keep at least one hand on the steering wheel while interacting with the system.
Speech based communications systems should include provision for hands-free speaking and listening.
The system should not require long and uninterruptible sequences of interactions.
System controls should be designed such that they can be operated without adverse impact on the primary driving task.
The driver should be able to control the pace of interaction with the system.
The system should not require the driver to make time-critical responses when
providing inputs to the system. 
The driver should be able to resume an interrupted sequence of interactions with the system at the point of interruption or at another logical point. 
The driver should have control of auditory information where there is a likelihood of distraction or irritation. 
The system’s response (e.g. feedback, confirmation) following driver input should be timely and clearly perceptible. 
Systems providing non-safety related dynamic visual information should be capable of being switched into a mode where that information is not provided to the driver.

**System behavior principles:**
Visual information not related to driving that is likely to distract the driver significantly (e.g. TV, video and automatically scrolling images and text) should be disabled or should only be presented in such a way that the driver cannot see it while the vehicle is in motion. 
The presence, operation or use of a system should not adversely interfere with displays or controls required for the primary driving task and for road safety. 
System functions not intended to be used by the driver while driving should be made impossible to interact with while the vehicle is in motion, or clear warnings should be provided against the unintended use. 
Information about current status, and any malfunction, within the system that is likely to have an impact on safety should be presented to the driver. 
In the event of a partial or total failure of the system, the vehicle should remain controllable, or at least be capable of being brought to a halt in a safe manner.

**Principles on information about the system:**
The system should have adequate instructions for the driver covering use and relevant aspects of installation and maintenance. 
System instructions should be correct and simple. 
System instructions should be in languages or forms designed to be understood by the driver. 
The instructions should clearly distinguish between those aspects of the system, which are intended for uses by the driver while driving and those aspects (e.g. specific functions, menus etc), which are not intended to be used while driving. 
All product information should be designed to convey accurately the system functionality. 
Product information should make it clear if special skills are required to use the system or if the product is unsuitable for particular users. 
Representations of system use (e.g. descriptions, photographs and sketches) should neither create unrealistic expectations on the part of potential users nor encourage unsafe or illegal use.

(Edward Commission 1999)

The main aim of the ESoP recommendations was the transfer of knowledge regarding the stated principles throughout Europe. In 2001, the European Commission published the Principles prepared together with its expert group.

The main actors in this area, as in industry, have given full consideration to the design of relevant new systems. An agreement by European car manufacturers to fully respect the ESoP (letter from ACEA) was issued in 2001, also. Independent of this agreement, some of the current systems on the market do not fully respect the ESoP, mostly the after-market systems.

New in-vehicle ITS systems should be designed according to not only the principles in the ESoP, but also to relevant ISO standards and ECE-rules. The system should be designed to
support the driver, and should not allow any potentially hazardous behaviour of the driver and/or other road users to arise. Before market introduction, the appropriate tests are needed to optimize the HMI design with as great as possible an elimination of aspects that could be negative for road safety. The best methods and practices of design shall promote suitable HMI solutions by simply applied principles.

HMI-principles themselves cannot guarantee safety, but can support systems and services which require a predictable amount of attention, in consideration of the visual, cognitive and manual demands on the driver - both for primary (driving itself) and secondary (handling the ITS system) tasks.

(Pauzié, Stevens 2006)

Statistical data or analysis:
General statistics not possible.
Specific statistics, regarding the drivers’ mental workload by primary and secondary tasks, are available from already finished research with testing drivers and individual systems.

Note / Background / Reference / Link etc:

References
The importance of a safe human-machine interaction (HMI) for in-vehicle information and communication systems has been expressed by various European institutions in the following documents:
- Council conclusions - 17 June 1997
- Opinion of the Committee of the Regions - 14 May 1998
- Commission Communication COM (97) 223 - 20 May 1997; related to a Community strategy and framework for the deployment of road transport telematics in Europe
- Council Resolution - 17 June 1997; on the development of telematics in road transport


Notes:
Related to eSafety WG-HMI Recommendations, 2005.
ESoP was updated as a new version in 2005; also the sections: ‘Recommendation on Safe Use’ and ‘Implementation’ included.
European vehicle manufacturers (ACEA) have made a self-commitment to follow the ESoP.
**4A13 Guideline concerning:**
In Car VMS. VMS (Variable Message Sign) information available in the vehicle. Includes variable speed limits, congestion ahead, et cetera.

**Guideline native name:**
Guideline focus – national (country)/international: Europe
Guideline name in English translation:
Guideline reference number:
Valid since (year):

**Completed by:**
Name: M. Wiethoff
Institution: TUDelft
Contact: C. Brugger
Institution: IIID

**Guideline reference:**
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**Type of guideline:**
☐ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☒ Other: developed and validated in the In Safety project
Guideline identification:

Road design:
- Road Risk Assessment
- Other: Safety improvement

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: In principle all roads, but mainly motorways

Communication:
- V2V (C2C) Vehicle (Car) to Vehicle
- V2I (C2I) Vehicle (Car) to Infrastructure
- Other: Infrastructure to Vehicle / Autonomous In-Vehicle /

Infrastructure generally:
- Communication channels
- Data exchange
- Other

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other

Vehicle
- HMI (MMI) – Human (Man) Machine Interface
- Design
- Other

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other

Operators’ training:
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other

Simulation models
- Microscopic
- Macroscopic
- Other
## Abstract of the guideline:
Overview of test-results of VMS pictograms for a great number of mainly warning signals
Overview of designing guidelines for bitmap representations

## Statistical data or analysis:
Regarding this guideline, do you have any statistical data (before\&after analysis), which
would support implementation of across Europe (Road Risk Assessment, accident rate
reduction, etc.)?
*Please, specify here.*

These are reported in:
Ref: In Safety CJT-IIID-Final Report pictograms tests

## Note / Background / Reference / Link etc:
*If you feel to add more about the topic or guideline.*
C. Brugger, IIID: In Safety report: CJT-IIID-Final Report pictograms tests
Bureau Mijksenaar: In Safety report Designing for Bitmap
4A14 Guideline concerning:
**European policy in ITS standardisation**

Guideline native name:
**Strategic Framework for Intelligent Transport Systems (ITS) Standards**

Guideline focus – national (country)/international: international – Europe

**Guideline name in English translation:**
Guideline reference number: first published output of ITSSG

Valid since (year): November 2004

Completed by:
Name: Eva Gelová
Institution: CDV

Guideline reference:

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Type of guideline:
☑ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:........................................................................................................
Guideline identification:

Road design:
- ☑ Road Risk Assessment
- ☐ Other: road safety generally

Type of road:
- ☑ Urban
- ☑ Peri-urban
- ☑ Rural
- ☑ Motorway
- ☑ Highway
- ☑ Other: no specification - generally

Communication:
- ☑ V2V (= C2C) Vehicle to Vehicle
- ☑ V2I (= C2I) Vehicle to Infrastructure
- ☑ Other: no specification - generally

Infrastructure generally:
- ☑ Communication channels
- ☑ Data exchange
- ☑ Other: no specification - generally

Infrastructure Traffic Management Systems:
- ☑ Variable messages signs
- ☑ Variable directions signs
- ☑ Dynamic lane allocation
- ☑ Ramp metering
- ☑ Other: generally - Traffic Management Systems, network efficiency, tolling, traffic and travel information, improved public transport services, eSafety

Vehicle
- ☑ HMI (= MMI) – Human (Man) Machine Interface
- ☑ Design
- ☑ Other: vehicle safety, vehicle identification

In-vehicle autonomous systems:
- ☑ IVIS – In-Vehicle Information Systems
- ☑ ADAS – Advanced Driver Assistance Systems
- ☑ Other:

Operators’ training:
- ☑ Infrastructure operator training
- ☑ Drivers' training
- ☑ Manual for drivers (non-mandatory)
- ☑ Other:

Simulation models
- ☑ Microscopic
- ☑ Macroscopic

Other:
- ☑ EU highest level of ITS policy
- ☑ Standardization
Abstract of the guideline:

Information & Communications Technologies Standards Board - Intelligent Transport Standards Steering Group (ICTSB/ITSSG) has prepared the Strategic Framework for Intelligent Transport Systems (ITS) Standards, which was launched at the CEN/CENELEC/ETSI organized Transport European Standardization conference in Brussels.

ITSSG exists to steer and co-ordinate at a strategic level the development and deployment of Intelligent Transport Systems standards internationally. ITSSG has a particular focus on the standards falling under the responsibility of the European Standardization Organizations (ESOs) CEN, CENELEC and ETSI and the links between the ESOs and ITS standards being developed through their global counterparts ISO, IEC and ITU.

ITSSG encourages all people involved in ITS standards development itself to consider how their current and future work programs fit within the Strategic Framework. Strategic framework summarises the next steps and includes a commitment to update the document on an annual basis.

The document focuses on a policy and policy delivery context. The document summarizes, except others, the current work streams of the key relevant standardization technical committees. There are two principal audience for this framework: developing standards within the ITS community and setting the high-level policy context.

Two key priorities, where standards are already being developed to protect interoperability and which are being taken forward as general transport measures using ITS are:
- Directive 2004/52/EC on the interoperability of electronic road toll systems in the EU; and
- EU High Level Group on Road Safety exploring the feasibility of electronic vehicle identification.

eEurope is a wide-ranging initiative that aims to optimize the use of electronic technologies to support a sustainable Europe. It is not specific to transport, but has acknowledged a specific ITS role in helping to tackle congestion, safety and service provision. This ITSSG document focuses on elements relevant to roads and multi-modal traffic and travel information.

The eSafety agenda includes a number of standardization issues through a European Commission (EC) Communication. The European Commission Trans-European Road Network initiative aims to establish appropriate inter-operable and accessible service provision on the strategic road network across national boundaries, and into urban areas.

ITSSG promotes
- Harmonized pan-European in-vehicle emergency call services on location-enhanced E-112
- A Human Machine Interface working group
- RTTI working group
- Achieving of harmonized access to radio spectrum in the EU (a time-limited use of 24GHz UWB short-range radar)

In the document, there are defined roles of standards and standardization mandates. Annexes describe key areas of CEN/TC278, ISO/TC204 and ETSI.
<table>
<thead>
<tr>
<th><strong>Statistical data or analysis:</strong></th>
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| **Note / Background / Reference / Link etc:** |
| The whole document, including the individual standardization topics, can be found on: http://www.ictsb.org/ITSSG/Documents/ITSSG_strategic_Framework_final_version_November_2004.pdf |
4A15 Guideline concerning:
VMS (Czech)
Guideline native name:
Požadavky na provedení a kvalitu proměnných dopravních značek a zařízení pro provozní informace na dálnicích a silnicích

Guideline focus – national (country)/international: national – Czech Republic

Guideline name in English translation: Requirements for implementation and quality of variable message traffic signs and devices for operating information on the highways and roads

Guideline reference number: ŘSD-10421

Valid since (year): 2005

Completed by:
Name: Jan Weinberger
Institution: CDV

Guideline reference:

Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:

☑ Existing technical specifications
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other: ..................................................................................................................
**Guideline identification:**

**Road design:**
- ☑ Road Risk Assessment
- ☑ Other: Information Service for road traffic participants

**Type of road:**
- ☑ Urban
- ☑ Peri-urban
- ☑ Rural
- ☑ Motorway
- ☑ Highway
- ☑ Other: ........................................................................................................

**Communication:**
- ☑ V2V (= C2C) Vehicle (Car) to Vehicle
- ☑ V2I (= C2I) Vehicle (Car) to Infrastructure
- ☑ Other: Infrastructure to the Car

**Infrastructure generally:**
- ☑ Communication channels
- ☑ Data exchange
- ☑ Other: ........................................................................................................

**Infrastructure Traffic Management Systems:**
- ☑ Variable messages signs
- ☑ Variable directions signs
- ☑ Dynamic lane allocation
- ☑ Ramp metering
- ☑ Other: ........................................................................................................

**Vehicle**
- ☑ HMI (= MMI) – Human (Man) Machine Interface
- ☑ Design
- ☑ Other:

**In-vehicle autonomous systems:**
- ☑ IVIS – In-Vehicle Information Systems
- ☑ ADAS – Advanced Driver Assistance Systems
- ☑ Other: ........................................................................................................

**Operators’ training:**
- ☑ Infrastructure operator training
- ☑ Drivers’ training
- ☑ Manual for drivers (non-mandatory)
- ☑ Other: ........................................................................................................

**Simulation models**
- ☑ Microscopic
- ☑ Macroscopic
- ☑ Other:
- ☑ ........................................................................................................
- ☑ ........................................................................................................
Abstract of the guideline:
This regulation determines requirements for implementation and quality of variable message traffic signs (VMS) and devices for operating information (DOI) on the highways and roads, which are in the management of Central office of roads and highways in Czech Republic on the free route and in the tunnels. It serves for designing, production and installation, confirmation, receiving, maintenance and control of traffic signs.
Technical specifications are determined for:
Authorities and subjects, who project, manufacture and place system of road variable message signs and devices for operating information on the highways and roads, ergo in the implementation stage the application of variable message signs and equipment for operational information on the roads.
All products, that are part of the system, have to be substantiate with congruity declaration and with quality certificate, possibly with minutes inclusive examination results and their evaluation (according the Czech Law).
Requirements in this regulation fill in and specify the national guidelines TP 165, ČSN EN 12 899-1 and the European standard prEN 12 966-1.
Variable message signs and devices for operating information have to be incorporate into Czech Law N. 185/2001 Sb.
Variable traffic signs and equipment for variable operating information on the road:
Is the visual tool, that affects the drivers and other participants of the traffic;
It advertises on the danger and determine prohibitions and restrictions, which arise from the momentary traffic situation;
It works on principle in the system, which it differ from invariable traffic sign or informative board;
It provides information, which is current and immediately affected with operational or meteorological conditions;
It is element of the system, which works in the basic succession - data collection - transmission - processing - measures fixing - command to the adjustment of variable system of road signs (equipment for variable working information) - possible feedback.

Statistical data or analysis:

Note / Background / Reference / Link etc:
Note 1:
The whole materials and components of variable message signs and devices for operating information have to be confirmed from Central office of roads and highways in Czech Republic before starting a job.
It is necessary to make the coordination of variable message traffic signs and devices for operating information and lamppost situating and consider the visibility of every VMS/DOI in the relation of covering with the lamppost. For securing the best visibility of VMS/DOI it necessary to station them circa 5m in front of the lamppost facing forward.

Note 2:
Author: Michal Prášil
Published by: Ředitelství silnic a dálnic ČR (Central office of roads and highways in Czech Republic – ŘSD)
4A16 Guideline concerning:

**Road signing**

Guideline native name:

**Best practice guide on horizontal, vertical and telematic signing**

Guideline focus – national (country)/international: international

**Guideline name in English translation:**

Guideline reference number: Draft IN-SAFETY WP5 D5.1

Valid since (year): Draft

Completed by:

Name: Frank Sulzmann,
Institution: University of Stuttgart

Guideline reference:

*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**

- Existing
- Planned to be implemented
- Verified in IN-SAFETY project
- Other: ..........................................................
Guideline identification:

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<th>Road design:</th>
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<td>Type of road:</td>
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| Communication: | V2V (= C2C) Vehicle (Car) to Vehicle |
|                | V2I (= C2I) Vehicle (Car) to Infrastructure |
|                | Other: Information to Vehicle |

| Infrastructure Traffic Management Systems: | Variable messages signs |
|                                            | Variable directions signs |
|                                            | Dynamic lane allocation |
|                                            | Ramp metering |
|                                            | Other: Horizontal, vertical and telematic signing |

| Vehicle | HMI (= MMI) – Human (Man) Machine Interface |
|         | Design  |
|         | Other: |

| In-vehicle autonomous systems: | IVIS – In-Vehicle Information Systems |
|                               | ADAS – Advanced Driver Assistance Systems |
|                               | Other: |

| Operators’ training: | Infrastructure operator training |
|                     | Drivers’ training |
|                     | Manual for drivers (non-mandatory) |
|                     | Other: |

| Simulation models | Microscopic |
|                  | Macroscopic |
|                  | Other: |

...
Abstract of the guideline:

This document combines results from IN-SAFETY WP2, WP3, WP4, WP5 and takes into account previous knowledge from other projects to result in a best practice guide. It gives an overview about horizontal, vertical and telematic signing. Every article deals with only one subject without going to much into detail. All topics are explored from different points of view. Often information from different sources are brought together. In some cases pilot studies of IN-SAFETY challenge the existing best practice.

The best practice guideline is divided in four sections and covers following topics:

**Horizontal signing:**
- Is there potential to substitute the infrastructure element milled rumble strips by an in-vehicle assistance system?
- Using high performance retro-reflective technology in combination with fluorescent colours to reduce accident rates
- Inventive ways using horizontal signing

**Vertical signing:**
- Suggestion and a systematic approach to harmonize symbols keywords
- How to provide language independent information
- Introduction of a new traffic typeface available for 25 languages, for all countries in EU
- Standardizing information
- Icons
- Verbal messages

**Telematic signing:**
- Dealing with common problems
- How to improve existing ADAS (advanced driving aid systems)
- Look and feel of future VMS (variable message signs)
- Application of VMS
- In-car traffic signing

**Traffic planning:**
- Using micro- and macro simulation
- Risk analysis

**Statistical data or analysis:**
Regarding this guideline, do you have any statistical data (before & after analysis), which would support implementation of across Europe (Road Risk Assessment, accident rate reduction, etc.)?

**Note / Background / Reference / Link etc:**

All topics are explored from different points of view. Often information from different sources are brought together. In some cases pilot studies of IN-SAFETY challenge the existing best practice.
**4A17 Guideline concerning:**
VMS (Czech)

**Guideline native name:**
Zásady pro systémy proměnného dopravního značení a zařízení pro proměnlivé provozní informace na pozemních komunikacích

Guideline focus – national (country)/international: national – Czech Republic

**Guideline name in English translation:** Principles for variable systems of road signs and equipment for variable operating information on the roads

Guideline reference number: TP 141

Valid since (year): 2001

**Completed by:**
Name: Jan Weinberger, Eva Gelová
Institution: CDV

**Guideline reference:**

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**Type of guideline:**
- [x] Existing
- [ ] Planned to be implemented
- [ ] Verified in IN-SAFETY project
- [ ] Other: ..........................................................
Guideline identification:

Road design:
- ☑ Road Risk Assessment
- Other: Information Service for road traffic participants

Type of road:
- ☑ Urban
- ☑ Peri-urban
- ☑ Rural
- ☑ Motorway
- ☑ Highway
- ☑ Other: all

Communication:
- ☑ V2V (= C2C) Vehicle (Car) to Vehicle
- ☑ V2I (= C2I) Vehicle (Car) to Infrastructure
- ☑ Other: Infrastructure to the Car

Infrastructure generally:
- ☑ Communication channels
- ☑ Data exchange
- ☑ Other: ……………………………………………………………………………

Infrastructure Traffic Management Systems:
- ☑ Variable messages signs
- ☑ Variable directions signs
- ☑ Dynamic lane allocation
- ☑ Ramp metering
- ☑ Other: ……………………………………………………………………………

Vehicle
- ☑ HMI (= MMI) – Human (Man) Machine Interface
- ☑ Design
- ☑ Other:

In-vehicle autonomous systems:
- ☑ IVIS – In-Vehicle Information Systems
- ☑ ADAS – Advanced Driver Assistance Systems
- ☑ Other: ……………………………………………………………………………

Operators’ training:
- ☑ Infrastructure operator training
- ☑ Drivers´ training
- ☑ Manual for drivers (non-mandatory)
- ☑ Other: ……………………………………………………………………………

Simulation models
- ☑ Microscopic
- ☑ Macroscopic
- ☑ Other:
- ☑ ………………………………………………………………………………………
- ☑ ………………………………………………………………………………………
Abstract of the guideline:
Principles for variable systems of road signs and equipment for variable operation information on the roads adapt the basic goals and principles of application, placement and erection real variable message signs and equipment for operating information on the roads. They route furthermore conditions for the proposal, realization and operation of variable road sign systems and equipment systems for operating information.

Technical specifications are determined for:
Authorities and subjects, who determine, adopt or suggest system of road signs, ergo application variable message signs included and equipment for operational information on the roads.
Authorities and subjects, who propose or adopt the method of road system management or assure the operating control.

All products that are as a part of the system, have to be substantiate with congruity declaration and with quality certificate, possibly with minutes inclusive examination results and their evaluation (according the Czech Law).

Each system of variable system of road signs and equipment for variable operating information is the part of complete system of road signs and it have to be solved in the cooperation with invariable system of road signs, portable system of road signs and with the activity of light signaling.

Variable system of road signs and equipment for variable operational information is the integral part of recent controlling information and communication technologies in the transport area.

Variable traffic sign and equipment for variable operating information on the road:
It is the visual tool, that affects on the drivers and other participants of the traffic;
It advertises on the danger and determine prohibitions and restrictions, which arise from the momentary traffic situation;
It works on principle in the system, which it differ from invariable traffic sign or informative board;
It provides information, which is current and immediately affected with operational or meteorological conditions;
It is element of the system, which works in the basic succession - data collection - transmission - processing - measures fixing - command to the adjustment of variable system of road signs (equipment for variable working information) - possible feedback;
The system, as a whole, requires responsibility for the correctness, currentness and reliability.

Statistical data or analysis:

Note / Background / Reference / Link etc:
A character of technical specification.
Authors: CityPlan spol. s r.o.: Ing. Jiří Landa, Ing. Petr Hofhansl
Published by: Ministry of Transport of the Czech Republic, Road Department
4A18 Guideline concerning:
Distraction when using various IVIS by various drivers categories and its impacts

Guideline native name:
**Influence of Modern In-vehicle Information Systems on Road Safety Requirements**

Guideline focus – national (country)/international: European - activity COST 352

Guideline name in English translation:

Guideline reference number:

Valid since (year): (Report delivered - December 2006)

Completed by:
Name: Eva Gelová
Institution: CDV

Guideline reference:

*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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Type of guideline:

- [ ] Existing
- [ ] Planned to be implemented
- [ ] Verified in IN-SAFETY project
- [X] Other: State-of-the-art report
### Guideline identification:

**Road design:**
- [ ] Road Risk Assessment
- [x] Other: .................................................................................................

**Type of road:**
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [ ] Motorway
- [ ] Highway
- [x] Other: .................................................................................................

**Communication:**
- [ ] V2V (C2C) Vehicle (Car) to Vehicle
- [ ] V2I (C2I) Vehicle (Car) to Infrastructure
- [ ] Other: .................................................................................................

**Infrastructure generally:**
- [ ] Communication channels
- [ ] Data exchange
- [x] Other: .................................................................................................

**Infrastructure Traffic Management Systems:**
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other: .................................................................................................

**Vehicle**
- [x] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other: .................................................................................................

**In-vehicle autonomous systems:**
- [x] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other: .................................................................................................

**Operators’ training:**
- [ ] Infrastructure operator training
- [x] Drivers’ training
- [x] Manual for drivers (non-mandatory)
- [ ] Other: .................................................................................................

**Simulation models**
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other: .................................................................................................
- [ ] .............................................................................................................
Abstract of the guideline:

The goal of the COST Action 352 is investigating the influence of In-Vehicle Information Systems on road safety. The first task of the project required review of previous and current research on this topic. The challenge is various for the information delivered by IVIS driving-related or not driving-related.

Distraction is a key issue when investigating the impact of IVIS on road safety. Definition of distraction proposed by Pettitt at al. (2005): „Distraction occurs when a driver is delayed in the recognition of the necessary information to safely maintain the lateral and longitudinal control of the vehicle (the driving task), due to some event activity, object or person, within or outside the vehicle that compels or tends to induce the driver’s shifting attention away from fundamental driving tasks by compromising the driver’s auditory, biomechanical, cognitive or visual faculties, or combinations thereof.”

The existing knowledge on the impact of IVIS on driver behaviour and road safety is considered for following four functions:

a) For non related driving tasks with integrated or nomadic systems:
   1) Phone call
   2) Consulting other information and communication services

b) And for embedded tasks with integrated or nomadic systems:
   3) Consulting traffic and weather information
   4) Consulting guidance and navigation information

A group of experts (OECD) defined the behaviour adaptation as “those types of behaviour that may occur following the introduction of changes to the road-vehicle-user system, and that were not intended by the initiators of the change” (OECD, 1990).

