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Recommendations for HMI Guidelines and Standards

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Authors (per company, if more than one company provide it together)		**Christhard Gelau and Roland Schindhelm (BASt); Klaus Bengler (BMW); Andreas Engelsberg (BOSCH); Villy Portouli (CERTH/HIT); Katia Pagle (ICCS); Harald Berninger (OPEL)**	
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List of abbreviations

AAM	Alliance of US Automobile Manufacturers
ADA	Advanced Driving Assistance
ADAS	Advanced Driving Assistance System
AIDE	Adaptive Integrated Driver-vehicle InterfacE
AMI-C	Automotive Multimedia Interface Collaboration
API	Application Programming Interface
ATIS	Advanced Traveller Information Systems
ATT	Advanced Transport Telematics
CEC	Commission of the European Community
CEN	Comité Européenne de Normalisation
DVE	Driver-Vehicle-Environment (_ state, _ module)
EC	European Community
EOT	Enhanced Occlusion Technique
ESoP	European Statement of Principles
FAA	US Federal Aviation Administration
FMEA	Failure mode and effect analysis
FHWA	US Federal Highway Administration
FOT	Field Operational Test
HMI	Human Machine Interface
ICA	Interaction and Communication Assistant
I/O	Input / Output
IP	Integrated Project
ISO	International Organization for Standardization
ITS	Intelligent Transportation System
IVICS	In-Vehicle Information and Communication System
IVIS	In-Vehicle Information System
JAMA	Japan Automobile Manufactures Association
NWI	New Work Item
OEM	Original Equipment Manufacturer
PDT	Peripheral Detection Task
PWI	Preliminary Work Item
SAE	Society of Automotive Engineers
SP	Sub-project
TICS	Transport information and control system
UN-ECE	United Nations - Economic Commission for Europe
UNI	Italian Organization for Standardization
VDM	Visual Demand Measurement
WG	Working Group
WP	Work package

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Executive Summary

This report presents a collection of recommendations to experts active in the field of standards and guidelines relevant to HMI development of IVICS and ADAS.

The recommendations are based on findings and results that have been achieved in the subprojects of the AIDE IP. The report considers different data sources which describe activities to present these results to institutions involved in standardization, to discuss recommendations on standards and guidelines and how to use them for future work of international standardization bodies, i.e. a joint workshop conducted together with ISO WG8, activities within the eSafety WG on HMI, exchange of information and discussions within the AIDE forums.

The report is intended to be a recommendation and helpful input but does not put any obligation to the recipient.

1 Introduction

The AIDE IP is targeted at the development of adaptive integrated human-machine interfaces (HMI) for advanced driver assistance systems (ADAS) and in-vehicle information and communication systems (IVICS) in road vehicles. The general objectives of the project are a) to model and simulate behavioural affects of ADAS and IVICS, b) to develop a generic methodology for the evaluation of HMI with respect to safety, and c) to develop and evaluate prototypes with an adaptive integrated HMI implemented.

This report refers to Task 4.3.2 “Recommendation for HMI Guidelines and Standards” within the subproject “Horizontal activities” (SP4) of AIDE. Guidelines and standards are important for the enabling of the deployment of AIDE technologies and methodologies, as the range of types and complexity of the HMI increases. In the AIDE project the results of this horizontal task will be a helpful synthesis of AIDE results meant as input to experts that are active in the field of standardization. Thus the results described in this report will contribute to initiate the updating and enlargement of existing standards as well as the elaboration of new standards.

With focus on the project structure the main part of the report contains recommendations for standards and guidelines on accidentology and Naturalistic Driving (ND) (chapter 2), on HMI evaluation methods (chapter 3), on HMI architectures (chapter 4) and on the future development of the European Statement of Principles on HMI (chapter 5). The final conclusions are given in chapter 6. The annex is connected to chapter 3 and contains details of the discussion during the joint workshop on recommendations regarding HMI evaluation methods.