A task for car producers, supplier industry, authorities, and others is to help drivers to correctly estimate the potential of all warning systems. For example, proper information about the possible malfunctions of equipment and the implications shall be provided and it has to be made very clear, what the equipment is not able to do (Risser and Petica, 1998).

Differentiation according to the driver population and characteristics - novice, elderly and professional drivers regarding the IVIS usage has been investigated.

The risky effects of telematics use and the legislation frames of ITS use were also reviewed.
Statistical data or analysis:

Manipulating and using IVIS are one part of the distractive activities (Stutts et al., 2005).

There are no unified means of collecting such statistical data (unified accident reporting forms) for local authorities, which would take into account such causes of traffic accidents.

The National Police Agency of Japan has been reporting data on crashes associated with navigation systems for several years (http://www.npa.jp/english/index.htm). Phone and navigation systems were identified as the most frequent risky factors.

The National Highway Traffic Safety Administration estimates that at least 25% of police-reported crashes involve some form of driver inattention. Driver distraction is one form of inattention and is a factor in over half of these crashes. By analysing the overall 1995-1999 CDS data, that includes about 32 000 detailed police reported crashes involving at least one passenger vehicle, Stutts et al. (2001), that 8.3% of the drivers were distracted at the moment of the crash.

Stevens and Minton (2001) analyzed fatal accident reports in England and Wales over the period 1985-1995 and they found that in-vehicle distractions are reported as a contributory factor in about 2% of fatal accidents.

Note / Background / Reference / Link etc:

References:
Brusque, C. et all. COST 352 WP I Deliverable - Existing Knowledge Inventory (Fifth draft)

Traffic telematic systems and their acceptance analyses: state of the art – shortcomings potentials
(Deutsches Zentrum für Luft- und Raumfahrt, DLR, Institut für Verkehrsforschung):
This was an acceptance study with the help of expert workshops, and telephone interviews. People were asked about user needs and affinities within the fields of traffic information systems, mobility and technology. The central items of the study were the perception of the usability of traffic information systems and the potential of behaviour changes through traffic information systems.
(Sample size 2.200)

The market and potential analyses of new integrated mobility services in Germany
(Prognosis on behalf of the Federal Ministry of education and research):
Customers’ potentials for different integrated mobility services and their requirements.
(Interviews with experts and citizens from three cities in Germany were carried out: total sample size 827)

BayernInfo
(technical University Munich on behalf of the Bavarian Government):
Evaluation of the project "BayernInfo" which has the goal to improve the distribution of traffic information through various channels
(Interviews, total sample size 866)
4A19 Guideline concerning:

**Safety management - results of RIPCORD–ISEREST consortium**

**Guideline native name:**

**Safety Handbook for Secondary Roads**

**Guideline focus – national (country)/international:** international - Europe

**Guideline name in English translation:**

**Guideline reference number:**

Valid since (year): planned for 2008

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**Type of guideline:**

- Existing
- Planned to be implemented
- Verified in IN-SAFETY project
- Other: findings of RIPCORD–ISEREST
Guideline identification:

Road design:

☐ Road Risk Assessment
☒ Other: Self explaining roads, Forgiving roads

Type of road:

☐ Urban
☐ Peri-urban
☒ Rural
☐ Motorway
☐ Highway
☐ Other: ........................................................................................................

Communication:

☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other: ........................................................................................................

Infrastructure generally:

☐ Communication channels
☐ Data exchange
☐ Other: ........................................................................................................

Infrastructure Traffic Management Systems:

☒ Variable messages signs
☒ Variable directions signs
☒ Dynamic lane allocation
☐ Ramp metering
☐ Other: ........................................................................................................

Vehicle

☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other: ........................................................................................................

In-vehicle autonomous systems:

☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other: ........................................................................................................

Operators´ training:

☐ Infrastructure operator training
☐ Drivers´ training
☐ Manual for drivers (non-mandatory)
☐ Other: ........................................................................................................

Simulation models

☐ Microscopic
☐ Macroscopic
☐ Other:

.................................................................
### Abstract of the guideline:
The objective of RIPCORD-ISEREST is to develop best practice guidelines based upon the current research results for:
- Road Safety Impact Assessment tools and Accident Prediction Models
- Road Design and Road Environment
- Road Safety Audit
- Road Safety Inspection
- Black Spot Management and Safety Analysis of Road Network

Furthermore regarding safety interventions secondary roads – roads not compromised by the primary network such as freeways and highways - so far got much less attention than primary roads even though a large proportion of fatalities in rural areas occur on secondary roads. Still, design guidelines for these types of roads rarely exist within Europe. As a result a vast number of these roads are in a state, which is inappropriate to modern road traffic. To fill this gap, RIPCORD-ISEREST will develop a Safety Handbook for Secondary Roads.

The project combines a team of 17 partners from 14 nations covering scientific organizations, road safety institutes, universities, road authorities and private companies. Starting in 2005, the project duration will be three years.

### Statistical data or analysis:
NA

### Note / Background / Reference / Link etc:
http://www.ripcord-iserest.com/
4A20 Guideline concerning:
Standards for vertical road traffic signs incl. VMS
Guideline native name:
CEN Standards for road vertical signs
Guideline focus – national (country)/international: international - Europe
Guideline name in English translation:
Guideline reference number:
Valid since (year):

Completed by:
Name: Martin Winkelbauer
Contact: KfV

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:
☑ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:..................................................................................................
**Guideline identification:**

Road design:
- [ ] Road Risk Assessment
- [ ] Other: ……………………………………………………………………

Type of road:
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [ ] Motorway
- [ ] Highway
- [x] Other: all types of roads

Communication:
- [ ] V2V (= C2C) Vehicle (Car) to Vehicle
- [ ] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other: ……………………………………………………………………

Infrastructure generally:
- [ ] Communication channels
- [ ] Data exchange
- [x] Other: roadside posts

Infrastructure Traffic Management Systems:
- [x] Variable messages signs
- [x] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other: ……………………………………………………………………

Vehicle
- [ ] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other: ……………………………………………………………………

In-vehicle autonomous systems:
- [ ] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other: ……………………………………………………………………

Operators´ training:
- [ ] Infrastructure operator training
- [ ] Drivers´ training
- [ ] Manual for drivers (non-mandatory)
- [ ] Other: ……………………………………………………………………

Simulation models
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
  - [ ] …………………………………………………………………………

### Abstract of the guideline:

The European standardization for traffic signs and variable message signs for production, implementation and operation includes following specific technical standards:

- **EN 12899-1**
  Fixed, vertical road traffic signs - Part 1: Fixed signs

- **EN 12899-2**
  Fixed, vertical road traffic signs - Part 2: Transilluminated traffic bollards (TTB)

- **EN 12899-3**
  Fixed, vertical road traffic signs - Part 3: Delineator posts and retroreflectors

- **EN 12899-4**
  Fixed, vertical road traffic signs - Part 4: Factory production control

- **EN 12899-5**
  Fixed, vertical road traffic signs - Part 5: Initial type testing

- **EN 12966-1**
  Road vertical signs - Variable message traffic signs - Part 1: Product standard

- **EN 12966-2**
  Road vertical signs - Variable message traffic signs - Part 2: Initial type testing

- **EN 12966-3**
  Road vertical signs – Variable message traffic signs - Part 3: Factory production control

### Statistical data or analysis:

Not applicable

### Note / Background / Reference / Link etc:

http://www.cen.eu
4A21 Guideline concerning:
Experience after the Vienna convention
Guideline native name:
Europaeism for making understandability of traffic signs/messages easy
Guideline focus – national (country)/international: Europe
Guideline name in English translation:
Completed by:
Name: Christian Galinski
Institution: INFOTERM

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Type of guideline:
- ☐ Existing
- ☐ Planned to be implemented
- ✗ Verified in IN-SAFETY project
- ☐ Other:
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other:………………………………………………………………………………

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: all types of roads

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:………………………………………………………………………………

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☐ Other:………………………………………………………………………………

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:………………………………………………………………………………

Vehicle
☒ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other:………………………………………………………………………………

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:………………………………………………………………………………

Operators´ training:
☐ Infrastructure operator training
☐ Drivers´ training
☐ Manual for drivers (non-mandatory)
☐ Other:………………………………………………………………………………

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☒ Understandability of traffic signs for road users
☐ …………………………………………………………………………………
Abstract of the guideline:
Studies have shown that the road/traffic signs, as laid down in the Vienna convention, are implemented and still being implemented with different design and modifications in various countries in Europe (not to mention the world). Besides, road/traffic signs are also classified differently in various countries in Europe (s. Diploma thesis Myrjam Ansorge, p. 32-35).

Generally speaking, the road/traffic signs are a semiotic system of information carriers, which broadly comprise danger warning signs (DE: Gefahrzeichen, AT: Gefahrenzeichen), regulatory signs (DE: Vorschriftzeichen, AT: Vorschriftszeichen) and informative signs (DE: Richtzeichen, AT: Hinweiszeichen). Regulatory signs are further subdivided into prohibitory or restrictive signs (AT: Verbots- or Beschränkungszeichen), mandatory signs (AT: Gebotszeichen) and priority signs (AT: Vorrangzeichen). Warnings, regulations and information are conveyed to traffic participants by means of colour, form, icons/pictograms (DE: Sinnbilder), and verbal additions. Road/traffic signs thus contribute substantially to traffic safety, not least due to the fact that a number of pragmatic rules are connected to them. This means that traffic safety also largely depends on the correct and unimpeded decoding of the message conveyed in the communication process from a road/traffic sign to the receiver (driver, pedestrian, etc.).

Basically road/traffic signs may consist of the road/traffic sign proper, additional signs above and/or below the road/traffic sign. Several such road/traffic signs together may form an even more complex message to the driver. According to the above-mentioned semiotic system the road/traffic signs are composed of different “morphological” elements (i.e. syntax), such as basic symbol (DE: Grundzeichen) danger warning symbol (DE: Gefahrenwarnzeichen) prohibitory symbol (DE/AT: Verbotszeichen) mandatory symbol (DE/AT: Gebotszeichen) informative symbol (DE/AT: Hinweiszeichen) reference symbol (DE: Bezugszeichen) additional signs (DE: Zusatzzeichen), which in themselves may be composed of several syntactic and semantic elements.

Verbal message elements can occur in combination with the reference symbol (DE: Bezugszeichen) (e.g. 10% [Steigung/Gefälle], 60 [km per hour speed limit], 6t [weight limit], etc.) or within additional signs (e.g. no /bicycles/, except /motorbikes/, …) or in informative signs (Richtzeichen/Hinweiszeichen) (e.g. city names, distance indications, etc.).

The semantics of a road/traffic sign derive from the combination of the individual morphological elements, such as in: basic symbol (Grundzeichen:) prohibition/restriction (DE: Verbot) reference symbol (Bezugszeichen:) + car (= cars/vehicles prohibited; DE: Verbot für Autos) additional sign (Zusatzzeichen:) + motorbike allowed (= vehicles prohibited, except motorbikes; DE: Motorradfahrer dürfen fahren)
total information (Gesamtinformation:) vehicles prohibited, except motorcycles (DE: Verbot der Einfahrt für alle Kfz, mit Ausnahme von Motorrädern)

Virtually all syntactic elements show variation in different countries in Europe. They vary virtually in every aspect: size, color (and coating), production details, symbol shapes, letter size and fonts, etc. In addition they are often used inconsistently within the same country, due to deviations between two or more regulatory documents. In Germany for instance the name of the traffic sign is sometimes capitalized, sometimes not. Especially in the UK it is quite difficult to identify a correct official name of a traffic sign, e.g. for vehicles exceeding height indicated prohibited (acc. to TSRGD) mandatory height restriction (acc. to Traffic Signs Manual) no vehicles over height shown (acc. to The Highway Code) vehicle height limit (acc. to Working Drawings for TS) since different government agencies call this and other traffic signs differently.

Statistical data or analysis:

Note / Background / Reference / Link etc:
Please, see the linked information in the chapter “Research need”.
4A22 Guideline concerning:

Findings of IN-SAFETY – multi-actor multi-criteria analysis

Proposal for policy guidelines based on initial prioritisation of scenarios

Guideline focus – national (country)/international:

Guideline name in English translation:

Guideline reference number:

Valid since (year):

Completed by:
Name: Klaas de Brucker,
Institution: VUB
Name: C. Macharis
Institution: VUB

Guideline reference:

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Type of guideline:

☑️ Existing
☒ Planned to be implemented
☑️ Verified in IN-SAFETY project
☐ Other:
Guideline identification:

Road design:
- [ ] Road Risk Assessment
- [ ] Other: ..............................................................

Type of road:
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [ ] Motorway
- [ ] Highway
- [ ] Other:

Communication:
- [ ] V2V (= C2C) Vehicle (Car) to Vehicle
- [ ] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other:

Infrastructure generally:
- [ ] Communication channels
- [ ] Data exchange
- [ ] Other: importance of planned activities vs. strategic goals of various actors

Infrastructure Traffic Management Systems:
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other:

Vehicle
- [ ] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other:

In-vehicle autonomous systems:
- [ ] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other

Operators´ training:
- [ ] Infrastructure operator training
- [ ] Drivers´ training
- [ ] Manual for drivers (non-mandatory)
- [ ] Other: ..............................................................

Simulation models
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [ ] Multiactors multicriteria analysis for weighing of importance
- [ ] Support for decision makers
Abstract of the guideline:

Introduction: methodology

The concepts of forgiving roads (FOR) and self-explaining roads (SER) turned out to be highly interdependent. This is due to the fact that a number of parameters/conditions instrumental to creating a particular state for either of these two environments will also affect the state of the other.

In WP1 and WP2 several alternative ways of creating FOR and SER environments were explored. A total of 18 potential or alternative ways for creating FOR and SER scenarios was developed. This set of 18 alternatives was constructed by combining six main types of safety-related errors (speeding in unexpected sharp bends on rural roads, speeding in general, violation of priority rules, wrong use of road, failure while overtaking, insufficient safety distance) with three dimensions along which systems can be developed (vehicle, infrastructure and a co-operative tool). These 18 alternatives were prioritized using a multi-actor multi-criteria analysis (MAMCA).

This specific and innovative approach to MCA allows various stakeholders with an interest in improving the present state of SER and FOR to understand which types of future states command the highest expected 'value added' from the community of stakeholders in its entirety, thereby uncovering information on the probability of successful implementation. Three main stakeholders were identified, namely users, society/public policy makers and manufacturers. The overall relative priorities reflecting the society’s point of view also correspond with the policy point of view. These overall relative priorities are to be taken as a starting base for policy purposes. The overall relative priorities of the users correspond with the user needs, and may therefore be indicative of the user acceptance of alternatives. The overall relative priorities of the manufacturers correspond with the perceived market value of the alternatives, meaning that if these priorities correspond with those of society, it is very likely they will be implemented by the market system, without much need for government intervention. In contrast, in the case of strong discrepancies between market priorities and society’s priorities, government regulation may be needed.

All the details of MCA procedure described above and its results can be found in IN-SAFETY D1.1 (Chapter 5) and D2.1 (Chapter 7).

Proposals for guidelines

The basic assumption of the research project was that the combination of infrastructure and telematics measures can provide a more cost-efficient solution, avoiding performing expensive infrastructure works by providing the same function through a telematics or other innovative system.

As regards the relative priorities of the alternatives, the IN-SAFETY project (WP1 and WP2) revealed that there are substantial differences in the rankings of alternatives depending on the point of view of the stakeholder groups ‘users’, ‘society/public policy makers’ and ‘manufacturers’.

From the societal point of view, alternatives focused on speeding (e.g. speed limit presented to the driver by VMS, speed alert system by recognition of traffic signs, etc.) are considered the most desirable, given their substantial impact on traffic safety, which was considered an important criterion by public policy makers.

Speeding related alternatives are not considered desirable from the point of view of the manufacturers or users. When the three alternatives regarding speeding are compared with each other, it turns out that the autonomous infrastructure alternative (e.g. speed limit presented to the driver by VMS) is less undesirable than the autonomous in-vehicle alternative (e.g. speed alert system by recognition of traffic signs), or the cooperative alternative (i.e. cooperating between vehicle and infrastructure, such as e.g. the speed alert system based on digital maps containing legal speed limits with additional info on recommended safe speed).

Manufacturers consider the autonomous, infrastructure based alternatives (e.g. traffic signs, separation of lanes by rumble strips where overtaking is forbidden, VMS signaling the danger
of the bend depending on actual speed and type of vehicle approaching, audible delineation) to be the most desirable, not only with regard to the speeding related alternatives, but regarding all alternatives. This is mainly caused by the liability problems involved in vehicle alternatives, which is the most important criterion for the manufacturers.

Users most often rank the vehicle related alternatives (e.g. advanced cruise control, lane departure warning assistant) at the bottom (with the exception of alternatives regarding bends and failure while overtaking). To a large extent, this is caused by the costs accruing to the user, and also to the relatively smaller effects on driver safety, as these are the most important criteria for the user.

A former research project ‘ADVISORS’ yielded comparable results. This research project was not specifically related to FOR and SER, but about ADAS in general. The results of ADVISORS suggest that the most promising ADAS include the integrated system, the driver monitoring systems, mandatory ISA and ACC. However, the various systems are viewed attractive for different reasons: for example, mandatory ISA provides high societal benefits, due to its substantial safety effects, whereas the ACC system results in lower safety or traffic benefits but is associated with a higher user desirability.

Also the stakeholder analysis conducted in ADVISORS revealed that users, as well as manufacturers, seem not to be in favour of mandatory forms of ISA. Society, however, seems to prefer mandatory forms of ISA, due to its substantial safety effects. The conclusion here was that if society would like to propagate the use of mandatory forms of ISA both substantial incentives and a media campaign may be necessary.

### Statistical data or analysis:

**Note / Background / Reference / Link etc:**

http://www.insafety-eu.org/

IN-SAFETY D1.1 (Chapter 5) and D2.1 (Chapter 7)
4A23 Guideline concerning:

**CEN and financing of standardization activities through the EC**

Guideline native name:

**CEN procedures and CEN/TC 278**

Guideline focus – national (country)/international: Europe

**Guideline name in English translation:**

Guideline reference number: CEN/TC 278, WG1 – WG15

Valid since (year): (current situation - 2007)

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**Completed by:**
Name: Christian Galinski
Institution: INFOTERM

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**Guideline reference:**

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**Type of guideline:**
- ☒ Existing
- ☒ Planned to be implemented
- ☐ Verified in IN-SAFETY project
- ☒ Other: CEN procedures
### Guideline identification:

Road design:
- [ ] Road Risk Assessment
- [x] Other: .................................................................

Type of road:
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [ ] Motorway
- [ ] Highway
- [x] Other: all types

Communication:
- [ ] V2V (= C2C) Vehicle (Car) to Vehicle
- [ ] V2I (= C2I) Vehicle (Car) to Infrastructure
- [x] Other: depending on the WG

Infrastructure generally:
- [ ] Communication channels
- [ ] Data exchange
- [x] Other: depending on the WG

Infrastructure Traffic Management Systems:
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [x] Other: depending on the WG

Vehicle
- [ ] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [x] Other: depending on the WG

In-vehicle autonomous systems:
- [ ] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [x] Other: depending on the WG

Operators´ training:
- [ ] Infrastructure operator training
- [ ] Drivers´ training
- [ ] Manual for drivers (non-mandatory)
- [x] Other: .................................................................

Simulation models:
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [x] Standardization procedures
- [ ] .................................................................
Abstract of the guideline:
There are two types of approaches when attempting to achieve a standard for a given topic at European level:
a regular standard of a CEN/TC
a CWA (CEN Workshop Agreement) of a CEN/ISSS Workshop, which is equivalent to an ISO/PAS (or prestandard type of document).
CEN/ISSS is the sub-organization “Information Society Standardization System” of the European Standards Committee (CEN).

The main task of a CEN/ISSS Workshop, as a rule, is to prepare CWAs (CEN Workshop Agreements). Such CWAs can also take the nature of a guide or recommendation or study etc. As a standard-like document, a CWA has a “life-cycle” of 3 years (which can be extended for another period, if the Workshop still exists). As a rule such a CWA – which is equivalent to a PAS (Publicly Available Specification) in ISO – should ultimately lead to an EN or ISO standard. The advantage of having a contract with the CEC for a WS project is that experts can be paid for working on a CWA,
the costs for the WS secretariat are covered,
CEN/ISSS receives a share of the contract for “hosting” the project.
In addition, there is an increased visibility and a certain recognition on the CEC’s side for the project and its results (depending on the personal engagement of the respective project officer and his/her superiors in the CEC).

On the other hand, the efforts necessarily to apply for a contract are quite big. Compared to this, the costs for collecting the money from industry and have industry experts preparing the CWA would be in the range of EUR 20,000 to EUR 30,000 (incl. about 20% for CEN/ISSS). This is possibly not much more than the costs for the activities in connection with the project proposal (and its admission).

For standardization in the field of the automotive industry, the CEN/TC 278 “Road transport and traffic informatics” is responsible (Secretariat with NEN, Netherlands). A CEN/TC’s main task is to prepare EN standards or, at least, specifications. There have been cases, where a CEN/TC opposed the establishment of a CEN/ISSS/WS, although the scope of that Workshop did not really interfere with the scope and the tasks of that TC. This might be the case of CEN/TC 278, which has a quite broad scope:
CEN/TC 278/WG 1 Electronic fee collection and access control (EFC)
CEN/TC 278/WG 2 Freight and Fleet Management systems (FFMS)
CEN/TC 278/WG 3 Public transport (PT)
CEN/TC 278/WG 4 Traffic and traveller information (TTI)
CEN/TC 278/WG 5 Traffic control (TC)
CEN/TC 278/WG 7 Geographic road data (GRD)
CEN/TC 278/WG 8 Road traffic data (RTD)
CEN/TC 278/WG 9 Dedicated Short Range Communication (DSRC)
CEN/TC 278/WG 10 Man-machine interfaces (MMI)
CEN/TC 278/WG 12 Automatic Vehicle Identification and Automatic Equipment Identification (AVI/AEI)
CEN/TC 278/WG 13 Architecture and terminology
CEN/TC 278/WG 14 After theft systems for the recovery of stolen vehicles
CEN/TC 278/WG 15 eSafety

On the other hand some of the aspects worth to be harmonized are not or not fit for a regular standard (which in addition would take a couple of years to be properly prepared and passed).
**Statistical data or analysis:**
Not relevant

**Note / Background / Reference / Link etc:**

**Note 1:**
Some of the aspects, having worth to be harmonized, are not, or do not fit for, a regular standard (which in addition would take a couple of years to be properly prepared and passed).

**Note 2:**
The personal situation in 2007:
Although standardization – in particular ICT standardization – is an item on the strategic agenda of the CEC, reality is rather “complex” (not to say sobering). In terms of hierarchy, it comes under the DG - Heinz Zourek (AT), who is working under Commissioner Günter Verheugen (DE).
In the Directorate D, which is responsible for ICT and eBusiness standardization from the technical point of view, the position of Director is vacant (acting Dir. Jean-Noël Durvy) Actual work is done in the unit of Constantin Andropoulos (GR, Head of Unit D), who also covers certain classification aspects (e.g. in eProcurement). Under the Director Pedro Ortun (ES), the Head of Unit I - Norbert Anselmann (DE) is responsible for standards policies and development.
4A24 Guideline concerning:
**Technical specification for road design**

**Guideline native name:**
Richtlinien für die Anlage von Straßen

**Teil: Linienführung (RAS-L), Ausgabe 1995**

Guideline focus – national (country)/international: national (Germany)

**Guideline name in English translation:** Guidelines for road design, part: alignment

Guideline reference number: FGSV Nr. 296 (FGSV-Verlag, Wesselinger Str. 17, 50999 Koeln, www.fgsv-verlag.de)

Valid since (year): 1995

**Completed by:**
Name: Katja Stumpf, Tim Wallrabenstein
Institution : TU Darmstadt

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**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- X Existing
- Planned to be implemented
- Verified in IN-SAFETY project
- Other: ........................................................................................................

January 2008 185 VUB-CDV
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Abstract of the guideline:
The guidelines describe the principles, methods, limits and standards for new and redesign of road as well as for the extension of roads in urban and rural areas. The geometric design of the road and the advices and principles for spatial alignment and design of driving space are given.

Statistical data or analysis:
No statistical data available.

Note / Background / Reference / Link etc:
(FGSV-Verlag, Wesselinger Str. 17, 50999 Koeln, [www.fgsv-verlag.de](http://www.fgsv-verlag.de))
4A25 Guideline concerning:
**Technical specification for traffic management**

Guideline native name:
**Allgemeine Verwaltungsvorschrift zur Straßenverkehrs-Ordnung (VwV-StVO), 1970**

Guideline focus – national (country)/international: national (Germany)

**Guideline name in English translation:** General administrative regulation of road traffic regulations

Guideline reference number: Bundesgesetzblatt

Valid since (year): 1970

Completed by:
Name: Katja Stumpf, Tim Wallrabenstein
Institution: TU Darmstadt

Guideline reference:
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**

- X Existing
- Planned to be implemented
- Verified in IN-SAFETY project
- Other:........................................................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other: …………………………………………………………………………..

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: …………………………………………………………………………..

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: …………………………………………………………………………..

Infrastructure generally:
- Communication channels
- Data exchange
- Other: …………………………………………………………………………..

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: …………………………………………………………………………..

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: …………………………………………………………………………..

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: …………………………………………………………………………..

Operators’ training:
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other: …………………………………………………………………………..

Simulation models
- Microscopic
- Macroscopic
- Other:
- …………………………………………………………………………………
**Abstract of the guideline:**
The regulations give advices how to deal with the road traffic regulations. You can find a commentary of these regulations in „Hinweise für das Anbringen von Verkehrszeichen und Verkehrseinrichtungen 12. Aufl., 2002” (advices for the application of traffic signs and transport facilities).
The commentary is a traffic engineering commentary of the laws, regulations and writs, which deal with the application of traffic signs and transport facilities. They give suggestions and recommendations, which are based on practical experiences.

**Statistical data or analysis:**
No statistical data available.

**Note / Background / Reference / Link etc:**
4A26 Guideline concerning:
**Terminology of Best, Good, Promising Practices**

Guideline native name:
**Findings of the SUPREME project**

Guideline focus – national (country)/international: Europe

**Guideline name in English translation:**
Guideline reference number:
Valid since (year):

**Completed by:**
Name: Martin Winkelbauer
Institution: KfV

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- ☐ Existing
- ☐ Planned to be implemented
- ☐ Verified in IN-SAFETY project
- ☒ Other: Verified in the SUPREME project
### Guideline identification:

**Road design:**
- Road Risk Assessment
- Other: .................................................................

**Type of road:**
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: ........................................................................

**Communication:**
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: ........................................................................

**Infrastructure generally:**
- Communication channels
- Data exchange
- Other: ........................................................................

**Infrastructure Traffic Management Systems:**
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: ........................................................................

**Vehicle**
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: ........................................................................

**In-vehicle autonomous systems:**
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: ........................................................................

**Operators’ training:**
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other: ........................................................................

**Simulation models**
- Microscopic
- Macroscopic
- Other:
  - Terminology, definition
  - ........................................................................
Abstract of the guideline:

Method:

The SUPREME project developed a clear definition of what should be considered to be "best practice". Here the 8 criteria:

1. Focus of the measure: Best Practice Measures (BPM) have a clearly defined focus. This includes a clear definition of the road safety problem to be solved and precise idea of how the measure will affect this problem.
2. Size of the road safety problem: BPM aim at reducing traffic accidents or risk factors which stand for a large proportion of severe injuries and fatalities in road accidents.
3. Expected effects on safety: BPM provide a quantitative assessment of the likely impact of the measure on accidents or on risk factors.
4. Evaluation of effects: An evaluation of effects of BPM on road safety is ideally based on accident statistics. Ideally, the implementation of BPM results in an obvious reduction of fatalities and severe injuries.
5. Costs and benefits: BPM provide a cost-benefit analysis with the result that benefits exceed their costs.
6. Acceptance: BPM have good public and policy maker acceptance.
7. Sustainability: BPM are not single events, they are rather characterised by duration and continuity. Likewise their effects on road safety are long-term effects.
8. Transferability: BPM include strategies for using the measure successfully on a larger scale, either on the regional, national or European level."

In SUPREME, there were also defined "good practice" and "promising practice", as follows:
A) Measures were called "good practice", if quantitative information of the safety impact or information about cost-benefit ratio was weak or partly missing.
B) Measures were considered "promising practice", if there was a sound theory behind it addressing safety-relevant parameters and pilot-studies yielded positive results.

(SUPREME Project team)

Statistical data or analysis:
NA

Note / Background / Reference / Link etc:
You can find more information about SUPREME in the official project website:
4A27 Guideline concerning:
Methodology for statistical road risk assessment; ex-ante and ex-post analysis
Guideline native name:
Unfallgeschehen im Bereich von Verkehrssteuerungsanlagen unter besonderer Berücksichtigung der Verkehrsbelastung
Guideline focus – national (country)/international: national (Germany)
Guideline name in English translation: Accident frequency in the area of Traffic Control Devices with a specific consideration of traffic volume
Guideline reference number: Forschungsprojekt FE 03.278 G93F der Bundesanstalt für Straßenwesen
Valid since (year): (1999)

Completed by:
Name: Eva Gelová
Institution: CDV

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:
☐ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☒ Other: Verified in the German Forschungsprojekt FE 03.278 G93F
Guideline identification:

Road design:
- Road Risk Assessment
- Other:

Type of road:
- Urban
- Peri-urban
- Rural
- Motorways: with 2-3 traffic lanes in one direction
- Highway
- Other:

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other:

Infrastructure generally:
- Communication channels
- Data exchange
- Other:

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other:

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other:

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other:

Operators´ training:
- Infrastructure operator training
- Drivers´ training
- Manual for drivers (non-mandatory)
- Other:

Simulation models
- Microscopic
- Macroscopic
- Other:

Other:
Abstract of the guideline:
The traffic safety increase depends on considerable implementation goals of Traffic Control Devices (TCD). That’s why it is necessary to develop procedures for quantification of safety benefits in area of the control systems. The procedures shall also enable valuation of the prospective safety benefits for planned control systems. In this development project, solely the TCD were investigated.
The methodology includes investigation of TCD influence on traffic safety under various conditions. This methodology follows a consideration that traffic safety in specific traffic load grades will be variously impacted by implementation of the control systems. That is included also in the procedure - with a respect to metering of safety benefits (ex-post or ex-ante).
There were taken into account only accidents with personal damages (German classification - Types 1, 6 and 7). In particular, mass accidents were complex investigated.

The following procedures were used:
An overview of principal goals on mechanisms for traffic flow influencing
A general description of context between accident frequency and traffic load
A systematic analyse of accident history in regard of existing TCD (10 devices) in a before/after comparison
An investigation of road safety increase when using implementation of equipments for route influencing (TCD)

When implementing TCD, it is possible to reach a significant benefit for enhancing the traffic safety - at higher traffic load, in the foggy weather and concerning mass accidents. An added value is an improvement of environment data examination (above all under the wet and icy conditions).

Statistical data or analysis:
The whole project was statistics oriented.
For the accidents amount, when using TCD, it has been planned, based on the results of investigation, to suggest a specific coefficient for roads with 2 and 2-3 traffic lines on the level of 12,0 accidents pro 108 Fz x km and for roads with 3 traffic lines on the level of 12,5 accidents pro 108 Fz x km.

Note / Background / Reference / Link etc:
The report prepared by IVT Ingenieurbüro für Verkehrstechnik GmbH, Karlsruhe
4A28 Guideline concerning:
Findings of the RANKERS project
Guideline native name:
**RANKing for European Roads Safety**
Guideline focus – national (country)/international: international - Europe
**Guideline name in English translation:**
Guideline reference number:
Valid since (year): (info - 2006)

Completed by:
Name: Eva Gelová
Institution: CDV

Guideline reference:
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Type of guideline:
- [ ] Existing
- [ ] Planned to be implemented
- [ ] Verified in IN-SAFETY project
- ☑ Other: Verified in RANKERS project
Guideline identification:

Road design:
☒ Road Risk Assessment
☐ Other:______________________________________________________________

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: all types of roads

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:______________________________________________________________

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☒ Other: classic and new, easy and cost effective solutions for road safety

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:______________________________________________________________

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other:______________________________________________________________

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:______________________________________________________________

Operators´ training:
☒ Infrastructure operator training
☐ Drivers´ training
☐ Manual for drivers (non-mandatory)
☐ Other:______________________________________________________________

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☐ ________________________________________________________________
Abstract of the guideline:

The project has prepared scientifically researched guidelines enabling optimal decision-making by road authorities, in their efforts to promote safer roads and eradicate dangerous road sections.

The main goal was to gain new knowledge by performing research and empirical studies of the road’s interaction with the driver and his vehicle in order to identify optimal road recommendations and predict their impact on safety. The main output of the project will include an index used for assessing and monitoring road safety and a comprehensive catalogue of road infrastructure safety recommendations ranked according to their cost-effectiveness.

When road safety policy is analyzed, three main areas of action can be defined corresponding to the three main actors involved in road safety: human, vehicle, and infrastructure. The three of them, usually called “the three safety pillars” are addressed in different ways. However, this range of domains must be dealt with subject to budget limitations. Consequently, cost efficiency of systems and measures needs to be a decisive factor for policy making. Road infrastructure, as the most visible component of the road transport network, represents an area where safety investments can have an immediate benefit.

RANKERS is unique in that it proposes to address traditional passive safety measures (“forgiving roads”) together with a better understanding of the accident causation scenarios, leading to a significant mitigation of the risks posed by the road and its environment. The roads design should be directly focused to the concept of making “self-explaining roads”, that is to say, advocating a traffic environment which elicits safe driving behaviour simply by its design so that the road user is neither confused nor invited to take risks.

Road Safety Index: One of the main outputs of RANKERS includes an index used for assessing and monitoring the objective risks posed by the road environment. This index will give evidence of the risk factor of a road section by means of the estimation of its driver protection (passive safety) and prevention levels (active safety). By building accurate, objective criteria for the evaluation of each safety feature of a road, current Road Safety Audit and Inspection procedures will be upgraded and roads sections will be prioritised according to their objective needs.

The second major RANKERS deliverable is a comprehensive catalogue of road infrastructure safety recommendations, ranked according to their efficiency. This list is intended to provide practical information to road operators, national road authorities and safety auditors on a cost-efficient and safety oriented management of road infrastructure.

The implementation plan for RANKERS comprises three main areas of work:
1) Identification of accident scenarios and accident causation mechanisms based on existing research on road safety reviews,
2) Analysis of road passive safety infrastructure, vehicle-road surface interaction and human behaviour, and
3) Recommendations for safe road infrastructure management validated by field tests.

(Guillermo RAMOS; 2006)
<table>
<thead>
<tr>
<th><strong>Statistical data or analysis:</strong></th>
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<tbody>
<tr>
<td>Road safety recommendations include for a specific solution cost-benefit analyse - costs (in €) vs. accident cost reduction (in %), what means objective, measurable parameters.</td>
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<th><strong>Note / Background / Reference / Link etc:</strong></th>
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<tr>
<td>RANKERS follows the RISER Project (Roadside Infrastructure for Safer European Roads)</td>
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4A29 Guideline concerning:
Findings of the IN-SAFETY project
Guideline native name:
Economic Assessment of Safety Benefits
Guideline focus – national (country)/international: international - Europe
Guideline name in English translation: .................................................................
Guideline reference number: ...........................................................................
Valid since (year): 2007

Completed by:
Name: Knut Veisten
Institution: TOI

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:
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- [ ] Planned to be implemented
- [x] Verified in IN-SAFETY project
- [ ] Other:
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| □ Peri-urban |
| □ Rural |
| □ Motorway |
| □ Highway |
| ☒ Other: all types of roads |
| Communication: |
| □ V2V (= C2C) Vehicle (Car) to Vehicle |
| □ V2I (= C2I) Vehicle (Car) to Infrastructure |
| □ Other:………………………………………………………………………………
| Infrastructure generally: |
| □ Communication channels |
| □ Data exchange |
| □ Other:………………………………………………………………………………
| Infrastructure Traffic Management Systems: |
| □ Variable messages signs |
| □ Variable directions signs |
| □ Dynamic lane allocation |
| □ Ramp metering |
| □ Other:………………………………………………………………………………
| Vehicle |
| □ HMI (= MMI) – Human (Man) Machine Interface |
| □ Design |
| □ Other:………………………………………………………………………………
| In-vehicle autonomous systems: |
| □ IVIS – In-Vehicle Information Systems |
| □ ADAS – Advanced Driver Assistance Systems |
| □ Other:………………………………………………………………………………
| Operators’ training: |
| □ Infrastructure operator training |
| □ Drivers’ training |
| □ Manual for drivers (non-mandatory) |
| □ Other:………………………………………………………………………………
| Simulation models |
| □ Microscopic |
| □ Macroscopic |
| □ Other:………………………………………………………………………………
| □ Economic analysis |
| □………………………………………………………………………………
Abstract of the guideline:

There are two main methods for economic analysis of public projects: cost-effectiveness analysis (CEA) and cost-benefit analysis (CBA). From the perspective of CEA, the most effective safety measure is either the one that reduces most fatalities/injuries (or injury accidents) at a given cost ("effect maximization") or reaches a desired fatality/injury reduction at the lowest cost ("cost minimization"). Thus, the cost-effectiveness of a road safety measure can, e.g., be defined as the number of fatalities/injuries, or injury accidents, prevented per unit cost of implementing the measure (Elvik et al. 2005, Vlakveld et al. 2005):

\[
\text{Cost-effectiveness ratio} = \frac{\text{number of injury accidents prevented}}{\text{cost of safety measure}}
\]

The number of injury accidents prevented forms the numerator, consistent with the idea that one wants to maximize the cost-effectiveness ratio.

CBA compares the costs of the measure to the benefits, where benefits are monetized values of the safety effect – the prevented fatalities and injuries. Efficiency in CBA is assessed with the net present value, the discounted value of all benefits and costs to the year 0 (or year 1) of the safety project, defined as:

\[
\text{Net present value} = \text{Present value of all benefits} - \text{Present value of campaign costs}
\]

If the net present value is positive the project is economically efficient. However, for a comparison of campaigns of different size (cost) the benefit-cost ratio is more handy – and it is defined as:

\[
\text{Benefit-cost ratio} = \frac{\text{present value of all benefits}}{\text{present value of costs of measure}}
\]

As is easily seen, when the net present value is positive, the benefit-cost ratio exceeds the value of 1.

For the purposes of IN-SAFETY WP5, in the cost-benefit analysis, the costs for the infrastructure and vehicle equipment were compared with the benefits of avoided target accidents (i.e. avoided costs). The accident data analysis took into account the scenario related accident causes (e.g. inappropriate speed) and types (e.g. run-of-the-road-accidents) and other criteria such as the location where the accidents happened (e.g. curve on rural road).

Statistical data or analysis:

Note / Background / Reference / Link etc:
4A30 Guideline concerning: 
I2V communication (1) – IN-SAFETY pilot project 
Guideline native name: 
**Infrastruktur till fordon kommunikation**
Guideline focus – national (country)/international: 
Guideline name in English translation: Infrastructure to vehicle communication 
Guideline reference number: .................................................................
Valid since (year): 2007

**Completed by:**
Name: Anna Anund  
Institution: VTI

**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
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- [ ] Other:.................................................................
**Guideline identification:**

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<th>Type of road:</th>
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<tr>
<th>Infrastructure Traffic Management Systems:</th>
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<th>Vehicle</th>
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<th>☐ Macroscopic</th>
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| ☐ Other: | | | |
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Abstract of the guideline:

*In vehicle information – in order to reduce speed*
The aim was also to evaluate the effectiveness of in-vehicle information about temporarily on-coming events e.g. when a school bus stops for taking off or leaving children at roadside.

The subjects were confronted with two situations with a parked school bus during each drive. One situation without prior warning and one situation with an in-vehicle warning before the school bus became visible.

The results support the hypothesis that an in-vehicle warning results in lower speeds when passing the bus compared to a no prior warning situation. Especially the speed development shortly before passing the parked bus was more favourable in terms of traffic safety when the drivers had received the warning. There is consequently a potential to use in-vehicle information to reduce speeds during temporary safety critical events. No difference in lateral position for the warning compared to the no warning situations was found. However, all subjects kept a safety distance to the bus. A tendency towards increased safety distance for the rumble strip scenarios compared to the no rumble strip scenario was also found.

Possible adaptation effects on such a warning strategy should be examined in a long time study.

Statistical data or analysis:
Regarding this guideline, do you have any statistical data (before & after analysis), which would support implementation of across Europe (Road Risk Assessment, accident rate reduction, etc.)?

The results are based on a driving simulator study done as one pilot within INSAFETY.

The pilot was carried through in the VTI moving base driving simulator using a simulated environment representing a Swedish two-lane highway. In total 20 subjects participated in the pilot. A repeated measures design was used for the study; the subjects drove both in alert and in sleep deprived condition. (INSAFETY internal report: IN-SAFETY Deliverable VTI pilot 2007-07-15.doc)

Note / Background / Reference / Link etc:
4A31 Guideline concerning:
I2V communication (2) – IN-SAFETY pilot project
Guideline native name:
Infrastruktur till fordon kommunikation
Guideline focus – national (country)/international:
Guideline name in English translation: Infrastructure to vehicle communication
Guideline reference number: .................................................................
Valid since (year): 2007

Completed by:
Name: Anna Anund
Institution: VTI

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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Type of guideline:
☐ Existing
☐ Planned to be implemented
☒ Verified in IN-SAFETY project
☐ Other: ................................................................................................
### Guideline identification:

Road design:
- [x] Road Risk Assessment
- [ ] Other: ..................................................................................

Type of road:
- [x] Urban
- [ ] Peri-urban
- [ ] Rural
- [x] Motorway
- [x] Highway
- [ ] Other: ..................................................................................

Communication:
- [x] V2V (= C2C) Vehicle (Car) to Vehicle
- [x] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other: ..................................................................................

Infrastructure generally:
- [x] Communication channels
- [ ] Data exchange
- [ ] Other: ..................................................................................

Infrastructure Traffic Management Systems:
- [ ] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [x] Other: ..................................................................................

Vehicle
- [x] HMI (= MMI) – Human (Man) Machine Interface
- [ ] Design
- [ ] Other: ..................................................................................

In-vehicle autonomous systems:
- [x] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other: ..................................................................................

Operators’ training:
- [ ] Infrastructure operator training
- [ ] Drivers’ training
- [ ] Manual for drivers (non-mandatory)
- [ ] Other: ..................................................................................

Simulation models
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [ ] ...................................................................................
Abstract of the guideline:

**Rumble strip**
The aim of this driving simulator study was to study the effects of haptic in-vehicle HMI as a substitute for infrastructure elements installed to increase the forgiving and self-explanatory nature of rural road environments. The infrastructure elements considered are milled rumble strips. The effects of milled rumble strips and in-vehicle “virtual” rumble strips was studied for both alert and fatigue drivers since there is a need for knowledge taking into account the differences between driver status.

Visible “milled” rumble strips was assumed to reduce the number of **overtaking** more than in-vehicle “virtual” rumble strips. No significant difference in the number of overtaking for different rumble strip mode was found. There was however a weak trend towards shorter overtaking duration with visible rumble strips.

In relation to speeds, visible rumble strips were assumed to reduce **speed** more than virtual rumble strips. No evidence in support of this assumption was found. The same result was found for speed variance; no impact of rumble strip mode could be established. The fact that virtual (invisible) rumble strips led to similar driver behaviour than real milled rumble strips speaks in favour of their effect. On the other hand there were few differences between no rumble strips and rumble strips. Field studies with a higher number of participants or of driven kilometers could help to disclose dissimilarities here.

**Lateral position** is an important issue in relation to rumble strips since shifted average and reduced variance in lateral position has implications for maintenance costs. No significant shift in lateral position was found. However, there was a trend towards keeping the vehicle further away from the right margin when the rumble strips were visible.

Statistical data or analysis:
The results are based on a driving simulator study done as one pilot within INSAFETY.

The pilot was carried through in the VTI moving base driving simulator using a simulated environment representing a Swedish two-lane highway. In total 20 subjects participated in the pilot. A repeated measures design was used for the study; the subjects drove both in alert and in sleep deprived condition. (INSAFETY internal report: IN-SAFETY Deliverable VTI pilot 2007-07-15.doc)

Note / Background / Reference / Link etc:
### 4A32 Guideline native name:

**Road Infrastructure Safety Management Directive**

Guideline focus – national (country)/international: international - Europe

**Guideline name in English translation:**

**Road Infrastructure Safety Management Directive of the European Parliament and the Council**

Guideline reference number: EC 2006/0182 (COD)

Valid since (year): 2006

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**Completed by:**

Name: Jan Weinberger
Institution: CDV

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**Guideline reference:**

*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**

- [x] Existing technical specifications
- [ ] Planned to be implemented
- [ ] Verified in IN-SAFETY project
- [ ] Other:........................................................................................................
Guideline identification:

Road design:
☐ Road Risk Assessment
☒ Other: Information for road traffic participants

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☐ Highway
☒ Other: For all kind of all road types users

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☒ Other: Road safety management

Infrastructure generally:
☒ Communication channels
☐ Data exchange
☐ Other

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☒ Other: Transport regulation, road safety

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:

Operators’ training:
☐ Infrastructure operator training
☒ Drivers’ training
☐ Manual for drivers (non-mandatory)
☐ Other: Roadworthiness tests, driving license

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☐ Other
Abstract of the guideline:
The purpose of this guideline is to ensure that safety is integrated into all phases of planning, design and the operation of the road infrastructure spanning the Trans-European Network. Along with economic and environmental considerations, safety will play a vital component to the preparation of new infrastructure. The proposed Directive will ensure that managers are given the correct guidelines, training and information needed to guarantee safety on the road network.

CONTENT: the Directive explicitly limits the requirements to a minimum. The comprehensive road safety programme centres on four proposed procedures. They are:
- Road safety impact assessments. These will help decision makers make the right choices when deciding on the development of new roads or major changes to the operation of existing roads, particularly so for adjacent networks.
- Road safety audits. These will offer independent control and recommendations for technical verification concerning the design of either new roads or the reworking of existing roads.
- Network safety management. The aim here is to target roads with a high concentration of accidents.
- Safety inspections. These will form a regular part of road maintenance.

According to Commission estimates, around 7000 injuries could be avoided and around 600 lives every year could be saved if the proposed measures to the Trans-European road network are applied.

Procedure subjects: Transport regulations, road safety, roadworthiness tests, driving license.

POLICY OPTIONS AND IMPACTS
In its impact assessment, the Commission examined three policy options.

1.1 - Option 1: No policy change.
Maintaining the status quo would not involve any direct cost or effort from the Community budget for improving the safety of road infrastructure. In this case, the improvement of the safety of road infrastructure would depend uniquely on the exchange of best practice. However, it has been shown that the exchange of best practice alone does not offer any guarantee that road safety will be further enhanced by Member States.

1.2 - Option 2: To adopt legislation requiring Member States to adopt guidelines on road infrastructure safety management but leaving it to them to decide on the details of their implementation.
In order to ensure that the adopted approaches are comprehensive, the Directive would require the application of guidelines on different aspects covering all stages from the draft design to the full operation of a road. The aim of this option would be to extend road safety measures to the whole of the trans-European road network, without defining technical standards or requirements, but leaving the Member States free to keep already existing procedures or to introduce new ones. The application of the comprehensive package of measures would make sure that road safety is included and borne in mind throughout the whole lifetime of a road of European importance, from its planning to its operation.

1.3 - Option 3: To provide Member States with harmonised legislation aimed at introducing common infrastructure safety management instruments.
The harmonisation of Member States’ legislation on road safety assessment, audits, management and inspections would provide common instruments to strengthen safety and maximise the benefit to road users and the public at large. These instruments would be uniform and consistent thus guaranteeing that common minimum safety requirements are reached on roads within the trans European network.
Both Options 2 and 3 would require the implementation of four road infrastructure safety management procedures, namely road safety impact assessment, road safety audits, network safety management and safety inspections.

CONCLUSION: Option 2 represents the best solution, for the following reasons: implementation costs for Member States would be significantly lower if they had to implement their own guidelines on the four infrastructure safety procedures. The prescribed measures
would be adopted and applied in a shorter time period and would therefore immediately contribute to reducing the number of EU road accident victims. Moreover, the development of different best practices in the Member States would enable the Commission to compare their effectiveness and, possibly, in the future, to adopt further harmonised guidelines, to be progressively extended to all Member States.