2 Recommendations on Standards and Guidelines from the perspective of an enlarged Accidentology (SP1)

In general, the AIDE project missed the input of an IP focused on accidentology questions. On the other hand the method of Naturalistic Driving (ND) came into vogue during the project life cycle of AIDE. This method is expected to enlarge the traditional approach of accidentology. A workshop invited by the HUMANIST network of excellence and AIDE, discussed the potential of naturalistic driving studies and field operational tests (FOT). Conclusions on the implications of naturalistic driving studies and FOTs for accidentology are given in chapter 2.3.

There is an increasing number of studies analysing driving behaviour in a naturalistic context. As a general rule, no measures of experimental control are taken. Rather, these studies are following an observational approach by trying to examine driving behaviour on a descriptive level under conditions of everyday life, i.e. variables of driving behaviour and driver performance are recorded over a longer period of time (e.g. one year), for all rides a driver performs with a certain car as part of his daily activities (e.g. commuting to/from work). Usually these studies are conducted in order to specify driver needs from observations and/or describe the impact of certain measures or systems on observed driving behaviour (e.g. Dingus et al., 2006a; Sayer et al., 2005; Stutts et al., 2003).

However, as by definition these naturalistic driving studies do not follow an experimental approach, there are concerns about their validity which are arising from numerous alternative explanations for the results produced. This means that some minimum methodological requirements need to be defined in order to ensure valid results from these expensive and time consuming large-scale studies.

Some requirements could be drawn from the experimental studies that were performed in AIDE, e.g. by CERTH/HIT in SP1. These studies revealed that inter-individual differences are significant among drivers. Therefore, grouping of participants should be based on their characteristics according to the driving task to be studied. For example, when studying a frontal collision warning system, participants should be grouped in such a way, that equal percentages of close-followers and non close-followers are represented in each group. For a lane deviation warning system, participants should be distributed according to their lane keeping performance, so that each group shows equal percentages of “good” and “bad” lane keepers.

Furthermore, unless warnings are considered as reliable by the drivers, when compared to their own driving style, the warnings will not be respected. Some kind of “soft” adaptation of warning thresholds should be available. For example, the system could monitor the driving behaviour and allow for some mitigation of the warning thresholds according to the driving behaviour, but of course within safety limits. Finally, multiple audio warnings show only weak driver acceptance, as they are considered as intrusive and irritating.

The “Workshop on Naturalistic Driving Studies” which was performed jointly with HUMANIST on 13th of September 2006 at the BMW premises in Munich, can be considered as a pilot step towards the goal of defining such experimental requirements. More precisely, the workshop addressed the methodological rules to be followed when planning FOTs and naturalistic driving studies, in order to reduce the effort of such studies, produce interpretable sets of data, analyse existing data and strengthen the conclusions drawn from such studies.

2.1 Summary of the presentations given at the "Workshop on Naturalistic Driving Studies", Munich, September 13, 2006

As a basis for discussion five presentations were given. The key note lecture was given by Jim Sayer (UMTRI) who can be considered as an expert with tremendous practical experiences with naturalistic driving studies which he gathered in numerous projects performed by his institute.

- *"Effects of Secondary Tasks on Naturalistic Driving Performance"* (Jim Sayer, UMTRI): A comprehensive review was given on research projects performed by UMTRI in the area of FOTs (6 projects during the last 12 years). It became clear that the UMTRI naturalistic driving data archive is a product of both Engineering Research Domains and Human Factors research. Results on the effects of secondary tasks on driving performance can therefore be considered as a product of a specific strategy of analysing the available data on naturalistic driving performance guided by a set of research questions. This presentation ended with several conclusions on the conditions under which drivers decide to perform secondary task activities while driving. According to the results of the UMTRI research drivers seem to prefer those situations for secondary task activities where driving skills are least needed. Moreover, some cell phone use was observed more often under special traffic conditions which may reflect a specific unexamined form of exposure to the risk of an accident.