**IMPACTS**

**Social impact:** In 2003, the thematic network, ROSEBUD, undertook an impact analysis for the proposed package of procedures. It found it realistic to estimate the reduction potential for the implementation of the four procedures to the TEN roads at more than 600 fatalities and about 7000 accident injuries per year. This corresponds to 12%-16% of fatalities and 7%-12% of accident injuries.

The Directive will pave the way for the explicit consideration of safety in road infrastructure projects, creating safety awareness at all stages of decision-making process. Similarly, the infrastructure safety management procedures will create the basis for establishing safety procedures that will help Europe achieve its ambitious objective to drastically reduce the number of road fatalities. They will allow road infrastructure safety management to become a comprehensive system based on a thorough analysis of accidents, the identification of risky designs, revised guidelines and training curricula, as well as the implementation of effective remedial measures.

**Economic impact:** The Directive is expected to reduce the number of victims on motorways and main roads by 1300 every year or 12% of the fatalities occurring in this part of the network. According to the monetary estimates in the Commission’s Transport White Paper (COM(2001)0370), this would correspond to more than EUR 5 billion per year.

**Administrative impact:** The road safety impact assessment consists of a document produced in parallel with the approval procedure and the design process of the road. Therefore, no additional delays in the approval procedures can be expected. Also, safety audits would be performed in parallel with the design and construction process of the road, and are therefore not expected to cause any delay.

**Environmental and other impacts:** The reduction in accidents due to the implementation of the Directive and the consequent reduced congestion on European roads will considerably decrease the impact of transport on the environment. Emissions of air pollutants by vehicles stopped in heavy traffic and the level of noise due to congestion will be reduced. Fuels and energy consumption will be decreased thanks to a more dynamic and efficient transport system.

The reduced congestion on EU roads will have other indirect positive impacts. It will improve the mobility of the people and the competitiveness of the European market, but also reduce operating costs of transports and mobility.

**Statistical data or analysis:**

NA

**Note / Background / Reference / Link etc:**

**FOLLOW-UP**

The Commission would have several ways to monitor the implementation of this Directive and to evaluate the impact of the measures adopted by Member States. These include the following:

- the Commission would be kept informed on an ongoing basis of Member States’ laws, regulations and administrative provisions brought into force to comply with this Directive;
- guidelines for the implementation of this Directive would be adopted by Member States within three years of its entry into force and notified to the Commission;
- reports on the implementation of the articles of the Directive would be provided by Member States to the Commission three years after its entry into force and every four years thereafter;
- on the basis of the analysis of the different solutions adopted by Member States, the
Commission, assisted by a Committee, would identify best practices for road infrastructure management;
Member States would inform the Commission of the names of their designated competent entities so that it could be provided with the information it requires to assess the effectiveness of infrastructure safety management.
Progress made in the Member States would be assessed on the basis of the reports submitted to the Commission. They would include information on rates, procedures and cost elements analysed to identify road designs that have shown to be very high risk or that have a high potential to reduce risk.
The assessment of the overall progress in the Member States would be checked by the Commission on the basis of the data on road accidents provided yearly by the Member States and regularly recorded in the CARE database (Community database on Accidents on the Roads in Europe).
4A33 Guideline concerning:
Safety management system
Guideline native name:
Guidelines for developing and implementing a safety management system for road controlling authorities
Guideline focus – national (country)/international: international - Europe
Guideline name in English translation: .................................................................
Guideline reference number: EDRMS ID: B490984
Valid since (year): 2005

Completed by:
Name: Jan Weinberger
Institution: CDV

Guideline reference:
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- [ ] Other:
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other:________________________________________

Type of road:
☒ Urban
☒ Peri-urban
☒ Rural
☒ Motorway
☒ Highway
☐ Other:

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☐ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:________________________________________

Infrastructure generally:
☐ Communication channels
☐ Data exchange
☐ Other:

Infrastructure Traffic Management Systems:
☐ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:________________________________________

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☐ Design
☐ Other:________________________________________

In-vehicle autonomous systems:
☐ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:________________________________________

Operators´ training:
☐ Infrastructure operator training
☐ Drivers´ training
☐ Manual for drivers (non-mandatory)
☐ Other:________________________________________

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☒ Safety management system for road controlling authorities
 ☐ Other:________________________________________
Abstract of the guideline:
These guidelines are intended to assist a road controlling authority (RCA) to fully implement their safety management system (SMS) so that the expected outcome of the system is achieved. The aim is to assist RCA to implement their SMSs to ensure safety is considered in decisions about planning, construction, maintenance and management of the road network. This will assist in the achievement of targets and goals identified in the national, regional and local road safety strategies. The guidelines:
provide an outline of the process, development and implementation methodology and the scope work
identify some key options, relationships, inputs and decisions that the RCAs will need to consider
provide checklists for reference and guidance.
These guidelines are intended to make the process of establishing a safety management system easier, rather than prescribe the format and operation for the system. They provide an outline for:
- scope of work
- methodology
- achieving buy-in
- review, monitoring and evaluation.
The stakeholders of any SMS encompass all road users. While all stakeholders have a role in the implementation of SMS, implementation of the SMS from an engineering point of view relies on a few direct stakeholder groups. These guidelines will concentrate on those stakeholders who have a particular influence on the implementation of the SMS. The direct stakeholder group are:
councillors: general, works committee and regulatory committee
community board members
RCA staff: roading, parks and recreation, etc.
consultants: network and project.
It is necessary to set out the SMS role of each direct stakeholder group in order to create understanding and achieve full implementation of the SMS.

Statistical data or analysis:

Note / Background / Reference / Link etc:
Development guidelines: A. SMS development process: 1. Methodology, programme, deliverables;
2. A timeline is included for the three stages of development through to sign-off
B. Memorandum of Understanding (partnership between the RCA a Transport organization)
C. Safety management system form
D. Road safety strategy guidelines for road controlling authorities
E. Delivery planning
F. Document control
4A34 Guideline concerning:
Reducing the level of fatal and injury crashes in urban streets
Guideline native name:
Urban Safety Management Guidelines
Guideline focus – national (country)/international:

Guideline name in English translation: Urban Safety Management Guidelines
Guideline reference number: TSRLM01311/USM
Valid since (year): 2003

Completed by:
Name: Jan Weinberger
Institution: CDV

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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<td>Policy</td>
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Type of guideline:
- [x] Existing
- [ ] Planned to be implemented
- [ ] Verified in IN-SAFETY project
- [ ] Other:
Guideline identification:

Road design:
- ✗ Road Risk Assessment
- ❌ Other: 

Type of road:
- ✗ Urban
- ❌ Peri-urban
- ❌ Rural
- ❌ Motorway
- ❌ Highway
- ❌ Other:

Communication:
- ❌ V2V (= C2C) Vehicle (Car) to Vehicle
- ❌ V2I (= C2I) Vehicle (Car) to Infrastructure
- ❌ Other: 

Infrastructure generally:
- ❌ Communication channels
- ❌ Data exchange
- ❌ Other:

Infrastructure Traffic Management Systems:
- ❌ Variable messages signs
- ❌ Variable directions signs
- ❌ Dynamic lane allocation
- ❌ Ramp metering
- ❌ Other: 

Vehicle
- ❌ HMI (= MMI) – Human (Man) Machine Interface
- ❌ Design
- ❌ Other:

In-vehicle autonomous systems:
- ❌ IVIS – In-Vehicle Information Systems
- ❌ ADAS – Advanced Driver Assistance Systems
- ❌ Other:

Operators´ training:
- ❌ Infrastructure operator training
- ❌ Drivers´ training
- ❌ Manual for drivers (non-mandatory)
- ❌ Other:

Simulation models
- ❌ Microscopic
- ❌ Macroscopic
- ❌ Other:
- ✗ Urban Safety Management guideline
Abstract of the guideline:
These guidelines show how it is possible to substantially reduce the level of death and injury on the urban streets. It is only by adopting the strategic Urban Safety Management (USM) approach that substantial progress can be made in reducing the large numbers of injury accidents which occur, not at high risk sites, but almost anywhere in the urban road network.

Traditionally, road safety in towns and cities has been approach on a piecemeal basis, tackling individual problems as they arise. But town and cities do nit work like this. Traffic and pedestrian movement is part of the essential way that a place lives. It affects the whole urban area. USM looks at whole communities and sets a vision and strategy for road safety management, which becomes proactive rather than reactive. This USM approach has been shown to yield significant benefits in casualty reduction. It uses an area-wide multi-disciplinary approach that considers safety in the whole area, to reduce the incidence of accidents of all kinds, including the scattered ones. USM involves many aspects of urban management: Traffic safety, engineering and law enforcement, road engineering and maintenance, public transport, land use planning, economic development, environment, health, education and welfare, strategy for the traffic safety of the whole urban community.

USM defines the principles of a good safety management strategy as one which:
- Formulates a safety strategy for the urban area as a whole;
- Integrates safety with other urban strategies (e.g. transportation, land use planning, Safer Routes to Schools);
- Considers all kind of road users, especially vulnerable road users;
- Considers the functions of different kinds of road;
- Integrates existing casualty reduction efforts into the strategy;
- Uses opportunities where other policies and strategies may help to enhance safety (e.g. improving safety within an urban regeneration project);
- Encourages all professional groups to help to achieve safety objectives;
- Guards against possible adverse safety affects of other policies;
- Encourage residents and all road users to become actively involved in the process and thereby take ownership of it;
- Translates the strategy and objectives into local area safety schemes.

Statistical data or analysis:

Note / Background / Reference / Link etc:
There are many elements in the urban safety strategy: Area Safety Schemes; Measures at High Risk Sites; Enforcement; Education, Training and Publicity; Health Welfare Education; land Use; Public Transport; Road construction and Maintenance; Environment; Measures to Help Pedestrians and Cyclists; Measures at High Risk Sites.
4A35 Guideline concerning:
Cooperative Vehicle-Infrastructure (Traffic) Management System
Guideline native name:
Infrastructure Management System (CVIMS)
Guideline focus – national (country)/international:
Guideline name in English translation: .................................................................
Guideline reference number:
Valid since (year):

Completed by:
Name: Eva Gelová
Institution: CDV

Guideline reference:
Please, mark below, both in the matrix and text, how the guideline can be defined.

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<tr>
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<td>Policy</td>
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</tbody>
</table>

Type of guideline:
☒ Existing
☐ Planned to be implemented
☐ Verified in IN-SAFETY project
☐ Other:
Guideline identification:

Road design:
- Road Risk Assessment
- Other:………………………………………………………………………………

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: not specified

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: communication with the TMC

Infrastructure generally:
- Communication channels
- Data exchange
- Other:

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other:………………………………………………………………………………

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other:………………………………………………………………………………

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other:………………………………………………………………………………

Operators’ training:
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other:………………………………………………………………………………

Simulation models
- Microscopic
- Macroscopic
- Other:
- A complex solution already accessible
- Electronic Fee Collection tasks included
**Abstract of the guideline:**

“Cooperative traffic management means the complete integration of all members of the traffic, all of them being enabled to participate in the flow of information via INTELLIGENT DEVICES AND INTERFACES. In a cooperative situation,”
- Vehicles communicate among themselves
- Vehicles communicate to infrastructure
- “Multi-modal transportation payment is fully integrated in the total solution
- Planned routes are agreed between traffic members to optimize total traffic, or even assigned to community members according to willingness to pay for faster routes
- Feed-forward feed-back management of all participants is enabled
- Past data of a vehicle is reported to other vehicles via ad-hoc networks. The history of one vehicle predicts the future of other vehicles without involvement of a central element”

(EFKON)

**Statistical data or analysis:**

NA

**Note / Background / Reference / Link etc:**

http://www.efkon.net/
### 4A36 Guideline native name:
**Speed Limit and VMS into Vehicle information application (based on the GPS with GPRS architecture).**

**Guideline focus – national (country)/international:** Greece

**Guideline name in English translation:**
Guideline reference number: GL/HIT1
Valid since (year): 1/11/07

---

**Completed by:**
Name: Pavlos Spanidis
Institution: HIT/CERTH

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**Guideline reference:**
*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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<thead>
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**Type of guideline:**
- [ ] Existing
- [ ] Planned to be implemented
- ✔ Verified in IN-SAFETY project
- [ ] Other: ...........................................................................................................
### Guideline identification:

**Road design:**
- [ ] Road Risk Assessment
- [ ] Other:  

**Type of road:**
- [ ] Urban
- [ ] Peri-urban
- [ ] Rural
- [x] Motorway
- [ ] Highway
- [ ] Other:

**Communication:**
- [ ] V2V (= C2C) Vehicle (Car) to Vehicle
- [x] V2I (= C2I) Vehicle (Car) to Infrastructure
- [ ] Other:

**Infrastructure generally:**
- [ ] Communication channels
- [x] Data exchange
- [ ] Other:

**Infrastructure Traffic Management Systems:**
- [x] Variable messages signs
- [ ] Variable directions signs
- [ ] Dynamic lane allocation
- [ ] Ramp metering
- [ ] Other:

**Vehicle**
- [ ] HMI (= MMI) – Human (Man) Machine Interface
- [x] Design
- [ ] Other:

**In-vehicle autonomous systems:**
- [x] IVIS – In-Vehicle Information Systems
- [ ] ADAS – Advanced Driver Assistance Systems
- [ ] Other:

**Operators’ training:**
- [ ] Infrastructure operator training
- [ ] Drivers’ training
- [x] Manual for drivers (non-mandatory)
- [ ] Other:

**Simulation models**
- [ ] Microscopic
- [ ] Macroscopic
- [ ] Other:
- [ ] Other:
### Abstract of the guideline:

The problem:
In the Speed Limit and the VMS into Vehicle information application, the speed plays an important role. The higher the speed of the vehicle, the smaller amount of warning the vehicle will receive.

Therefore, there is a need of adjusting the vehicle’s requests with the speed of the last. If the speed is high, the warnings that the Traffic Management Centre sends to the vehicle should be more often and vice versa.

The solution:
The GPS provides a number of different protocols. Each of them provides different information (position, speed, direction, number of satellites, etc). Therefore, there is a need of using the GPVTG protocol, which provides speed and develop an algorithm which will associate the speed with the warnings of the application.

### Statistical data or analysis:

### Note / Background / Reference / Link etc:
Reference: IN-SAFETY_WP4_D4.2_Certh_HIT_Pilot paragraph 2.3.1-VMS info into vehicle – GPS with GPRS architecture.
**4A37 Guideline native name:**
VMS into Vehicle information application (based on the WiFi architecture)

**Guideline focus – national (country)/international:** Greece

**Guideline name in English translation:**
Guideline reference number: GL/HIT2

**Valid since (year):** 1/11/07

**Completed by:**
Name: Pavlos Spanidis
Institution: HIT/CERTH

**Guideline reference:**

*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- Existing
- Planned to be implemented
- Verified in IN-SAFETY project

Other: ............................................................................................................
Guideline identification:

Road design:
- Road Risk Assessment
- Other: .................................................................

Type of road:
- Urban
- Peri-urban
- Rural
- Motorway
- Highway
- Other: ........................................................................

Communication:
- V2V (= C2C) Vehicle (Car) to Vehicle
- V2I (= C2I) Vehicle (Car) to Infrastructure
- Other: ........................................................................

Infrastructure generally:
- Communication channels
- Data exchange
- Other: ........................................................................

Infrastructure Traffic Management Systems:
- Variable messages signs
- Variable directions signs
- Dynamic lane allocation
- Ramp metering
- Other: ........................................................................

Vehicle
- HMI (= MMI) – Human (Man) Machine Interface
- Design
- Other: ........................................................................

In-vehicle autonomous systems:
- IVIS – In-Vehicle Information Systems
- ADAS – Advanced Driver Assistance Systems
- Other: ........................................................................

Operators’ training:
- Infrastructure operator training
- Drivers’ training
- Manual for drivers (non-mandatory)
- Other: ........................................................................

Simulation models
- Microscopic
- Macroscopic
- Other:
- ........................................................................
- ........................................................................
Abstract of the guideline:

The problem:
The architecture of this application is based on the Windows OS. In Windows, if there is a WiFi adaptor attached on the PC, the OS searches the area every a specific number of seconds. The OS contains also a list with the Preferred Networks. The Preferred Networks are the networks where the OS has been connected in the past for at least one time. The problem of the architecture is the WLAN search frequency of the OS. It has been realized that it is not so frequent in order to support an application like the VMS into Vehicle information. Again the speed of the vehicle plays the first role on this problem. When the speed of the vehicle is high, the time that the vehicle is inside the WiFi area of the VMS is very short and the connection-communication can not take place.

The solution:
Linksys (the Access Points’ manufacturer) provides drivers that are totally different from these that Windows OS support. It has been realised that using these drivers, the search frequency of the WiFi was higher. Although the problem had been bypassed, this solution is not so professional. The best solution for this problem is a development of a set of drivers where the search frequency can be controllable.

Statistical data or analysis:

Note / Background / Reference / Link etc:
Reference: IN-SAFETY_WP4_D4.2_Certh_HIT_Pilot paragraph 2.3.2-VMS info into vehicle – WiFi architecture
**4A38 Guideline native name:**
VMS into Vehicle information application (based on the Bluetooth architecture)

**Guideline focus — national (country)/international:** Greece

**Guideline name in English translation:**

**Guideline reference number:** GL/HIT3

**Valid since (year):** 1/11/07

**Completed by:**
Name: Pavlos Spanidis
Institution: HIT/CERTH

**Guideline reference:**

*Please, mark below, both in the matrix and text, how the guideline can be defined.*

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**Type of guideline:**
- Existing
- Planned to be implemented
- ☑ Verified in IN-SAFETY project
- ☑ Other: ...........................................................................................................
Guideline identification:

Road design:
☐ Road Risk Assessment
☐ Other:………………………………………………………………………………

Type of road:
☐ Urban
☐ Peri-urban
☐ Rural
☐ Motorway
☒ Highway
☐ Other:………………………………………………………………………………

Communication:
☐ V2V (= C2C) Vehicle (Car) to Vehicle
☒ V2I (= C2I) Vehicle (Car) to Infrastructure
☐ Other:………………………………………………………………………………

Infrastructure generally:
☒ Data exchange
☐ Other:………………………………………………………………………………

Infrastructure Traffic Management Systems:
☒ Variable messages signs
☐ Variable directions signs
☐ Dynamic lane allocation
☐ Ramp metering
☐ Other:………………………………………………………………………………

Vehicle
☐ HMI (= MMI) – Human (Man) Machine Interface
☒ Design
☐ Other:………………………………………………………………………………

In-vehicle autonomous systems:
☒ IVIS – In-Vehicle Information Systems
☐ ADAS – Advanced Driver Assistance Systems
☐ Other:………………………………………………………………………………

Operators´ training:
☐ Infrastructure operator training
☐ Drivers´ training
☒ Manual for drivers (non-mandatory)
☐ Other:………………………………………………………………………………

Simulation models
☐ Microscopic
☐ Macroscopic
☐ Other:
☐ …………………………………………………………………………………
**Abstract of the guideline:**

The problem:
Bluetooth is a very widely used communication protocol. Although its advantages, an architecture based on it will have limitations due to the signal transmission speed. Bluetooth offers communication in a range of 10 to 150 meters. Therefore, interactions at higher distances cannot be supported. Another limitation of the Bluetooth is its limited bandwidth. The Bluetooth can transmit and receive data at a rate of 720 KBps.

The solution:
At the moment, there is not a solution, which can solve the above problems. Therefore, the thought of development of the VMS into Vehicle information application based on the Bluetooth architecture should be avoided.

**Statistical data or analysis:**

**Note / Background / Reference / Link etc:**
[http://ntrq.cs.tcd.ie/undergrad/4ba2.05/group3/index.html](http://ntrq.cs.tcd.ie/undergrad/4ba2.05/group3/index.html)
TRAVELGUIDE (D6.1)

4A39 In-car traffic sign information

<table>
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<tr>
<td>Category</td>
<td>Integration of in-vehicle information and conventional traffic sign information</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Road operators and authorities</td>
</tr>
<tr>
<td>Short Title</td>
<td>In-car traffic sign information</td>
</tr>
<tr>
<td>Description</td>
<td>The results suggest road authorities to promote further development of this type of information systems, which seem to be proper to various user groups. Integration of traffic sign information on an in-car device is a promising approach. It seems to contribute to improve the effects of warning signs and speed limit signs.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>For the road authorities it is important to find new approaches to enhance traffic safety. In this context, it also is road authorities’ and operators’ interest that all traffic signs are perceived and that they affect driver behaviour as meant. In practice, the messages of warning signs are frequently not detected however, and therefore it would be preferable to find out ways to support traffic sign information.</td>
</tr>
<tr>
<td>Example</td>
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<td>Documentation</td>
<td>TRAVEL-GUIDE D5: T5.5</td>
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<tr>
<td>References</td>
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</tbody>
</table>

Testing Verifications

The main conclusions of the study are based on subjective evaluations of 20 test drivers. Because of the limited number of drivers and descriptive nature of data, the conclusions should be viewed as tentative.

The results showed that the subjects accepted the integration of traffic sign information and reported that the IVT (In-vehicle Traffic sign) information increased the effect of traffic signs. These findings to all driver groups (e.g. the effects of gender and age were not remarkable).

The objective measurements of driver behaviour should be viewed as trends only. These results showed that the number of glances indicating search of pedestrians or bicyclists was greatest for the condition in which complete instruction was provided. In contrast, the number of glances on IVT was lowest for this message condition. Overall, the number of glances on IVT was relatively low (1.9 – 2.6) in all conditions and the gaze duration was short on average.

The speed results showed that the auditory information seemed to decrease driving speed. Consequently, it seems that even if drivers do not like auditory messages and consider them as irritating, the auditory messages have a safety-increasing effect on speed behaviour. This finding is important because there are not too many studies, which have shown information to influence driver’s speed choice.

The most effective systems seemed to be the ones giving not only information but instructions as well.

Suggestions for More empirical research in the future is needed to verify the findings,
### Further Research

i.e. various effects of this kind of systems on driver behaviour. For example, further research could investigate the optimal characteristics of the IVT with a larger driver sample and with a procedure allowing to make strong conclusions about the efficiency of the system. Another broad issue is how drivers adapt their behaviour to this type of systems in the long term. This could be examined by a longitudinal study involving a limited number of drivers who are willing to take part in a data collection including a black box installed in their vehicle recording their driving behaviour. Finally, although it might be possible to design a system resulting in high degree of detected traffic signs, there is no guarantee whether it would improve total traffic safety.

### Remark

Many drivers frequently reported problems in the use of the IVT while driving. Most frequently reported problems included unintentional speed decreases and late detection of another road user, vehicle or obstacle on the road. Given that the secondary task was relatively easy including simple visual and auditory messages and no control tasks, this finding is striking.

This finding suggests to introduce new information systems carefully. It is highly important to develop evaluation tools and use them in assessing all effects (including unfavourable effects), of planned systems before they are implemented in wider use.

Legal issues deserve attention.
### 4A40 Traffic congestion & Parking information provision

<table>
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<td>Category</td>
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<td>Target Groups</td>
<td>System developers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Traffic congestion &amp; Parking information provision</td>
</tr>
</tbody>
</table>

**Description**
- If possible, use a map to provide information about parking and congestion location. Information about name of parking/street should be displayed in a different font/characteristics, e.g. in italics or quoted. For congestion, present names of roads in country specific way, e.g. Via/Corso ABC or C. ABC, V. ABC.
- Mark with arrows (or other scrolling widgets) every page in which message content continues
- Provide users with the following parking information: Park timetable, €/hour, number of free slots, total slots, distance from destination, parking address, type of parking, payment modalities, public services available from the parking, presence of slots for disabled, park name. Information on *free slots*, had sometimes been misunderstood by participants. To avoid this possible ambiguity on free slots number, make a clear distinction between slots free *now* and slots which will be free *in 15-20 minutes*, as shown in the following example:
  
  Free now: 359  
  Free in 15 min 365  

- If parking space in a larger area than just one street is indicated then this must be made clear to the user

---

**Problem Identified**  Format of information provision

**Example**  Misunderstanding about dynamics of free parking slots

**Documentation**  

**References**  

**Testing Verifications**  

**Suggestions for further research**  

4A41 Graphical Interface features

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-3-B-CRF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td></td>
</tr>
<tr>
<td>Target Groups</td>
<td>System developers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Graphical Interface features</td>
</tr>
</tbody>
</table>
| Description   | Capital/Lower letter format  

Except for the title and for labels, avoid capital letters to present information.

**Minimum contrast ratio**

The minimum contrast ratio between symbol and background shall be:

- 5:1 for night conditions
- 3:1 for day conditions
- 2:1 for sunlight conditions

(higher luminance to lower). This is especially important if characters are close to the minimum specifications for the dimensions (see 4.4 below). Lower contrast should be avoided unless dimensions are properly increased and/or the reading task is simple.

**Luminance balance**

The ratio of area average luminance of the display and of the surrounding (luminance balance) should not exceed 10:1 (higher luminance to lower). Higher ratios are often acceptable; a ratio of 100:1 (higher luminance to lower) would be expected to produce a small but significant drop in performance.

**Polarity**

Display luminance is intended as the symbol luminance if the display is driven in negative polarity (i.e. light symbols on a dark back-ground), or as the background luminance if the display is in positive polarity (i.e. dark symbols on a light background).

Either polarity is known to give satisfactory performance. The choice is determined by the area average luminance of the areas that are frequently viewed in sequence. Therefore negative polarity should be used for night condition. In day condition both are acceptable, taking into account that the immediate surroundings of displays in vehicles (i.e. the dashboard) are often dark. For non sheltered displays, positive polarity could better help in order to reduce the visibility of reflections.

**Colour**

**Colour combinations**

When a symbol and its background are in different colours, minimum luminance contrast shall be provided. Due to physiological and psychological reasons not all symbol/background colour combinations are acceptable. Therefore, when selecting colours in full multicolour displays, symbol/background colour combinations should be chosen according to Table 1 below.

**Colour discriminability**

For minimum colour discriminability, a colour difference of $\Delta E_{uv} = 20$ shall be the minimum. The $\Delta E_{uv}$ colour difference metric is defined in
the CIE 1976 colour space model CIELUV (CIE No. 15.2). Reference white is the white produced by the display. Reference white is the white produced by the display in each condition.

**Colour contrast**

Concerning legibility, the relevant metric is luminance contrast.

<table>
<thead>
<tr>
<th>Background Colour</th>
<th>White</th>
<th>Yellow</th>
<th>Orange</th>
<th>Red ('), Purple</th>
<th>Green, Cyan</th>
<th>Blue ('), Violet</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td></td>
<td></td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Yellow</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Red ('), Purple</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Green, Cyan</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue ('), Violet</td>
<td>++</td>
<td>+</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

++ preferred  
+ recommended  
0 acceptable with high saturation differences  
- not recommended  
(* ) pure red and blue should be avoided because the eyes may have trouble focusing on these colours, due to eye chromatic aberration

**Alphanumerical character dimensions**

**Height**

For alphanumerical characters, height, measured as the subtended angle from the farthest design viewpoint, shall comply with Table 2 below.

<table>
<thead>
<tr>
<th>arcminutes</th>
<th>radians (°)</th>
<th>Suitability level</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>6.98 \times 10^{-5}</td>
<td>Recommended</td>
</tr>
<tr>
<td>20</td>
<td>5.82 \times 10^{-5}</td>
<td>Acceptable if colour is a coding dimension</td>
</tr>
<tr>
<td>18</td>
<td>5.24 \times 10^{-5}</td>
<td>Acceptable if colour is not a coding dimension</td>
</tr>
<tr>
<td>15</td>
<td>4.36 \times 10^{-5}</td>
<td>Conditional (*)</td>
</tr>
</tbody>
</table>

( * ) if multiplied by the viewing distance, it gives (in the same units) the actual character height  
( * ) when requirements for accuracy and speed of reading are modest, or when readability is incidental to the task (e.g. subscripts)

**Width-to-height ratio**

The alphanumerical character width-to-height ratio should be between 0.6 and 0.8. A wider range from 0.5 to 1 is acceptable, especially if factors like line length or proportional spacing are important.

**Stroke width-to-height ratio**

The alphanumerical characters stroke width-to-character height ratio shall be between 0.08 and 0.16.

**Spacing**
For character fonts without serifs, the between-character spacing shall be a minimum of one stroke width. If characters have serifs, the between-character spacing shall be one stroke width between the serifs of adjacent characters. A minimum of one character width (capital “N” for proportional spacing) shall be used between words. If a list is presented, a minimum of one stroke width shall be used for spacing between lines of text. This area may not contain parts of characters or diacritics.

Pixel matrices character format

Upper and lower case
A 5x7 (width to height) character matrix shall be the minimum used for alphanumeric characters. If lower case letters are used, or the legibility of individual alphanumeric characters is important for the task, a 7 x 9 (width to height) character matrix should be the minimum.

Diacritics
The alphanumeric character matrix shall be increased upwards by at least two pixels if diacritics (e.g. Ö, Ñ, Å, È) are used. If lower case is used, the character matrix shall be increased downward by at least two pixels, to accommodate the descenders of lower case letters.

Subscripts or superscripts
A 4 x 5 (width to height) alphanumeric character matrix shall be the minimum for: subscripts and superscripts, numerators and denominators of fractions displayed in a single character position, and for information not related to the task such as the Copyright symbol ©.

<table>
<thead>
<tr>
<th>Problem Identified</th>
<th>Legibility of displays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
**4A42 In car device: output modalities**

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-4-B-VTT2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Integration of in-vehicle information and conventional traffic sign information</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers</td>
</tr>
<tr>
<td>Short Title</td>
<td>In car device: output modalities</td>
</tr>
<tr>
<td>Description</td>
<td>Only simple and understandable symbols should be presented. It seems that drivers prefer visual (simple) information to auditory instructions (acceptance). However, it is emphasised that the design of both visual and auditory information/instruction presentation requires further research. The instructions and auditory messages should be included in the systems carefully.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>For the information providers it is important that the messages are well comprehended and accepted. It is also important to collect information about acceptance of different types of information and compare different ways to present information.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE D5: T5.5</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>The main results showed that the subjects accepted the integration of traffic sign information. In addition, a vast majority of the subjects was willing to pay for purchasing the IVT that has the properties they were defined as most desirable. Specifically, the most desirable information was route guidance and visual sign.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>The main conclusions of the study are based on subjective evaluations of 20 test drivers. Because of the limited number of drivers, and descriptive nature of data, the conclusions should be viewed as tentative. More empirical research in the future is needed to verify the findings.</td>
</tr>
</tbody>
</table>
### 4A43 Information content of in-car devices

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-5-B-VTT3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Integration of in-vehicle information and conventional traffic sign information</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Information content of in-car devices</strong></td>
</tr>
<tr>
<td>Description</td>
<td>Complicated information should be avoided. Further research and development is needed to optimise the information content and effectiveness.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>For the information providers it is important that the messages are well comprehended and accepted. It is also important to collect information about acceptance of different types of information and compare different ways to present information.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE D5: T5.5</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>The message conditions that included less favourable aspects such as instructions resulted in desirable behavioural changes. Many drivers frequently reported problems in the use of the IVT while driving.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>The main conclusions of the study are based on subjective evaluations of 20 test drivers. Because of the limited number of drivers, and descriptive nature of data, the conclusions should be viewed as tentative. More empirical research in the future is needed to verify the findings.</td>
</tr>
</tbody>
</table>
In-vehicle information systems should provide background information about the reasons for certain system operations

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-6-B-IFA7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers</td>
</tr>
<tr>
<td>Short Title</td>
<td>In-vehicle information systems should provide background information about the reasons for certain system operations</td>
</tr>
<tr>
<td>Description</td>
<td>User trust and compliance to information provided by traffic information systems is enhanced when the users knows the reasons for certain system operations (e.g. calculation of a new route because of a congestion ahead)</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Certain system operations are not transparent and comprehensible for the user</td>
</tr>
<tr>
<td>Example</td>
<td>TRAVEL-GUIDE WP1, HMI analysis</td>
</tr>
<tr>
<td>Documentation</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Identification of optimal feedback to the user about system operations</td>
</tr>
</tbody>
</table>
Information presentation: Information should be provided on the visual as well as on the auditory and haptic channel

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-7-B-IFA8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>System developers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Information presentation: Information should be provided on the visual as well as on the auditory and haptic channel</strong></td>
</tr>
<tr>
<td>Description</td>
<td>Besides an increasing tendency for auditory output, emphasis today is still on the visual channel. Stronger involvement of auditory output and further research on haptic output possibilities is required.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Driver distraction</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, HMI analysis</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Identify best presentation forms for individual messages (reduction of workload, optimization of compatibility etc.)</td>
</tr>
<tr>
<td>Code</td>
<td>IV-8-B-IFA13</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>On-trip Information providers, designers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Adapt information provision to driver workload</td>
</tr>
<tr>
<td>Description</td>
<td>Besides more than a decade of research no system is available on the market, which schedules information based on online driver workload conditions. On-trip systems and Neither timing nor information complexity is based on current traffic situation demands.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Driver workload-independent information provision</td>
</tr>
<tr>
<td>Example</td>
<td>Example of good practice: GIDS system</td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>see GIDS book</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Develop a system prioritizing information provision based on online driver workload</td>
</tr>
</tbody>
</table>
Control of message timing has to be shifted from the system to the user

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-9-B-IFA14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>On-trip information providers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Control of message timing has to be shifted from the system to the user</td>
</tr>
<tr>
<td>Description</td>
<td>Timing of messages is generally system-controlled, without user options to tune timing of message provision to individual preferences. Systems should offer time interval options because different drivers have different preferences and inter-individually different information processing resources as well as strategies.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>System control of message timing</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Identification of optimal time frames for provision of particular messages</td>
</tr>
</tbody>
</table>
4A48 | Adapt information provision to the requirement of different driver subgroups
--- | ---
**Code** | IV-1-B-IFA15
**Category** | T 6.2: Information Providers
**Target Groups** | Researchers, designers, information providers
**Short Title** | Adapt information provision to the requirement of different driver subgroups
**Description** | On-trip systems do not provide efficient services tailored to specific driver groups yet. As different user groups have different information needs detailed identification of information requirements of subgroups is required
**Problem Identified** | Information not sufficiently tailored to the needs of driver subgroups
**Example** | Familiar vs. unfamiliar drivers, young vs. old etc.
**Documentation** | TRAVEL-GUIDE WP1, TIS review
**References** | TG D1
**Testing Verifications** | 
**Suggestions for further research** | Identify needs of different driver subgroups, adapt info provision to subgroup requirements
**4A49** Extend ‘yellow page’ services.

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-10-B-IFA16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>On-trip information providers, system developers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Extend ‘yellow page’ services.</strong></td>
</tr>
<tr>
<td>Description</td>
<td>Advanced systems and services do provide regional cultural and logistic background like information about museums, hospitals, car garages etc. These services have to be further optimised up to the level of booking and the services have to be extended to information areas not included yet.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Yellow page services cover only selected information areas today.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Identify actual non-driving info requirements</td>
</tr>
</tbody>
</table>
4A50 All in-vehicle navigation systems should allow an effective combination of different routing types.

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-11-B-IFA17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>On-trip Information providers, system developers</td>
</tr>
<tr>
<td>Short Title</td>
<td>All in-vehicle navigation systems should allow an effective combination of different routing types.</td>
</tr>
<tr>
<td>Description</td>
<td>Dynamic route guidance based on TMC should be possible in connection with other user-defined routing preferences.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Non-flexible routing strategies of navigation systems</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Extend routing options</td>
</tr>
</tbody>
</table>
### Support Transeuropean traffic

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-12-B-IFA18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>On-trip Information providers, system developers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Support Transeuropean traffic.</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Traffic data collection commonly does not exceed the national level, and data exchange between different data collectors and / or content providers is difficult due to different kinds of data as well as different communication standards. Thus, no traffic information service supports international drivers during all parts of their journey effectively yet.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Lack of Trans-European on-trip information services.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>TG WP1, TIS review</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TG D1</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td>Develop Trans-European driver information service</td>
</tr>
</tbody>
</table>
### Develop databases including qualitative knowledge about the driver

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-13-B-IFA20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T6.1/6.2/T6.3: Authorities, Information Providers, Manufacturers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Authorities, information providers, designers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Develop databases including qualitative knowledge about the driver</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>To support drivers effectively, intelligent information systems should have implemented not only a knowledge database about the physical layout of the road network. In addition, they should have integrated a database with qualitative knowledge about the drivers' perceptual and attentional biases in particular situation to guide the drivers' attention to those road features and traffic elements they are not sufficiently aware of.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Experts in traffic technologies are not sufficiently aware of the dynamic relation between the objective traffic situation and the drivers' subjective representation of the objective situation.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>Drivers' information search in dynamic traffic situations is based on prior experience with similar situations. Attention is directed to situation elements with a high subjective priority. Drivers' subjective prioritisation of traffic elements can have a regular bias in particular situations. E.g. drivers concentrate on pedestrians in situations including a zebra crossing, while they are not sufficiently aware of other critical road features like an intersection ahead.</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>TG WP5 additional pilot (Ifado)</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TG Internal Report: Driver Situation Awareness Under Normal Driving Conditions: Effects of Situation Complexity and Driving Task (Ifado)</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td>see internal report</td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td>Identification of the drivers' subjective information prioritisation in prototypical traffic situations (zebra, crossing, highway merging etc.)</td>
</tr>
</tbody>
</table>
### Timing of queue warning messages

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-14-B-IAT1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td></td>
</tr>
<tr>
<td>Target Groups</td>
<td>System developer</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Timing of queue warning messages</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The timing of an incident / queue warning has a high correlation to the driving situation and environmental aspects. Thus the effect of the information depends on the accuracy of the time interval between warning and event. Here the balance has to be found between presenting the warning early enough to react and late enough not to forget it.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Proper timing of messages is still insufficient today.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>TMC queue warning is sometimes extremely early (even 200 km before actually reaching the queue) or late (due to the update rate of 30 minutes).</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TRAVEL-GUIDE D1 2-3-1, TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td>Under the circumstances given in the test, even a time headway of 10 sec. was perceived as too long. However, in reality this time headway would be insufficient since it would not allow decision making for detouring. In the simulation there was no option for detouring.</td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td>To examine the time interval after that a given message is forgotten and to work on strategies to recall the message again from the in-car-device (sometimes e.g. the option to re-calculate the route is given only in a limited time frame and after that has to be selected from a very low level of hierarchy in the menu).</td>
</tr>
</tbody>
</table>
**4A54 Provision of complete information for services**

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-15-B-MIZ6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Who gathers information from the sources</td>
</tr>
<tr>
<td>Short Title</td>
<td>Provision of complete information for services</td>
</tr>
<tr>
<td>Description</td>
<td>A service provider should find all the relevant information about a specific transport network at the same source. For example the traffic management system that supplies monitoring of traffic conditions should provide also road description, maps, traffic restrictions on the same network. This supplementary information could be forgotten because they are already available on several other traditional channels. It is more efficient and reliable if the auxiliary information is added at the source than every service provider repeats the same search.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Difficulty for the service provider in gathering different kind of information about the same transport network at different sources.</td>
</tr>
<tr>
<td>Example</td>
<td>TRAVEL-GUIDE tested in Torino on-board information services about traffic and parking. With regard to parking information, the 5T-Titos urban traffic centre supplies observed and foreseen available slots related to parking identified by name and co-ordinates. It would be useful to put together some simple supplementary static news about each parking site, as address, closure time, fee and accepted payment cards, public transport connections.</td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td>TRAVEL-GUIDE, deliverable 5 “Demonstration and testing”, 2002</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>Suggested by direct experience of the service provider and intervisted users.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
**4A55** Information timing: In vehicle TI systems should provide more timely and accurate information with emphasis in safety restraints

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-16-B-AUT6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Information timing: In vehicle TI systems should provide more timely and accurate information with emphasis in safety restraints</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>In-vehicle TI systems can provide more personalized information. Furthermore information can be given at any time and the user may receive them at anytime. So it will be useful if the information is accurate and given as fast as possible, but it is very important to ensure that the amount of information given and the way of presenting that information will not distract the driver.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Driver distraction</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TRAVEL-GUIDE Review</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td></td>
</tr>
</tbody>
</table>
**4A56** SMS: Speed and simplification of use. Possibly better to be a service on demand.

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-17-B-AUT23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information Providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>SMS: Speed and simplification of use. Possibly better to be a service on demand.</strong></td>
</tr>
<tr>
<td>Description</td>
<td>Information provision through SMS requires a full automated, fast system. Upon user request, possibly at a 4-digit number, a dense message on two languages containing all the most needed information will be sent.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>SMS service is considered as an additional information provision system, many times difficult to use it on road.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE Thessaloniki pilot</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
**4A57** Radio: a popular system, detailed announcements after a well-known and understandable sound/music.

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-18-B-AUT24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information Providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Radio: a popular system, detailed announcements after a well-known and understandable sound/music.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Most of users still prefer the radio as the main information provision system. The best plan is a radio station with many announcements during the day, with a special sound and/or music as an introduction. Slow and clear speech is required.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Even if a radio station provides information on city transportation, many users may not receive this information because they don’t understand when these announcements start.</td>
</tr>
</tbody>
</table>

**Example**

**Documentation**

**References**

TRAVEL-GUIDE D5, I2

**Testing Verifications**

**Suggestions for further research**
**4A58** RDS: suggestions and use optimisation

<table>
<thead>
<tr>
<th>Code</th>
<th>IV-19-B-AUT25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information Providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>RDS: suggestions and use optimization</strong></td>
</tr>
<tr>
<td>Description</td>
<td>RDS should not be rather considered as a main information system. It has still many technical problems (rolling speed varies, lack of characters except Latin, incompatibility issues etc.). On the other hand, if functioning smoothly, since most modern car-radios have an RDS, it can be useful to drivers, as a pre-trip mode.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>RDS has still many technical problems (rolling speed varies, lack of characters except Latin, incompatibility issues etc.).</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td>TRAVEL-GUIDE D5, I2</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Still remains unclear the legal issues of using RDS while driving.</td>
</tr>
</tbody>
</table>
### 4A59 Regular inspection of traffic management systems (TMS)

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-22-A-IFA1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators &amp; authorities</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Road operators, authorities</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Regular inspection of traffic management systems (TMS)</td>
</tr>
<tr>
<td>Description</td>
<td>Some surveys show a range of system failures between 10% and 15%. In order to guarantee data reliability validation techniques have to be developed and used by traffic control centres. Identification of erroneous traffic data ensures reliability by identifying wrong detectors. TMS should be inspected at least 10 to 25 times a year and ideally permanently because data have to be highly reliable and effective for efficient traffic management strategies.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Decreased reliability of traffic data due to failure of systems for traffic data collection and processing</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE WP1, TMS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Identification of cost-effective system control procedures</td>
</tr>
</tbody>
</table>
**4A60 Incident prevention should have priority over incident management**

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-23-A-IFA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators &amp; authorities</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Authorities</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Incident prevention should have priority over incident management</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>The key factor for future traffic management systems is incident prevention by traffic forecasts. Goal for the future has to be reaching the driver before a congested area and redirect the driver’s route.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Focus has to be shifted from incident management to incident prevention.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>TRAVEL-GUIDE WP1, TMS review</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TG D1</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td></td>
</tr>
</tbody>
</table>
Standardise information provided by Variable Message Signs

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-24-A-IFA19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers, designers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Standardized information provided by Variable Message Signs</td>
</tr>
<tr>
<td>Description</td>
<td>A variety of icons is used for the same message across Europe. To facilitate journeys in international corridors uniform icons are required.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TG WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Optimisation of information presentation by VMS</td>
</tr>
</tbody>
</table>
### 4A62 Evaluation of Full Colour Information Panels (FCIPs)

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-25-B-RUG1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>On-site information providers, VMS – FCIP</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Road authorities, information providers, traffic participants (end-users)</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Evaluation of Full Colour Information Panels (FCIPs)</td>
</tr>
<tr>
<td><strong>Study Description</strong></td>
<td>The studies concern development of optimal comprehensibility of screen layout and content of a &quot;Next-generation VMS&quot;, the Full Colour Information Panels (FCIP). Different constituting elements of a FCIP were systematically varied in a four-phased experiment. Comparisons between coloured and black &amp; white information elements, as well as pictorial vs. textual, relative vs. Absolute travel information, and stacked vs. diagrammatic road structure were made. Additionally, comprehensibility for non-native speakers was also considered. Most interestingly, comparisons between the choice distribution of the three route alternatives were made, either based on imaginary route choice (phase I and II, classroom and expert study) or on actual route choice (phase III and IV, simulator studies). Since the FCIP is ultimately implemented on a motorway near the city of The Hague in The Netherlands (phase V) the central background themes were increasing the efficiency of the use of the existing road network and promoting the use of public transportation.</td>
</tr>
<tr>
<td><strong>Study Context</strong></td>
<td>The recommendations and findings that are stated here are only valid in their very specific context. This context is shaped by the type of traffic sign (a FCIP), the content of the FCIP (three route alternatives, etc.), and the characteristics and limitations of the used experimental designs.</td>
</tr>
<tr>
<td><strong>Guideline Description</strong></td>
<td>The design of an ergonomically correct (legible, understandable) FCIP enforces both qualitative and quantitative constraints. These constraints are mutually dependent: an obvious panel layout and contents will allow a larger number of information elements to be displayed. Next to clearly 'perceptual' qualitative constraints, one has to take existing habits and familiarities into account. Main theme in the text below is that one should strive for parsimony (i.e. as few information elements as possible) during the design process. Exploiting ergonomic design principles while taking existing design types into account adds at least some degrees of freedom to this parsimony, i.e. allows for extra content on the panel.</td>
</tr>
</tbody>
</table>
Qualitative features

A) Diagrammatic display:
For complex panels, a diagrammatic layout is preferable to a textual one.
The road structure should be kept simple. This usually means that it is an abstract version of the actual road structure. Deviations from the actual road structure are acceptable, as long as they increase the effectiveness and efficiency decision process.

B) Colour use:
The use of colour coding, if it at all, should be kept to a minimum, i.e. standards such as red for “danger” or “avoid”, green for “safe” or “free”. Conventional VMSs generally lack colour coding, therefore colour coding tends to yield an unfamiliar appearance. The use of spatial colour coding however does have the potential to subdivide the total image into separate units (which one may call ‘visual chunks’).
It remains unclear whether the use of a colour coded map is recommendable. The difference with conventional traffic signs might be too big. One should be cautious as to not to overuse colour.
The use of tonal colour coding (highlighting) indicating relative travel time is generally poorly understood and therefore to be advised against.
The red-coloured road alternative is sometimes misinterpreted as obstructed, instead of congested.
Colours can help to increase recognition of a symbol (e.g., a white P on a blue background is better recognised as parking lot compared with a dot-matrix white P on a black background, see also below)
See also: IV-3B-CRF2 (advise against use of saturated blue or red because of chromatic aberration)

C) Symbol and pictogram use (pictorial information):
In general, pictorial information is preferable to textual information. Pictorial information is inherently language-free and information-dense. It has the potential to enhance (speed of) general interpretation, especially for non-native speaking drivers.

Specific findings of the experiment to date in relation to pictorial information are:
The red X-shaped symbol is associated with ‘road closed’ and should therefore only be applied in this context.
The smiley symbol (an unfamiliar, or at least out-of-context symbol) might be distracting, and is rated quite differently (liked or disliked, not in between).
The meaning of the ‘P&R (Park and Ride) symbol’ is not known by many drivers, moreover, it is not used some European countries at all.
**D) Language use (textual information).**

In principle, text is the language-dependent counterpart of symbol use. Apart from near-pictogram like statements such as "OK", language use should be kept to a minimum. This is especially true if this leads to interpretation problems for non-native speaking drivers. Provided that they are well-designed, the efficiency of information transfer is potentially greater for pictograms compared to text. Specific findings of the experiment to date in relation to textual information are:

- The use of the Dutch terms FILE – FILEVRIJ (Congestion - No congestion) is to be advised against. Non-native speakers generally do not understand this message.

**Ambiguity**

The travel time information was found to be ambiguous. It was sometimes interpreted as parking time. Small scale tests/surveys can indicate whether there is a risk of more than one interpretation of information.

**Quantitative features**

<table>
<thead>
<tr>
<th><strong>F) Information density</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Even with the best layout, pictograms, and other screen content, there is a real risk of overloading drivers with information. The [Reading Time = ( \frac{N_{items}}{3} + 2s )] formula should be used as a rough guideline (T5.3.3 page 4). However, the problem with this formula is that an 'item' is a rather ill-defined concept. The interrelationship between the number of information elements on the one hand, and the informational content on the other should be stressed.</td>
</tr>
</tbody>
</table>

**Problem identified**

In FCIP design, one should strive for as few information elements as possible. The hazard of information overload can be counteracted by reducing the number of information elements and by using qualitatively different screen designs and layout (like pictograms, colour coding and diagrammatic displays). However, too radical design changes do not facilitate recognition, since they conflict with expectancy bias. In the context of complex novel designs one has to find the middle way between increasing the efficiency of information transfer by means of new techniques on the one hand, and by maintaining familiarity on the other hand.

**REMARK**: When designing and evaluating traffic information panel designs, the only really effective solution is testing. Ideally such a test should have as much similarity with the real traffic conditions as possible (i.e. generalisable test results).

**Example**

- The use of a green smiley -an unfamiliar, novel pictogram in this context- to indicate a favourable, non-congested route alternative was not understood or was even found to be annoying by a substantial group of people, despite of the fact that it is more 'information efficient' than language-dependent alternatives.

**Documentation**

- TRAVEL-GUIDE D5: T5.3.1-4 (Task 5.3, test 2, part 1-4)

**References**

- TRAVEL-GUIDE D5; also: TROPIC (RO-96-SC.303/2) and RACE ISSUE (Project 1065)

**Testing limitation**

- The limited resolution of the projectors used in simulator study phases III and IV reduced the visual quality of the FCIPs, thereby inhibiting recognition to a certain degree.

**Suggestions for further research**

- A follow-up experiment is carried out in an actual roadside environment, namely at the A-12 motorway near The Hague. An alternative experiment might be to superimpose various new FCIP designs to a digital film of the actual roadside environment. Such a
trick film ought to give the viewer the illusion that the inserted (superimposed) FCIP is actually present in a real environment. In both follow-ups route choice distribution will be looked at, questioning if the users favour the public transportation alternative and if they understand that one of the alternative has a (much) longer travel time. In the on-site experiment questionnaires about the FCIP will also be administered.

<table>
<thead>
<tr>
<th>Documentation</th>
<th>TRAVEL-GUIDE D5: T5.3.1-4 (Task 5.3, test 2, part 1-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>References</td>
<td>TRAVEL-GUIDE D5; also: TROPIC (RO-96-SC.303/2) and RACE ISSUE (Project 1065)</td>
</tr>
<tr>
<td>Testing Limitation</td>
<td>The limited resolution of the projectors used in simulator study phases III and IV reduced the visual quality of the FCIPs, thereby inhibiting recognition to a certain degree.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>A follow-up experiment is carried out in an actual roadside environment, namely at the A-12 motorway near The Hague. An alternative experiment might be to superimpose various new FCIP designs to a digital film of the actual roadside environment. Such a trick film ought to give the viewer the illusion that the inserted (superimposed) FCIP is actually present in a real environment. In both follow-ups route choice distribution will be looked at, questioning if the users favour the public transportation alternative and if they understand that one of the alternative has a (much) longer travel time. In the on-site experiment questionnaires about the FCIP will also be administered.</td>
</tr>
<tr>
<td>Code</td>
<td>OS-26-B-IAT2</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------</td>
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<tr>
<td>Category</td>
<td></td>
</tr>
<tr>
<td>Target Groups</td>
<td>System developer</td>
</tr>
<tr>
<td>Short Title</td>
<td>Language Independent Information: Graphical Design of Traffic Signs</td>
</tr>
<tr>
<td>Description</td>
<td>When designing new traffic information by means of pictograms, it is not recommended to modify well known traffic signs. Recognizing a familiar pattern seems to suppress careful reading and lead to misunderstanding or non recognition of the differences.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Graphical modifications of a well known traffic sign have not been perceived by subjects.</td>
</tr>
<tr>
<td>Example</td>
<td>In the test case the pictogram of “queue” as recommended in the related project TROPIC has been modified to express low, medium and dense traffic to have a finer distinction between different degrees of congestion. This has been done by varying the number of queued cars shown in the triangular traffic sign.</td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td>References</td>
<td>TROPIC II, TRAVEL-GUIDE D1, TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>Without knowing that there are 3 variations for 3 different states (i.e. low, medium and dense traffic) it is difficult to realize the fine differences between each variation. Under real life circumstances with full resolution and bigger size of the signs it might be easier, which should be tested in a more realistic simulator with 1:1 dimensions or in a real environment. At least most of the people understood that there is a traffic jam as such illustrated on the signs.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>The feature “Traffic Jam Warning” is graded positively, but the subjects wish to receive additional information like location of the incident and expected time delay. It should be found out, which other information needs related to a queue warning travellers have and how different degrees of traffic density can be expressed in a pictorial way without causing misunderstandings.</td>
</tr>
</tbody>
</table>
**4A64 Graphical Information Design of New Features**

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-27-B-IAT3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>System developer</td>
</tr>
<tr>
<td>Short Title</td>
<td>Graphical Information Design of New Features</td>
</tr>
<tr>
<td>Description</td>
<td>When designing new functionalities by means of pictograms, it is recommended to use carefully well known graphic elements - <strong>familiar patterns</strong> seem to suppress careful reading and lead to misunderstanding or non-recognition of the differences. To convey information related to new functionalities, a balance has to be found between unambiguous understanding of the meaning (new) and the use of familiar elements (recognition).</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>to express new functionalities in a language independent, unambiguous way.</td>
</tr>
<tr>
<td>Example</td>
<td>In the respective tests the scenario of a bus driver was imposed who has to keep in schedule (neither too fast nor too late). The same information could also be relevant for a businessman who is travelling with a route guidance system and wants to be informed whether he is earlier in time than originally scheduled or delayed. These three stages “delayed”, “in time” and “too fast” have been displayed in a pictorial form in which a car silhouette was moving on a “time-beam” from left to right. Left stage: car is displayed in red colour, indicating the delay. Middle stage: Car is displayed green and within a permanently shown “centre frame”. Right stage: Car is displayed in red colour again, indicating the (too) fast cruising speed.</td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td>References</td>
<td>TRAVEL-GUIDE D4, TRAVEL-GUIDE D5</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>In some cases even the explanation of the context did not help to avoid misunderstanding of information. The dissimilarity between the 'imagined' (the driver is supposed to drive a public bus) versus the displayed car silhouette may have contributed to this misunderstanding. Next reason for this misunderstanding might be the use of an arrow to represent running time. There was no correlation between any of the arrow representations and driver behaviour. It was generally poorly understood that the arrows represented the time schedule of the car trip. This lack of understanding may have been caused by the fact that the same arrows had also been used in the previous experimental driving task.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>It could be examined to which degree semiotic similarity can be applied to unfamiliar meaning. Which warning earcons are effective and still accepted? Here further research is required since sounds are an important element of acceptance. The same is true for the differentiation between male and female voice messages. New investigations are necessary to examine significant differences, especially with exposing the subject to a higher workload.</td>
</tr>
</tbody>
</table>
4A65 Information content: Roadside Traffic Information Systems should contain only information of interest to every driver

<table>
<thead>
<tr>
<th>Code</th>
<th>OS-28-B-IAT4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Information content: Roadside Traffic Information Systems should contain only information of interest to every driver</strong></td>
</tr>
<tr>
<td>Description</td>
<td>The roadside TI systems are public paid, visible to all drivers (typical, elderly, disabled, foreigners, professional). Moreover due to physical and safety restraints the amount of information given should be limited. So a very careful selection of messages to be displayed should be done and those selected should concern everyone and be of great importance.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Sometimes roadside information systems show information which is not of direct interest, to the drivers, i.e. Municipality announcements.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL GUIDE Thessaloniki pilot</td>
</tr>
<tr>
<td>References</td>
<td>TRAVEL GUIDE Thessaloniki pilot</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
**4A66** Information presentation: A common way of presenting information should be adopted across all European Countries

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
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<tr>
<td>Target Groups</td>
<td>Information providers, designers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>Information presentation: A common way of presenting information should be adopted across all European Countries</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Inter border traveling has become an everyday reality. So it is important that in every country the information is presented in a similar way so that it will be easy for drivers to understand the messages in every country. Even if they are not completely familiar with the language and the road network, a familiar format of the messages will make it easier for them to understand the meaning of it.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Different information presentation formats confuse the drivers.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>AUTh/CT pilot: Use of local and English language and additionally, the appropriate pictograms.</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TROPIC project, Thessaloniki pilot</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td></td>
</tr>
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</table>
4A67 Information presentation: A common way of presenting information should be adopted across all European Countries

<table>
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<tr>
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</thead>
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<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers, road operators</td>
</tr>
<tr>
<td>Short Title</td>
<td>VMS: Information presentation: Use of two VMS at the same time when traffic and parking info is displayed.</td>
</tr>
<tr>
<td>Description</td>
<td>Even if the VMS screens timing is ideal, the idea of using two VMS, one dedicated to present traffic info and the second presenting parking availability info, is the most desirable by the subjects/users. NOTE however that this guideline contradicts the FCIP layout guidelines provided by RUG (OS-25-B-RUG1 in this document)</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Due to limited time available for looking the VMS information, driver can perceive limited amount of information only.</td>
</tr>
<tr>
<td>Example</td>
<td>Thessaloniki pilot</td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
<tr>
<td>Code</td>
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<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers, road operators</td>
</tr>
<tr>
<td>Short Title</td>
<td>VMS: Information presentation: Appropriate roadside system location (spot, height, horizontal distance)</td>
</tr>
<tr>
<td>Description</td>
<td>VMSes seem to be extremely useful when located at city entrances and generally at an appropriate distance before places where one has to choose one of a number of possible alternatives. The roadside system’s height correct, being high enough (higher than the highest estimated truck/vehicle), but not very high (to be easily seen from the drivers).</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Possible wrong positioning of the road-side systems</td>
</tr>
<tr>
<td>Example</td>
<td>Driving a car, a VMS could not be seen if a high truck is in front.</td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
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<tr>
<td>Suggestions for further research</td>
<td></td>
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<tr>
<td>Code</td>
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<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information Providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>VMS: information timing: Road side systems time interval/information density</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Road side systems must change their screens approximately every 5 seconds, having in mind that the urban speed limit generally is 50 km/h. The momentaneous density of the provided information deserves special attention. NOTE however that this notion of alternating information presentation contradicts with the FCIP layout guidelines provided by RUG (OS-25-B-RUG1 in this document)</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Information messages on road-side systems may be too fast to understand or too slow to read all the necessary information.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
**4A70 VMS: information presentation: languages, text position and use of pictogram**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
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<tr>
<td>Target Groups</td>
<td>Information Providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td><strong>VMS: information presentation: languages, text position and use of pictogram</strong></td>
</tr>
<tr>
<td>Description</td>
<td>If applicable, a good and tested VMS screen template is the following: Left: Local language text Middle: appropriate pictogram Right: English (or other internationally known language)</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Mix of languages might confuse drivers.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td>TRAVEL-GUIDE Thessaloniki pilot</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
4A71 Common data exchange protocols and smooth co-operation between the different information providers and operators

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Researchers, designers, information providers</td>
</tr>
</tbody>
</table>

**Short Title**

Common data exchange protocols and smooth co-operation between the different information providers and operators

**Description**

Different actors on information providing must agree to a common way of exchanging data in terms of ease of communication and compatibility. A smooth TIS/TMC operation is required, providing to the users the impression of a unique and robust information provider.

**Problem Identified**

Many times, different actors are involved in the information collection and distribution. The processing of information by TIS/TMC center is facilitated when common agreed exchange protocols exist together with common information presentation formats.

**Example**

<table>
<thead>
<tr>
<th>Documentation</th>
<th>References</th>
<th>Testing Verifications</th>
<th>Suggestions for further research</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TRAVEL-GUIDE Review and pilots</td>
<td></td>
<td></td>
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</table>

January 2008 271 VUB-CDV
4A72 Pre-trip information: Integrate up-to-date traffic information into route recommendations

<table>
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<tr>
<th>Code</th>
<th>EI-40-B-IFA9</th>
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<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Pre-trip Information providers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Pre-trip information: Integrate up-to-date traffic information into route recommendations</td>
</tr>
<tr>
<td>Description</td>
<td>Only very few web-based pre-trip systems integrate up-to-date traffic information into route recommendations. As a consequence of static support, drivers and travellers might be confronted with delays or even dangerous situations due to unexpected events on their route. Route recommendations should be based on online traffic situations.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Lack of dynamic integration of current traffic situations into pre-trip driver information</td>
</tr>
<tr>
<td>Example</td>
<td>TG WP1, TIS review</td>
</tr>
<tr>
<td>Documentation</td>
<td>TG WP1, TIS review</td>
</tr>
<tr>
<td>References</td>
<td>TG D1</td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
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</tr>
</tbody>
</table>
4A73 Local or regional web-based services should be provided in several languages.

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>Category</td>
<td>T 6.2: Information Providers</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Pre-trip Information providers</td>
</tr>
<tr>
<td><strong>Short Title</strong></td>
<td>Local or regional web-based services should be provided in several languages.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>In order to facilitate transnational journeys, foreigners should be able to understand information provided by regional pre-trip services as well.</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Information provision in local languages only.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>TG WP1, TIS review</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>TG D1</td>
</tr>
<tr>
<td><strong>Testing Verifications</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Suggestions for further research</strong></td>
<td></td>
</tr>
</tbody>
</table>
### 4A74 Advice to travellers on confirmed events

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers and road operators</td>
</tr>
<tr>
<td>Short Title</td>
<td>Advice to travellers on confirmed events</td>
</tr>
<tr>
<td>Description</td>
<td>Automatically or on request, information about traffic congestion is presented to travellers. The content of information can include location of the congestion, cause and estimated duration, when possible. Reliability and limitation of the number of messages provided to a user are fundamental to the success of such a service. Experiences in the sector suggest to provide only verified information. When the detection of congestion is automatic, an operator will verify and confirm it before the information is published. Fully automated information can be used for other services, as route suggestion, but not for direct advice to travellers. Also experience of the Titos system in Torino confirms that automatically detected congestion is not suggested to be supplied to final users as explicit messages, unless they are confirmed manually by an operator. The amount of the anomaly warnings would be out of control. They can be used as input for other services or displayed on a map, for example.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Reliability and frequency of messages to final users</td>
</tr>
<tr>
<td>Example</td>
<td>This guideline applies to all kinds of messages provided directly to the traveller catching his attention, as voice news, text messages on screens or variable road signs.</td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td>This recommendation results by the common opinion produced by the experience in several independent existing information systems.</td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>

### 4A75 Expression of the entity of traffic anomalies

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Information providers and road operators</td>
</tr>
<tr>
<td>Short Title</td>
<td>Expression of the entity of traffic anomalies</td>
</tr>
<tr>
<td>Description</td>
<td>On routes or on road trunks it is possible to define indexes based on observed average speed, that help to express the traffic conditions. The perception of a traffic anomaly is different by familiar or foreign travellers, since the first ones can know the usual traffic condition in the current time and day of the week, while the unfamiliar drivers can not have a particular reference. A possibility is to provide two indexes. Congestion index, the ratio between the observed travel time and the free flowing travel time. 100% means that the observed travel time is equal to the free flowing travel time. Anomaly index, the ratio between the observed travel time and the historical travel time referred to the current time and day of the week. 100 % means that the observed travel time is perfectly typical. The most diffused TMC encoding represents congestion by a variable with six possible values called level of service and a classification of the kind of event. The level of service represents in six steps the</td>
</tr>
<tr>
<td><strong>Problem Identified</strong></td>
<td>Different perception of traffic anomalies by familiar or foreign travellers</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>Congestion index and anomaly index are complementary. Occasional travellers – like tourists – can be interested in the congestion level of roads, while expert travellers – like commuters – are mainly interested in anomalies with respect to usual conditions, as they already expect congestion which happen repeatedly.</td>
</tr>
</tbody>
</table>

**Documentation**

**Testing Verifications**

To be done. This guideline is a proposal to solve a problem raised by information providers

**Suggestions for further research**

It is necessary to verify the acceptance of the two proposed indexes by information providers and the usability in services to users. Also other ways to express traffic condition can be proposed and then compared
Use of national languages

<table>
<thead>
<tr>
<th>Code</th>
<th>EI-47-B-MIZ4</th>
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<tr>
<td>Category</td>
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</tr>
<tr>
<td>Target Groups</td>
<td>All the service providers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Use of national languages</td>
</tr>
<tr>
<td>Description</td>
<td>The union through the countries in Europe becomes steadily stronger. Cross border journeys and presence in foreign countries increase. The limitations of information provided only in local language become more and more obvious. Information can be provided in different languages at the same time or also in language independent ways. 1. Language independent information: the presentation uses only icons, numbers, locality names, standard measurement units, earcons (an 'earcon' is the auditory equivalent of the (visual) icon). All these symbols, even if they cannot be of global use, can be understood over a wider range of users than the local language. Sometimes information details cannot be language independent, then it is advisable to have the essence of the information language independent and only details in local language. 2. Language choice: the information is provided in several languages. In case of private access to the information, the language can be selected (internet, car on-board devices...). In case of public presentation (road signs) it is necessary to display all the languages. In this case the size of the display can represent a limit. The recommendation of this paper can seem obvious and needless, but sometimes it was forgotten.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Understandability of services by people who do not speak the local language</td>
</tr>
<tr>
<td>Example</td>
<td></td>
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<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
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<tr>
<td>Testing Verifications</td>
<td></td>
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<tr>
<td>Suggestions for further research</td>
<td></td>
</tr>
</tbody>
</table>
Data exchange between information centres

<table>
<thead>
<tr>
<th>Code</th>
<th>EI-48-B-MIZ5</th>
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</thead>
<tbody>
<tr>
<td>Category</td>
<td>T 6.1: road operators</td>
</tr>
<tr>
<td>Target Groups</td>
<td>Researchers, system developers</td>
</tr>
<tr>
<td>Short Title</td>
<td>Data exchange between information centres</td>
</tr>
<tr>
<td>Description</td>
<td>Existing information systems are often concerned with only one transport operator, or different operators strictly bound on the same network. One service informs about one mode, one area, one kind of road (urban or motorway). Transport management and control are mainly based on self-collected information. Urban road administrators, motorway operators, public transport companies have got their own monitoring system, composed of detectors, communication links, processing and databases. In the same region different operators – for example managing different travel modes – have their separated information systems. The provision of multimodal user information is a major target of a transport environment. In a complex transport network a number of applications introduce measures that affect flow patterns. Co-operative monitoring and control are key functions for ensuring optimal use of the supply network. The greater the effects that desired by telematics, the greater the need for collaboration between applications in elaborating and actuating control strategies. It is clear that data exchange can improve the effectiveness of management and control of their specific systems. Meantime travellers require complete and integrated services. Traffic information collecting centres are beginning to develop and would be the essence of the improvement. At the moment data exchange is limited. The lack of standard is perceived as an high obstacle. Also the variety of used media indicates the lack of a standard. Most of them are generic media, except Alert C and Alert + which are specific for traffic. XML and internet are increasing in use. Different system architectures have been designed for exchanging transport information, covering different requirements between data centres. A secondary problem is the confidential nature of data and their commercial protection. These questions need to be still studied. The co-operation cannot reach a unique centralised travel information system for all Europe. The whole information system has to be thought distributed.</td>
</tr>
<tr>
<td>Problem Identified</td>
<td>Technical obstacles in data exchange</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>Documentation</td>
<td></td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Testing Verifications</td>
<td></td>
</tr>
<tr>
<td>Suggestions for further research</td>
<td>Research is wished in order to define a wide-use traffic data channel that can be proposed as standard.</td>
</tr>
</tbody>
</table>
AWAKE (D9.1)

General Guidelines for Auditory Displays and Speech Design

Loudness

The following guideline (guideline number: 4A78) limits the loudness of auditory tones. This guideline is an existing one and references to usability.

<table>
<thead>
<tr>
<th>Guideline Number: 4A78</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td>Auditory tones should be about 15dB above the masked threshold, but no more than 115dB absolute level.</td>
</tr>
<tr>
<td><strong>Text:</strong></td>
</tr>
<tr>
<td>The 15 dB level reflects a compromise of the recommendations found in studies investigating the use of warning sounds in aircraft cockpits.</td>
</tr>
<tr>
<td><strong>Reference:</strong></td>
</tr>
<tr>
<td><strong>Comments:</strong></td>
</tr>
</tbody>
</table>

This guideline is an existing one and references to usability.
Discriminability of warning sounds

The following guideline (guideline number: 4A79) concentrates on the discriminability of warning sounds. It is an existing guideline and references to usability.

<table>
<thead>
<tr>
<th>Guideline Number: 4A79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
</tr>
<tr>
<td>Discriminability of warning sounds</td>
</tr>
<tr>
<td>Text:</td>
</tr>
<tr>
<td>Limit the number of different warning tones to three or four.</td>
</tr>
<tr>
<td>To create distinguishable sounds, vary two or more of the following parameters:</td>
</tr>
<tr>
<td>Spectral content.</td>
</tr>
<tr>
<td>Pulse duration.</td>
</tr>
<tr>
<td>Pulse shape.</td>
</tr>
<tr>
<td>Temporal pattern.</td>
</tr>
<tr>
<td>The sound should be composed of 10 or more harmonically spaced components, at least 4 of which are prominent and in the range of 100 to 4000Hz.</td>
</tr>
<tr>
<td>Most of the energy of lower-priority warning signals should be in the first 5 harmonics, whereas higher-priority signals should have relative more energy in harmonics 6 through 10.</td>
</tr>
<tr>
<td>Urgency can be emphasized by incorporating a small number of additional, non-harmonically related, components or by introducing rapid glides in the fundamental frequency.</td>
</tr>
<tr>
<td>The duration of a signal should be between 100 and 150ms.</td>
</tr>
<tr>
<td>Pulse shaping should be done by providing onsets of no greater than 1dB that are linear or concave down. Offsets should match onsets.</td>
</tr>
<tr>
<td>Varying the temporal pattern (i.e., the timing and amplitude) of successive tone bursts substantially aids discriminability.</td>
</tr>
<tr>
<td>Reference:</td>
</tr>
<tr>
<td>Publication No. FHWA-RD-94-087</td>
</tr>
</tbody>
</table>

Comments:
Synthetic Versus Recorded Speech

The following guideline (guideline number: 4A80) defines when the use of synthetic speech is necessary versus the use of record speech. This guideline is an existing one and references to usability.

<table>
<thead>
<tr>
<th>Guideline Number: 4A80</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong> Synthetic Versus Recorded Speech</td>
</tr>
</tbody>
</table>
| **Text:** Use non-speech auditory massages (sounds) only for the purposes of alerting either as a self-contained message, or as a method of alerting the driver to an in-vehicle visual message or to a spoken message that follows.

Other auditory messages, including complex warnings, should be speech.

Computer-generated, on line speech is recommended for situations that require substantial flexibility in generating spoken messages.

Where the choice of messages is relatively limited and known ahead of time, recorded human speech is preferred.


| Comments: |
Auditory / Tonal code

The following two guidelines (guidelines number: 4A81, 4A82) refer to the use of auditory, tonal codes and the auditory message length. These guidelines are existing ones and reference to the usability.

**Guideline Number: 4A81**

**Title:**
Auditory / Tonal code

**Text:**
A tonal signal should be used for attracting attention, and for delivering a preparatory message.

It may also be selected to deliver general information such as "attention" or "danger".

A tonal code is also recommended for information requiring a quick response from the driver, but only if the meaning is obvious.

The number of tonal signals used in a car should be limited to 3.

Tonal codes should be perfectly audible and recognizable without any risk of confusion for the drivers, whatever the characteristics of the driving situation.

**Reference:**

**Comments:**
Guideline Number: 4A82

Title:
Auditory message length

Text:
Messages that require an urgent action should be a single word or a short sentence with the fewest number of syllables possible. Drivers should be able to understand the message immediately. Messages that are not urgent or for which a response may be delayed can be a maximum of 7 units of information in the fewest number of words possible. If the information cannot be presented in a short sentence, the most important information should be presented at the beginning and/or the end of the message.

Navigation instructions should be limited to 3 or 4 information units.

Reference:
Warning tone design

The following two guidelines (guidelines number: 4A83, 4A84) concentrate on the design and the use of the warning tones. The guideline with number 4A83 is a new one and the guideline with number 4A84 is an existing one but both reference to usability.

**Guideline Number: 4A83**

**Title:**
Use non-speech auditory messages (sounds) only for the purposes of alerting, either as a self-contained message, or as a method of alerting the driver to an in-vehicle visual message or to a spoken message that follows.

**Text:**
Warning tones can be perceived very quickly but may be difficult to be interpreted. If the number of different in-vehicle warning tones is high, care must be taken to keep them distinguishable. This can be done by introducing voice messages as a supplement.

**Reference:**
AWAKE

**Comments:**

**Guideline Number: 4A84**

**Title:**
Sound sources for presenting auditory warnings should be located so that they do not direct the driver's attention away from the roadway ahead.

**Text:**
Drivers who are in a drowsy state will likely be more startled by an auditory warning than an alert driver, and sleep inertia may cause the driver to be temporarily disoriented. Thus every effort should be made to minimize confusion. Speakers should be located so that the auditory warnings do not distract the driver's attention from the roadway ahead.

**Reference:**
Preliminary Human factors Guidelines for Crash Avoidance Warning Devices
NHTSA report DOT 808 342

**Comments:**
Speech message design

The following two guidelines (guidelines number: 4A85, 4A86) concern with the design and the use of the speech messages. The guideline with number 4A85 is a reviewed one and the guideline with number 4A86 is an existing one but both reference to usability.

<table>
<thead>
<tr>
<th>Guideline Number: 4A85</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td>Complex auditory messages should be speech messages</td>
</tr>
<tr>
<td><strong>Text:</strong></td>
</tr>
<tr>
<td>A speech format is superior to a non-speech format when a complex message is presented via the auditory channel. Voice warnings are more flexible and informative than sounds; they provide better diagnostics, and they better assist the user in taking corrective action. Text displays for providing further explanations should be avoided due to possibly long eyes-off-the-road durations. Normally, drivers will interact rather seldom with the system, which leads to the necessity of instantly comprehensible system output. However, also care must be taken so that the warning voice is discernible from that of a passenger or radio messages. For these reasons, speech warnings may be most effectively used as part of a combination of two or more types of warnings.</td>
</tr>
<tr>
<td><strong>Reference:</strong></td>
</tr>
<tr>
<td><strong>Comments:</strong></td>
</tr>
</tbody>
</table>

- reviewed
- new
- technical
- usability
- other
Guideline Number: 4A86

**Title:**
Rate of Speech

**Text:**
For warning messages, use a speaking rate of approximately 150 wpm. A slower rate may be desirable for training listeners who are unfamiliar with the speech accent.

**Reference:**

**Comments:**
Auditory vs Visual

The following two guidelines (guidelines number: 4A87, 4A88) constrain the type of information (auditory or visual) depending on the complexity of the information. Both guidelines are existing ones and reference to usability.

### Guideline Number: 4A87

**Title:** Auditory versus Visual

<table>
<thead>
<tr>
<th><strong>Text:</strong> Use of visual information is recommended:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- When the delay between the message and the expected action is long</td>
</tr>
<tr>
<td>- For the parts of messages requiring proper nouns and figures. For example, in the case of recommended detours because of road obstruction, indications regarding precisely where to leave and rejoin the planned route should be given through visual presentation.</td>
</tr>
<tr>
<td>- When multi-language, multi-cultural drivers are the targets of information.</td>
</tr>
<tr>
<td>- When the message may be delivered in very noisy situations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Use of auditory information is recommended:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- For the messages which ask for immediate or nearly immediate action.</td>
</tr>
<tr>
<td>- For messages delivered when the visual channel is already quite overloaded</td>
</tr>
</tbody>
</table>

**Reference:**

**Comments:**
Guideline Number: 4A88

Title:
Sensory modality for presenting ATIS/CVO messages

<table>
<thead>
<tr>
<th>Information Characteristic</th>
<th>Sensory Modality</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Complexity</td>
<td>Visual</td>
</tr>
<tr>
<td>Low Complexity</td>
<td>Auditory</td>
</tr>
<tr>
<td>High Priority</td>
<td>Auditory</td>
</tr>
<tr>
<td>Low Priority</td>
<td>Visual</td>
</tr>
<tr>
<td>Intermittent Display</td>
<td>Auditory</td>
</tr>
<tr>
<td>Continuous Display</td>
<td>Visual</td>
</tr>
<tr>
<td>Requested Presentation</td>
<td>Auditory (Unless complex, then visual)</td>
</tr>
<tr>
<td>Automatic Presentation</td>
<td>Visual (Unless high priority, then auditory)</td>
</tr>
</tbody>
</table>

Reference:

Comments:
Complexity is a function of how much information is being provided and how difficult it is to process.
Priority is a function of the urgency of a response and the consequences of failing to make a response.
General Guidelines For Advanced Traveler Information System (ATIS) Displays

The following guideline (guideline number: 4A89) gives some constrains about the design of head-up displays. This guideline is an existing one and reference to usability.

**Guideline Number: 4A89**

**Title:**
Design of Head-Up Displays for ATIS

**Text:**

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Viewing Distance</td>
<td>Locate the HUD image 2.35 to 2.80 meters from the design-eye-position of the HUD.</td>
</tr>
<tr>
<td>Image Distortion</td>
<td>No HUD element should vary from its intended size by more than +/- 10%. No point on the HUD display should be displaced by more than 5% of the total image width or height (horizontal or vertical FOV).</td>
</tr>
<tr>
<td>Luminance Adjustment Control</td>
<td>A luminance adjustment control for the HUD image should be provided. A continuous rotary knob, slide, or a thumbwheel should be the type of control provided for this adjustment. Luminance values, as a function of control position, should be derived from a power function (see equation below).</td>
</tr>
</tbody>
</table>

Footlambert = \[ (P \times L_{\text{max}}^{0.33}) + ((1-P) \times (L_{\text{min}}^{0.33})) \] ^{1/0.33}

where:
P = the proportion of total control movement
L_{\text{max}} = maximum luminance provided
L_{\text{min}} = minimum luminance provided

**Reference:**

**Comments:**
System activation / deactivation

The following three guidelines (guidelines number: 4A90, 4A91, 4A92) concentrate on the activation and deactivation of the system and constrain the consideration of the parameters of the optimal performance of the system. The guideline with number 4A90 is an existing one and reference to usability. The guideline with number 4A91 is a new one and reference to technical. The guideline with number 4A92 is an existing one and reference to technical.

<table>
<thead>
<tr>
<th>Guideline Number: 4A90</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td><strong>Text:</strong></td>
</tr>
<tr>
<td><strong>Comments:</strong></td>
</tr>
</tbody>
</table>
### Guideline Number: 4A91

**Title:**
Parameters of optimal performance of the system should be taken into account in order to avoid false alarms.

**Text:**
Frequency of false alarms should be as low as possible. Drowsiness alarms under certain circumstances like when the vehicle is reversing or in urban environments are more likely to be false alarms and might be automatically suppressed. The optimal environment for system performance is clearly rural roads and motorways. Driving under these conditions should either activate the system or at least lower the threshold for drowsiness alarms.

**Reference:**
AWAKE

**Comments:**

### Guideline Number: 4A92

**Title:**
Automatic system check should be implemented and results be fed back to the driver.

**Text:**
Built in diagnostic tests should be implemented with the detection/warning system. These tests should be engaged every time the system is activated. If the built in diagnostic test detects a system failure the driver should be notified immediately. However, this information should not be displayed in such a way that the driver could mistake the warning for one requiring a more immediate response.

**Reference:**
Fahey, S. E., Wierwille, W. W.
Advisory and alarm stimuli optimization for a drowsy driver detection system

**Comments:**
Adjustment possibilities

The following two guidelines (guidelines number: 4A93, 4A94) refer to the need of the adjustable systems and the self-calibration of devices. The first guideline (guideline number: 4A93) is a reviewed guideline and reference to usability. The second one (guideline number: 4A94) is an existing guideline and reference to technical.

### Guideline Number: 4A93

**Title:**
Certain system settings have to be adjustable or personalized.

**Text:**
Multiple settings should be available on warning alarms. These settings should be adjustable. The settings should default to a predetermined setting. It is very likely that multiple drivers will drive one vehicle and possibly in different environments.

Ideally driver needs and preferences are stored in an individual profile that can be activated by the respective driver. The profile should comprise presence, intensity and type of warnings. Settings may be changed for drivers with hearing and/or visual impairments as well as for drivers that will use the system more frequently than others (such as drivers with sleep disorders).

In order to account for different levels of brightness and environmental sound volume, automatic system adaptation is preferred to manual calibration.

Brightness of visual displays should be related to the actual conditions in the vehicle by using brightness sensors and acoustic warnings have to be made audible firstly by muting the car radio (if in operation) and by adapting the sound level of the warning output to the surrounding noise level.

**Reference:**
Fahey, S. E., Wierwille, W. W.
Advisory and alarm stimuli optimization for a drowsy driver detection system

**Comments:**
<table>
<thead>
<tr>
<th>Guideline Number: 4A94</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong> The device should be self-calibrating. If the device is not self-calibrating, driver requirements for calibrating the device should be minimized and should be as simple and intuitive as possible.</td>
</tr>
<tr>
<td><strong>Text:</strong> By their nature, driver alertness monitoring devices based on physiological measures will require calibration to accommodate individual driver differences, often on a trip by trip basis. Drivers will not use the device if it requires lengthy or difficult calibration procedures. If the device is to be accepted and used consistently, the device calibration should preferably be automatic. If automatic calibration is not possible, then the procedure for calibration should be as simple and straightforward as possible.</td>
</tr>
<tr>
<td><strong>Comments:</strong></td>
</tr>
</tbody>
</table>
Physical Characteristics

Display Position

The following five guidelines (guidelines number: 4A95, 4A96, 4A97, 4A98, 4A99) define the position of the displays. These guidelines are existing ones and reference to usability.

**Guideline Number: 4A95**

**Title:**
Displays should be arranged according to their role in assisting the driver.

**Text:**
Displays, which present important information during driving, should be installed in the cone of fixation of the driver. It is recommended that the angle of incidence be a maximum of 15°-30°. Displays, which are only used to configure a system, and are not used during driving, should also be located in the drivers' cone of fixation, but the angle of incidence is not so critical.

**Reference:**

**Comments:**

**Guideline Number: 4A96**

**Title:**
Displays should be located in adequate positions or protected, to make sure that incoming light does not disturb their perception.

**Text:**

**Reference:**

**Comments:**
### Guideline Number: 4A97

**Title:** Displays should not be covered by functional parts of the vehicle (e.g. the gear lever).

**Text:**

- Displays should not be covered by functional parts of the vehicle (e.g. the gear lever).

**Reference:**


**Comments:**

### Guideline Number: 4A98

**Title:** In-vehicle display for passenger car with ten or fewer occupants and for commercial vehicles derived from passenger car and similar shaped vehicles.

**Text:**

- The display shall be mounted in a position where the downward viewing angle is less than 30 degrees. The Downward Viewing Angle should be set between two lines that project on the vehicle’s Y plane. The first line projected on the Y plane should be drawn from the JIS (Japan Industrial Standard) eye-point parallel to the x-axis and the second line should be drawn from the center of the Display Monitor to the JIS eye-point.

- The upper edge of the display shall conform to the driver’s visual range requirements (90/630/EEC) for the lower limit with the forward range of 180 degrees.

**Reference:**


**Comments:**
### Guideline Number: 4A99

**Title:**
In-vehicle display for a vehicle that is not specified in guideline number 4A98 shall be mounted in the position at which:

**Text:**
The downward viewing angle shall be less than the value obtained from the formula below.

\[ \text{Angle}^\circ [\text{degrees}] = 0.01303 \times (\text{eye point height from the ground} [\text{mm}]) + 15.07 \]

The upper edge of the display shall meet the following requirements.

- When the height of eye point above the ground is less than 1700mm, comply with the lower limit requirements for the forward range of 180 degree defined in the driver's visual range requirements (90/630/EEC).
- When the height of eye point above the ground is 1700mm or more, comply with the lower limit requirements for the critical zone A as defined in the de-mist requirements (ADR15/01).

**Reference:**

**Comments:**
The following five guidelines (guidelines number: 4A100, 4A101, 4A102, 4A103, 4A104) obligate the representation of information provided by the display without flicker, with the minimum glare and reflection possible and with the optimal adaptable illumination depending on the ambient. All these guidelines are existing ones and reference to usability.
Flicker

<table>
<thead>
<tr>
<th><strong>Guideline Number:</strong> 4A100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td><strong>Text:</strong></td>
</tr>
</tbody>
</table>

| **Reference:** |

| **Comments:** | }
Reflection

**Guideline Number: 4A101**

**Title:**
Reflection of light from the surface of the display should be minimized.

**Text:**
Reflected light disturbs and complicates the assimilation of information and reduces legibility.

<table>
<thead>
<tr>
<th></th>
<th>existing</th>
<th>reviewed</th>
<th>new</th>
</tr>
</thead>
</table>

**Reference:**

<table>
<thead>
<tr>
<th></th>
<th>technical</th>
<th>usability</th>
<th>other</th>
</tr>
</thead>
</table>

**Comments:**

Glare

**Guideline Number: 4A102**

**Title:**
Glare from the surface of the display should be minimized.

<table>
<thead>
<tr>
<th>Text:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glare reduces visual functions such as difference-sensitiveness or shape sensitiveness.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference:</th>
</tr>
</thead>
</table>

**Comments:**
Guideline Number: 4A103

**Title:**
The illumination of the display should be adaptable to changes in ambient light (e.g. day or night) to ensure that the illumination of the display is suitable for all ambient light conditions. *It is recommended that the display is illuminated automatically according to the ambient light.*

**Text:**

| existing | reviewed | new |

**Reference:**

**Comments:**
Luminance

<table>
<thead>
<tr>
<th>Guideline Number: 4A104</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td>The luminance of the display should be easily adjustable by the driver, to suit the conditions (ambient illumination). An automatic adjustment of the display according to the ambient light is recommended.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Text:</th>
</tr>
</thead>
<tbody>
<tr>
<td>An optimal luminance increases safety in performance of the visual task: Safe recognition of the information in an adequate time and a reduction in mental workload whilst viewing the display.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Comments:</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>existing</th>
<th>reviewed</th>
<th>new</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>technical</th>
<th>usability</th>
<th>other</th>
</tr>
</thead>
</table>
Safety and Warning Guidelines

The following three guidelines (guidelines number: 4A105, 4A106, 4A107) constrain the type of presentation of warning information for hazard warning, for vehicle condition monitoring, and for road condition. These guidelines are existing ones and reference to usability.

### Guideline Number: 4A105

**Title:**
Presentation of immediate hazard warning information.

**Text:**

<table>
<thead>
<tr>
<th>Information Element</th>
<th>Display Type</th>
<th>Trip Status</th>
<th>Display Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inform driver of incident/hazard</td>
<td>Auditory and Visual</td>
<td>Vehicle in Motion</td>
<td>Iconic or graphic representation with voice or text</td>
</tr>
<tr>
<td>Indication of the type of hazard</td>
<td>Auditory and Visual</td>
<td>Vehicle in Motion</td>
<td>Iconic or graphic representation</td>
</tr>
<tr>
<td>Distance to hazard</td>
<td>Auditory</td>
<td>Vehicle in Motion</td>
<td>Alerting tone, then speech</td>
</tr>
<tr>
<td>Status of hazard</td>
<td>Auditory</td>
<td>Vehicle in Motion</td>
<td>Alerting tone, then speech</td>
</tr>
<tr>
<td>Alternate route</td>
<td>Visual</td>
<td>Vehicle at a Stop</td>
<td>Iconic or graphic representation with or without text</td>
</tr>
</tbody>
</table>

**Reference:**

**Comments:**
Guideline Number: 4A106

Title: Presentation of vehicle condition monitoring information.

<table>
<thead>
<tr>
<th>Information Element</th>
<th>Display Type</th>
<th>Trip Status</th>
<th>Display Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inform driver of current problem</td>
<td>Auditory and Visual</td>
<td>Vehicle in Motion</td>
<td>Iconic or graphic representation</td>
</tr>
<tr>
<td>Inform driver of ways to correct problem</td>
<td>Visual</td>
<td>Vehicle in PARK</td>
<td>Iconic or graphic representation</td>
</tr>
<tr>
<td>Provide more detailed information at the driver's request</td>
<td>Auditory and Visual or Auditory</td>
<td>Vehicle in PARK</td>
<td>Iconic or graphic representation with speech or text</td>
</tr>
<tr>
<td>Inform the driver of needed warranty services due</td>
<td>Visual</td>
<td>Vehicle in PARK</td>
<td>Iconic, graphic, or text presentation</td>
</tr>
</tbody>
</table>


Comments:
### Guideline Number: 4A107

**Title:**
Presentation of road condition information.

**Text:**

<table>
<thead>
<tr>
<th>Information Element</th>
<th>Display Type</th>
<th>Trip Status</th>
<th>Display Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inform driver of road traction, visibility, congestion, construction activity, or weather conditions</td>
<td>Visual</td>
<td>Vehicle in Motion</td>
<td>Iconic or graphic representation with or without text</td>
</tr>
<tr>
<td>Distance to congestion or construction activity</td>
<td>Auditory</td>
<td>Vehicle in Motion</td>
<td>Alerting tone, then speech</td>
</tr>
</tbody>
</table>

**Reference:**
Requirements of warning messages

The following two guidelines (guidelines number: 4A108, 4A109) concentrate on the requirements of the warning messages such as the effectiveness and the acceptance for the driver, by alerting him/her, by giving him/her information on the current situation and by maintaining an increased level of vigilance over a short period of time. The guidelines with numbers 4A108, 4A109 are existing guidelines and reference to usability.

### Guideline Number: 4A108

**Title:**
Warning signals must be effective and acceptable.

**Text:**
An effective warning signal must be intrusive and convey a sense of urgency. However, warning systems in vehicles must not be so intrusive and urgent that they startle the driver, and possibly put him or her in danger, or annoy the driver to that point that he or she will deactivate the system. At the same time the warning must not be so conservative that it fails to result in the desired effect of alerting a driver of an approaching danger.

**Reference:**
Preliminary Human factors Guidelines for Crash Avoidance Warning Devices
NHTSA report DOT 808 342

### Guideline Number: 4A109

**Title:**
Priority of warning messages.

**Text:**
When delivering time-critical information by voice, as in warnings, incorporate a priority system to order concurrently triggered voice messages so that the most critical is presented first.

**Reference:**
APPENDIX 4B : QUESTIONNAIRE RESPONSES REGARDING RESEARCH NEEDS

<table>
<thead>
<tr>
<th>4B1 Name of the need:</th>
<th>Impacts on visibility of VMS</th>
</tr>
</thead>
</table>

**Completed by:**
Name: Pavel Tučka  
Institution: CDV  
Name: Jan Weinberger  
Institution: CDV

**Description of the need:**
WMS comprise two types, continuous and discontinuous:
- continuous signs are similar to fixed signs, the only difference being that by some electro-mechanical means they can show various messages.
- discontinuous signs create message using individual elements that can be in one of two states (or more) and can thereby create various messages on the same sign face.

The problem is the reduced visibility and legibility of information conveyed by VMS at the momentary strong lighting of sunshine – by discontinuous signs.
The need is to find new technology and possibilities how to increase the illumination power of discontinuous VMS by bad externally light conditions (direct sun illumination).

**Suggested way for finding solution:**
The solution can be in the domain of research in the field of optics and technology – here is the real need to find new technologies which can enable to increase the luminance ratio emitted from the sign in the ON state promptly, according to intensity of externally (sun) illumination.
### 4B2 Name of the need:
**Impacts of IVIS/ADAS - more exact measuring**

### Completed by:
Name: Martin Winkelbauer  
Contact: KfV

### Description of the need:
Development of ADAS/IVIS currently strongly considers technical feasibility and market acceptance. Still, in many cases there are only rough estimates about impact on road safety. In some cases, information about implementation is even misleading: If systems are implemented not isolated (e.g. VMS and automatic enforcement together) it is not possible to identify what one would have achieved without the other. Therefore field operational tests, large scale experiments or other research about IVIS and ADAS are needed, which are representative for Europe's population, infrastructure and vehicles.

In particular, to put one single function into reality, there is normally more than one possibility. In most of the cases, the question is whether to implement an infrastructure-based system, an autonomous system or a cooperative one. There is a clear need to identify the best solution for each of the functions and to consider also the implementation of other functions in order to find common targets and synergetic effects.
Suggested way for finding solution:
A practical solution would be an improvement of accident statistics. In addition to in-depth studies and field operational tests or simulator studies, statistical information should be given in the national accident record. I.e., accident statistics should contain information about ADAS & IVIS: Which system has been present at the time of the accident in the vehicle and which one has been in operation. Detailed information about the systems is needed; a structured way of describing the system should be available and flexible enough to also cover new systems. Although this might be limited to in-depth investigation, information would be needed, whether these systems could probably have had an impact on accident causation, and these systems have possibly been misused or possible have failed to give the correct and efficient information.

In general, political decision about road safety measures should be more based on hard facts instead of public acceptance. Of course, public acceptance is an important issue, however, effectiveness (particularly cost effectiveness) should be strongly considered. Therefore additional information is needed about ADAS & IVIS:
- Clear definition of problem to be solved;
- Some idea of the size of the problem;
- An estimate of expected safety effects;
- Evaluation of actual effects;
- Estimate of costs and benefits;
- Monitoring of public acceptance;
- Sustainability of effects;
- Transferability of effects.

For the purpose of estimating costs and benefits, beyond the safety impact other information is needed:
- Frame conditions and parameters (e.g. duration of the measure, interest rates);
- Costs of implementation and maintenance of the measure;
- Impact on noise emissions;
- Impact on air pollution;
- Impact on travel time;
- Impact on mobility;

Stability of all these estimates and sensitivity of the result of the analysis. Any road safety measure that is implemented should be implemented together with a study about the effects (safety and other effects). Resources need to be made available for these studies, even if efficiency is documented from other measures in other places (i.e. countries, continents).
## 4B3 Name of the need:
**ADAS/IVIS costs definition**

### Completed by:
Name: Martin Winkelbauer  
Institution: KfV

### Description of the need:
Data on the costs of ADAS/IVIS is very difficult to estimate. Electronic functions are frequently integrated in existing control units, sensors and/or actuators are/can be used for other functions as well. Costs for development are kept under cover and finally, there is a strong uncertainty in terms of market penetration. I.e., new features are normally implemented first in the luxury class vehicles and later slowly spread into the other classes, which makes estimates for the costs very difficult.

### Suggested way for finding solution:
The way, how to exactly determine or allocate costs, could be to link them to defined individual specific impacts of equipment, if there is a setting up of more systems.

However that does not encourage manufacturers to inform expert public or potential users, because of the manufacturers’ competition policy in the market.
### 4B4 Name of the need:
**Evaluation by cost-benefit analysis**

### Completed by:
Name: Martin Winkelbauer  
Institution: KfV

### Description of the need:
Some of the politicians and other decision makers tend to introduce measures, which improve likeability of being voted again. Something that does not hurt anyone and give good press feedback. Safety improvement seems to be secondary and thinking about getting the best from their money (i.e. selection by cost-benefit criterion) seems to be mostly unknown (except for infrastructure experts). It gets more than evident, that there is a strong lack of good evaluations.

(Derived from the recent results of "SUPREME", also considering "ROSEBUD")

### Suggested way for finding solution:
Most of road safety measures are introduced without thinking about an evaluation study, which could be useful for this measure and for any other similar measure of the future. Much is done on the basis of theoretical assumptions and/or calculation but practical impact is hardly investigated.
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<th><strong>4B5 Name of the need:</strong></th>
<th><strong>COST 352 findings - multiple needs</strong></th>
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**Completed by:**
Name: Eva Gelová  
Institution: CDV

**Description of the need:**

“For each system, new behaviours might be induced by the use of an IVIS, especially a navigation system. Actually, the cognitive under-stimulation in terms of collecting and memorizing spatial information could lead to a great dependence on a route guidance system, making the person unable to drive without that information. The same may occur by the use of a collision warning system, which could affect situation awareness.

Larger and detailed statistics of accidents caused within the use of IVIS are missing: Accident statistics data were not collected systematically. Detailed information from local authorities needs to be obtained.

Standards (CEN/ISO) of human centred demands on technical parameters of IVIS were established. Rules of use for private users and possibility of their supervision and checking are needed.

Education and training programs for private and professional drivers concerning ITS use, neither studies nor reports about specific education, training courses or programs for users of in-vehicle telematic devices were found in the literature. Even the precise guidelines for truck and bus companies do not cover the area of the specific training of drivers who are using IVIS. Only questionnaires for management and drivers encompassing issues connected with the use of in-vehicle telematic devices are available.

There is a research need on studies focused on the positive/negative impacts of IVIS implemented to fleet management (not only commercial aspects, but also safety aspects, driver’s attitudes and feelings, difficulties connected with specific categories of drivers – experience, age, risky drivers).

Several studies refer to risky behaviours or difficulties experienced by older drivers; warnings about use of IVIS by older drivers was given (such system may not be suitable for them). This issue requires detailed elaboration and more focused evaluation.”

(COST 352 team)
**Suggested way for finding solution:**

"The induced behaviours when the systems using by various categories of drivers should be studied in order to prevent potential decrease in fitness for driving. The misuse of a system should be studied as well, aiming at identifying the wrong and risky ways in which a system could be used.

..."

Appropriate methodology(ies) for the topics above should be designed. The impacts of telematic systems on traffic safety need to be thoroughly explored. Nevertheless, certain effort to develop an integrated IVIS assessment method exists (Cherry, Nodari, Toffetti, AIDE project, 2004).

...

Unfortunately there are no unified means of collecting statistical data (unified accident reporting forms) for local authorities, which would take into account such causes of traffic accidents. The National Police Agency of Japan has been reporting data on crashes associated with navigation systems for several years ([http://www.npa.jp/english/index.htm](http://www.npa.jp/english/index.htm)). New data categories (note: for crash analyse when specific IVIS using) should be required from the local authorities.

...

Rules of IVIS use for private users and possibility of their potential supervision or checking are needed."

(COST 352 team)
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<th><strong>4B6 Name of the need:</strong></th>
<th><strong>Lane change behaviour in microsimulation models</strong></th>
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<tr>
<td><strong>Completed by:</strong></td>
<td>Name: Lila Gaitanidou</td>
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<td>Institution: CERTH/HIT</td>
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**Description of the need:**

Microsimulation models should be able to cover the lane change behaviour of vehicles. By this, it is implied that although in relevant software like VISSIM, during simulation the number of lane changes is being calculated, there are not any relevant parameters that the researcher could change so that the behaviour of a vehicle having an ADAS like LDW or CAS could be simulated.

**Suggested way for finding solution:**

The relevant models should be extended so as to include parameters relevant to the behaviour of an equipped vehicle. Such parameters could be the distance from the vehicle ahead in relation to the speed of the vehicle in which the vehicle would change lane to keep the desired speed, as well as the distance from the vehicle coming from behind in the target lane, also in relation to the speed of the vehicle striving to change lanes.
**4B7 Name of the need:**

**System for personalized information transmission from VMS into the Vehicle**

**Completed by:**
Name: Pavlos Spanidis  
Institution: CERTH/HIT

**Description of the need:**

At the moment, the Greek Pilot - Application of the IN-SAFETY - project is able to inform the driver of the vehicle for a specific event that occurred on the road when the vehicle is still far away from the VMS, which describes the event. It is also able to alert the driver when he has exceeded the speed limit of the part of the road that he is driving on.

In future, the information of a VMS can become more personalized according to the driver’s needs. More analytically, the information of the VMS can be translated to the driver’s language when he travels abroad or can be ignored if it does not follow the needs of the driver (information for impaired people). Furthermore, the application can collect, instead of only a pictogram from the VMS, the whole pack of information, containing any text, which will be translated.

**Suggested way for finding solution:**

The same Client – Server Agents architecture can be used as base for the interconnection of the Vehicle and the VMS. The future application should contain an advanced database, which will store the needs and preferences of the driver and/or the needs and preferences of a number of drivers. The received data can be translated from a sub-application (translator) to the driver’s language in order to personalize the information.
### Name of the need:
**European standardization/regulation issues**

### Completed by:
Name: Christian Galinski  
Institution: INFOTERM

### Description of the need:
One of the biggest result of harmonization at European level could be the stress reduction of the European driver when crossing a EU member state border (because he need not learn too many additional conventions), the non-European drivers, who, in increasing numbers, are using a car to drive in several European countries, which would directly impact accident causing factors in actual traffic situations. In addition, this harmonization would lead to certain simplifications, which would make it easier for device producers to render all information multilingual (in written or spoken form – whenever necessary).

### Suggested way for finding solution:
Accordingly to the definition within the standardization framework, harmonization is the process by which differences between standards or regulations issued by different authorities are made compatible or at least *interoperable*. Harmonization of variation, as well as solutions to inconsistencies/contradictions of syntax and semantics of road/traffic signage in Europe would not only make the road/traffic sign system in Europe more transparent and easier to be followed as a whole, but also reduce some unnecessary complexity, thus creating room for new needs (without overloading the system as a whole). Harmonization may occur at different levels (and in different frameworks), such as

- by EU directives on the European level in order to harmonize diverging/inconsistent national legal stipulations,
- in standardization (e.g. by CEN or CEN/ISSS) – in order to harmonize diverging/conflicting regulations in national standards,
- by industry consortia, in order to harmonize competing requirements (e.g. for the sake of reducing production costs, avoiding alienation of the user, increasing investment safety, etc.).
**4B9 Name of the need:**  
**More Europeanism for traffic signs/messages**

**Completed by:**  
Name: Christian Galinski  
Institution: INFOTERM

**Description of the need:**

The more "Europeanisms" can be harmonized at European level,

the less:

- the potential for misunderstandings, reduced perceiveability etc.,
- the need for the driver to get accustomed,
- the necessity for all kinds of secondary variations and special regulations (e.g. concerning the specifications for traffic/road sign production, etc),

the more:

- traffic/road signs (and clusters thereof) can be designed,
- "events" can be formulated,
- extended verbal messages ("micro-propositions") based on traffic/road signs, such as "parking area 500 m ahead 50 places available", can be formulated,
- extended verbal messages ("micro-propositions") based on RDS-TMC events, such as "traffic congestion ahead, leave at next exit", can be formulated,
- in a coherent and consistent way. Driver/car information/communication system developers would have more legal security on the one hand and more flexibility in designing "personalization" strategies (e.g. verbal messages spoken with male or female voice, verbal messages based on traffic/road signs or events in more polite or less polite form...), which would enhance there investment safety.
**Suggested way for finding solution:**

Concerning the “Europeanisms” there may be:
- verbal messages as Europeanisms: TAXI, i/=information/, etc. quasi verbal/graphical representations: @ (for Internet access)
- pictograms as Europeanisms (of course also having a verbal representation, such as /gasoline stand/, etc.)
- pictograms and their respective verbal message both as Europeanisms (/bus/ & BUS, etc.)

The systematic approach to “syntax” (whether for graphical representations /in or without combination with verbal messages/, verbal messages/verbal message elements or extended verbal messages) gives more flexibility in designing new traffic/road signs and verbal messages (as well as formulating new extended verbal messages) in a transparent way. The benefits for the drivers of all nationalities in Europe should be evident.

The possibly biggest counter-argument: established national legislation: EU member states could keep their national legal wordings in laws and regulations (even with minor or major differences between language communities in several countries, such as AUSFAHRT/ABFAHRT). They only need to add: “in traffic/road signage this xxx is represented as yyy).

This calls for
- a complete analysis of the syntactical elements occurring all across road/traffic signage and identifying
- inconsistencies and contradictions
- solutions for the simplification and elimination of inconsistencies/contradictions
- harmonization efforts at European level.
4B10 Name of the need:
Systematic approach to structured content in traffic/road signage

Completed by:
Name: Christian Galinski
Institution: INFOTERM

Description of the need:
When analysing traffic/road signs and related VMS (as well as traffic events etc.) one finds numerous inconsistencies as well as national/regional variation, which may or may not be really justified.

“structured content” in traffic/road signage etc. may comprise:

- traffic/road signs and related VMS
  o their verbal representations (in all EU languages)
  o pictographic elements thereof (and their verbal representations)
  o spoken verbal representations (in all EU languages) of the above
  o units, measures and other symbols and their verbal representations
  o representation of the above to certain types of handicapped people

- traffic events (e.g. RDS-TMC “events” in EN-ISO 14819-2:2003 “Traffic and Traveller Information (TTI) – TTI messages via traffic message coding” and DATEX)
  o their verbal written form (in all EU languages)
  o their verbal spoken form (in all EU languages)
  o possible inclusion of pictographic elements as well as units, measures and other symbols
  o representation of the above to certain types of impaired or handicapped people

A systematic approach to (short or un-complex) traffic/road signs and related VMS as well as traffic events on the one hand, and especially those (or elements of those), which are reused in complex traffic/road signs and related VMS as well as traffic events on the other hand would

- reduce the number of individual content units/items thus
  o increasing perceivability and understandability
  o reducing the need to “learn” new signs/VMS… in border areas
  o facilitating consistent and coherent data models across Europe
  o providing planning safety to road operators
  o providing investment safety to pertinent industry
- facilitate solutions for impaired or handicapped persons

that would serve the very purposes of the IN-SAFETY project, namely to enhance self-explanatory and forgiving roads.
According to a high-level recommendation in the field of eBusiness, today (see MoU/MG/05 N0221 / ISO/TC 37 N496 “Semantic Interoperability and the need for a coherent policy for a framework of distributed, coordinated repositories for all kinds of content items on a world-wide scale”) „...semantic interoperability [cannot be separated from] the requirements of
- multilinguality
- cultural diversity
- multimodality
- accessibility (incl. the requirements of people with special needs)
- multi-channel presentations.“

Given the development of pan-European information networks for traffic information, the variety of communication situations between traffic information systems and the car-driver system (with all the devices developed and used therein) the above-mentioned requirements also apply to traffic telematics.

Suggested way for finding solution:

By
- Recording all “structured content” in traffic/road signage, traffic events, etc. in all possible variations and representations in a multilingual terminology database adapted to this purpose (like the ISO/CDB – Concept DataBase – under development)
- Analysing the content entries and identifying double entries, fully synonymous entries, as well as entries, which could be combined into one etc.
- Identifying fundamental principles for representing structured content in visual and non-visual ways (depending on purpose and requirements)

the number of unnecessary variations would be greatly reduced and existing inconsistencies eliminated. This would also bring about a „streamlining“ of existing structured content, which would make room for adding new elements, signs, messages, etc. in a systematic way (and in accordance with European language conventions), if the need occurs.

Some of the results should be geared into standardizing activities (or even legislation), whenever proved useful.
### Name of the need:
**Avoiding of parallel solutions of one problem by more systems**

### Completed by:
Name: Martin Winkelbauer  
Institution: KfV

### Description of the need:
For consideration in design of the scenarios, many of the functions can be done by completely different technical solution.

To take "safe curve speed warning" as an example: This could be done by digital maps or by beacons on the roadside for indicating the safe speed. Input is necessary when considering the actual weather conditions; even the condition of the vehicle could be of interest for calculating a safe speed.

On the other hand, the MMI can be done differently, which could be a forced speed reduction of the vehicle, a beeping in the vehicle, warning light, haptic information to the driver or other.

It is of strong interest in order to avoid double costs for picking up both the infrastructure approach and the digital map approach to make an early decision on which system to choose.

In addition, it needs to avoid that the every corner has to be equipped with a specific beacon for various vehicles equipped by various manufacturers etc.

### Suggested way for finding solution:
It implies, that efforts in system standardisation are necessary - in order to reduce costs.
**Name of the need:**

*Compatibility/interoperability of various systems and communication among them*

**Completed by:**

Name: Eva Gelová  
Institution: CDV

**Description of the need:**

The only agreed frequency for transport on the European level is for the EFC. No one other solution has been found till today in communication, because of a competitive environment.

Regarding the architecture, the KAREN/FRAME are as a reference for the road transport, but that should be created more intermodal – to combine data from the other transport modes, that could be useful on road – e.g. dynamic time information at P&R facilities on arriving trains or congestion impact on ETA of truck drivers, having defined time windows for pre/on-carryage in intermodal terminals.

Geographically, the European standards can have a possssitive impact on solutions like for cross-border road traffic management, for example.

**Suggested way for finding solution:**

Both specific and integrated systems should be seen, since their planning and design beginning, from the point of view of current or potential future co-operation among them – for sharing information and also for sending messages, to achieve interoperability, or better, compatibility.

The system logical architectures should be created independently on specific operators or individual technologies, because both of these could be changed or completed in the future. The solutions for information flow (like interfaces/messages) should be standardised with the aim to have them as simplest as possible, from the point of view of their users. Simplicity is also very important from the financial perspective, for everything for SMEs, independently on their roles in the system.
**4B13 Name of the need:**

Cooperation with insurance companies

**Completed by:**
Name: Eva Gelová  
Institution: CDV

**Description of the need:**
Using of ADAS represents a positive contribution for active road safety. Nevertheless, independent on it, the insurance institutions have only small interest to change their behaviour to the customers with vehicles equipped in this way. There are no differences in bonuses for equipped and unequipped cars and their owners, for both private passenger cars and company fleets, yet.

**Suggested way for finding solution:**
Based on particular ADAS, reduction in rates could be offered- individually or in synergy as packages with other positive impacts, in the form of more dynamic services.

Also monitoring based on recorded data from the in-vehicle can offer, for police or insurance company, identification and penalization of violators among the drivers, if would be allowed, and would also contribute to positive changes in behaviour of them.

A research support for evaluating methodology of data in regard of reduction of damages would be needed.

The legislation changes for these topics would be needed.
**4B14 Name of the need:**

**Too many dangerous points in urban contest for the In-Safety Application**

**Completed by:**
Name: Carlo Liberto
Institution: CRF

**Description of the need:**

In particular in the Urban contest the number of dangerous points to be indicated to the driver is very big. The risk in this case is that these points could be ignored by the driver or could became not so useful. This need isn’t perceived directly by the driver, but it is very important for the In-Safety application in order to be more efficient and less distractive or annoying.

**Suggested way for finding solution:**

A way to discriminate if a dangerous point of an urban contest has to be announced to the driver or not, could be feasible by adding new features for each point, for example:
- Validity time (if a cross is dangerous in very high traffic condition, a time range in the day in which this condition is verified could be very useful);
- Weather validity conditions (some points like a curve could be dangerous in bad weather conditions and not in good ones);

Then the discrimination of dangerous points could be done directly on the remote centre before sending the data to the vehicle or on the vehicle by the In-Safety application.
4B15 Name of the need:
**Symbols/pictograms**
Research needs propositions from IN-SAFETY WP2

Completed by:
Name: Stefan Egger
Institution: IIID

Description of the need and suggested way for finding solution:
*Improvement of symbols/pictograms that failed to hit the benchmark*
Redesign, refinement and retesting of symbols/pictograms failed to hit the defined benchmark to be considered for inclusion into the list of recommendation symbols/pictograms; such symbols/pictograms like "(Underground trains) depart every x minutes" stand for complex referents/meanings which require further investigations

*Defining symbols/pictograms as character sets*
Defining symbols/pictograms as character sets to go with the defined „Tern“ fonts. This would facilitate the ease of application through automated display software

*Identifying the most usable arrow*
Extensive evaluation of the standard Vienna Convention arrow in comparison with the „Belgian arrow“ used for general public information, the evaluation would have to be done with regard to anticipated scenarios and applications

*Evaluating variations of spacing between symbols/pictograms*

*Research on alternative durations and sequences of animations on VMS*
- Research on alternative durations and sequences of flashing elements
- Research of alternative durations and sequences of animated symbols/pictograms

*Research on a warning depending the distance to a hazard*
Research on the distance to a hazard or an impassable facility from which a symbol/pictogram should be superimposed with a flashing danger warning triangle or a diagonal cross

*Evaluation of elements indicating impassable road infrastructure*
Test results and the need for a consistent logic of the system concerning VMS messages as proposed in the deliverable D2.3 demand further research to clarify whether to use a diagonal red cross or red circle as suggested by the Vienna Convention On Road Signs And Signals, Symbol C,2, to signal impassable road infrastructure.
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<th>4B16 Name of the need:</th>
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<tbody>
<tr>
<td><strong>Keywords/Europeanisms</strong></td>
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<tr>
<td>Research needs propositions from IN-SAFETY WP2</td>
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<tr>
<td>Name: Stefan Egger</td>
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<td>Institution: IIID</td>
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<tr>
<th>Description of the need and suggested way for finding solution:</th>
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<tr>
<td><em>Verification of adequate comprehensibility of the Europeanisms</em></td>
</tr>
<tr>
<td>Verification of adequate comprehensibility of the Europeanisms, suggested for use by INFOTERM, also considering the languages of the most recent EU members states, Bulgarian and Romanian</td>
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*Place names, notation*
Determining precise conditions for capitalization. Clarification of steps to be taken with regards to placename and direction signs on road and place names in road maps

*Place names, abbreviations*
Elaborating suggestions for abbreviating long place names
4B17 Name of the need:

**Content structure**

Research needs propositions from IN-SAFETY WP2

Completed by:

Name: Stefan Egger
Institution: IIID

Description of the need and suggested way for finding solution:

*Developing advanced test techniques for the evaluation of the effectiveness of composite messages* - Considering the importance of the correct reaction of drivers to be displayed information, advanced test techniques would combine the recording of message interpretation and, by employing a driving simulator, the resulting performance of motorists.

*Scenario building and programming* - Building scenarios and programming all conceivable combinations of information elements for concrete applications on freely programmable VMS as defined in D2.3.

*Full scale test installations* - Evaluation of the results and suggestions elaborated under 4.3.2 (in D2.3) on full scale test installations; also to find out whether a linear increase of increments underlying VMS displays would be justifiable for applications on motorways where vehicles travel faster than 100 km/h.

*Sequence of information elements on VMS* - Evaluation of recommendations of D 2.3 employing eye-tracking techniques; also try find out wheather approaching hazards which have their origin outside of the motorway (e.g. „deer on road“) require the depicted refernt to indicate movement from right to left (resp. from left to right in countries where traffic keeps to the left) or whether reading direction is the determining factor. The ranking of information elements, from left to right, should be as follows:

- Information on danger hazard or „out of order“ ahead – Prohibition, restriction, and/or mandatory information – Ancillary information.

In case the danger is signalled by a directionally dependent symbol/pictogram the order is to be reversed: a symbol/pictogram indicating an approaching danger must not only be shown against reading direction it also reverses the sequential oder of the overall composition of the display.

*Rules governing the maximum number of information elements on VMS* - Evaluation of the rules governing the permissible maximum number of information elements on a VMS.

*Principles of diagram traffic signs* - Developing principles of (VMS-) diagram traffic signs to graphically indicating (an) alternative route(s) in case of a blocked stretch of motorway.

*Positioning criteria* - Developing rules for positioning VMS signs, also a declared concern of Mare Nostrum, of special relevance in complex roid situations where information on the same event needs to be split up for being shown on two (or more) VMS signs.

*Repetition of information* - Determining criteria for the repeated display of information according to insights reported by Covault et al., which have a positive influence on lane-keeping and travel speed stability.
4B18 Name of the need:
Research needs extracted from the TRAVELGUIDE project

Completed by:
Name: Eva Gelová
Institution: CDV

Description of the needs and suggested ways for finding solutions:

*In-car traffic sign information - Integration of in-vehicle information and conventional traffic sign information*

Messages or warning signs, at roadside, are frequently not detected by drivers; it would be preferable to find out ways to support traffic sign information via an empirical research, verifying findings i.e. various effects of systems on driver behaviour.

Optimal characteristics of the IVT and efficiency of the system could be investigated, with a larger driver sample.

Drivers adapt their behaviour in the long term. This could be examined by a longitudinal study of drivers who are willing to take part in an exact data collection recording the driving behaviour.

It might be possible to design a system resulting in high degree of detected traffic signs; there is no guarantee whether it would improve total traffic safety.

*In car device: output modalities - Integration of in-vehicle information and conventional traffic sign information*

For the information providers it is important that the messages are well comprehended and accepted. It would be also important to collect information about acceptance of different types of information and compare different ways to present information.

The main conclusions of the (TRAVELGUIDE) study are based on subjective evaluations of 20 test drivers. More empirical research in the future is needed to verify the findings.

*In-vehicle information systems should provide background information about the reasons for certain system operations*

Certain system operations are not transparent and comprehensible for the user

*Information presentation: Information should be provided on the visual as well as on the auditory and haptic channel*

Identify best presentation forms for individual messages (reduction of workload, optimization of compatibility etc.) to minimize driver distraction

*Adapt information provision to driver workload*

There is no system on the market, which schedules information, based on online driver workload conditions. Develop a system prioritizing information provision based on online driver workload
Control of message timing has to be shifted from the system to the user

Systems should offer time interval options because of different preferences and information processing resources as well as strategies. Identification of optimal time frames for provision of particular messages seems to be necessary.

Adapt information provision to the requirement of different driver subgroups

Information is not sufficiently tailored to the needs of driver subgroups. Identification of different driver subgroups needs, and adaption info provision to subgroups’ requirements.

Extend ‘yellow page’ services.

Identify actual non-driving info requirements from the road network environment.

All in-vehicle navigation systems should allow an effective combination of different routing types.

Dynamic route guidance, based on TMC, should be possible in connection with other user-defined routing preferences. Today, there are mostly non-flexible routing strategies of navigation systems. It is asked to extend routing options.

Support Transeuropean traffic.

No traffic information service supports international drivers during all parts of their journey effectively, yet. Lack of Trans-European on-trip information services asks to develop a Trans-European driver information service.

Develop databases including qualitative knowledge about the driver

Identification of the drivers’ subjective information prioritisation in prototypical traffic situations (zebra, crossing, highway merging etc.) is to be investigated.

Timing of queue warning messages

Proper timing of messages is still insufficient today. TMC queue warning is sometimes extremely early or late. To examine the time interval and to work on strategies to recall the message again from the in-car-device shall support a better service.

RDS: suggestions and use optimization

RDS has still many technical problems (rolling speed varies, lack of characters except Latin, incompatibility issues etc and the legal issues of using RDS while driving still remain unclear.

Regular inspection of traffic management systems (TMS)

Decreased reliability of traffic data due to failure of systems can happen, while traffic data collection and processing. Identification of cost-effective system control procedures could eliminate their amount to the minimum level.

Standardized information provided by Variable Message Signs

A variety of icons is used for the same message across Europe. To facilitate journeys in international corridors, the uniform icons are required to reach optimisation of information presentation by VMS.
Evaluation of Full Colour Information Panels (FCIPs)

A (TRAVELGUIDE) follow-up experiment is carried out in an actual roadside environment, near The Hague. An alternative experiment to this might be to superimpose various new FCIP designs to a digital trick film of the actual roadside environment. It could be looked at, if the users favour the public transportation alternative and if they understand all alternatives.

Language Independent Information: Graphical Design of Traffic Signs

Graphical modifications of a well known traffic sign have not been perceived by subjects. Although the feature "Traffic Jam Warning" is graded positively, the subjects wish to receive additional information like location of the incident and expected time delay. It should be found out, which other information needs related to a queue warning.

Graphical Information Design of New Features

It could be examined to which degree of semiotic similarity can be applied to unfamiliar meaning.

Which warning earcons are effective and still accepted? New investigations are necessary to examine significant differences, especially with exposing the subject to a higher workload.

Expression of the entity of traffic anomalies

Different perception of traffic anomalies by familiar or foreign travellers is known. It is necessary to verify the acceptance of the two proposed indexes by information providers and the usability in services to users. Also other ways to express traffic condition can be proposed and then compared.

Data exchange between information centres

Technical obstacles in data exchange still remain. Research is wished in order to define a wide-use traffic data channel that can be proposed as a technical standard.
4B19 Name of the need: Research needs identified from the AWAKE project

Completed by:
Name: Eva Gelová
Institution: CDV

Description of the need:

1. Use of sounds for alerting:
Warning tones could be difficult to interpret by a driver what might happen if the number of different in-vehicle warning tones is high.

2. False alarms avoidance:
For touching the optimal performance of the system, false alarms shall be avoided or their frequency should be as low as possible. Drowsiness alarms, under certain circumstances, are more likely to become false alarms.

(AWAKE project)

Suggested way for finding solution:

1. Use of sounds for alerting:
Care must be taken to keep set of (non-speech) sounds distinguishable. A stand-alone message should be completed by a visual message or by spoken following message). Differences in perceiving and understandability of both (stand-alone) sound alert and combined types of alerts should be investigated.

2. False alarms avoidance:
Drowsiness alarms, under specific conditions, might be automatically suppressed. The optimal environment, for such detection, are rural roads and motorways. Driving under these conditions should either activate the system or, at least, lower the threshold for drowsiness alarms. Specific conditions and their impact on frequency of drowsiness false alarms should be investigated.

(AWAKE project)