- *"Is the 100-car study an 1000 answers study?"* (Hans-Peter Krüger, IZVW): It was pointed out that all observations one can make are naturalistic in some way. The main difference between the naturalistic driving approach and an experimental approach for the analysis of driver behaviour lies in the fact that in the former case one has to "wait" until the behaviour under consideration appears whereas in the latter case it is provoked. Doubts about the unobtrusiveness of data from naturalistic driving studies were raised. Moreover, the external validity of the 100-car-study was questioned. But it was also pointed out as an endeavour of this approach that it makes it possible to separately analyse effects of certain influences on inter-individual and intra-individual variability of driving behaviour.

- *"Naturalistic driving studies to investigate IVIS uses and distraction exposure: interests and constraints of the approach"* (Corinne Brusque, Arnaud Bonnard, INRETS): This presentation started with a review of the kind of questions for which naturalistic driving studies seem to be a promising methodological tool. This was followed by detailed discussion of methodological constraints due to data protection requirements, lack of sample representativeness, lack of reliability of the data coding system and statistical problems. However, the final conclusion was that naturalistic driving *"is an interesting challenge that promises many visionary outcomes"*.

- *"Driving for safety – naturalistic field studies"* (Mark Vollrath, DLR): An interesting summary of practical experiences from studies on driver behaviour under conditions of real traffic was given in terms of general statements (e.g. "Effects will always be different than you think") which were then illustrated and exemplified. As a conclusion these statements were detailed with respect to the naturalistic driving approach and closed with the statement that it is worthwhile to take all the costs and efforts to be expected.

- *"Finding a position of naturalistic driving studies in the methodological spectrum"* (Richard van der Horst, TNO): This presentation started with an extensive review of research at TNO Human Factors in the area of field observational and simulator studies which ended with several comments on the naturalistic driving approach. As a weakness of the naturalistic driving approach it was pointed out that it does not tell us anything about the (psychological) mechanisms underlying the observed driving behaviour. Thus, naturalistic driving cannot replace "traditional" experimentally oriented approaches. Nevertheless, naturalistic driving research is in an early phase of its development and future research activities should consider this and the potentials naturalistic driving studies offer to generate hypotheses.

2.2 Conclusions

The discussion following the presentations focused on the following three general issues: comparative understanding of the utility of naturalistic driving studies; interpretation of results and exchange between different methodological approaches. The results and conclusions concerning these issues will be summarised in the next paragraphs.

2.2.1 Comparative understanding of the utility of naturalistic driving studies vs. FOT vs. experimental studies (simulator, laboratory) vs. Accidentology

As a result of the discussion it was concluded that naturalistic driving are one step on a scale/continuum of data acquisition methods with a low level of information given to the participants and without instructions. naturalistic driving studies were considered as a reasonable methodological approach to reach the following aims:

- estimate the size of a problem or an effect,
- determine driver needs,
- study intra-individual longitudinal effects,
- test or develop algorithms,
- generate exposure data (e.g. for secondary tasks), and
- describe/understand pre-crash behaviour.

Naturalistic driving studies can be conducted to generate hypotheses and also to test hypotheses (Caveat: if data are used to test hypotheses consider that data include totally uncontrolled conditions). However, in most cases experiments are a more appropriate approach to test hypotheses and should supplement naturalistic driving studies. It was also stressed several times in the discussion of this point that naturalistic driving studies an interesting approach to analyse intra-individual variance of driver behaviour as it is possible to collect from one driver a great amount of behavioural data over a long period of time in many different situations.

With regard to the relationship between naturalistic driving studies and accidentology, the results of the discussion were not quite conclusive. However, it has been recently suggested by Dingus et al. (2006b) that under the condition the availability of an appropriate data collection and analysis system, naturalistic driving studies might be considered as a methodological approach which bridges the gap between experimental studies and epidemiology.

2.2.2 Interpretation of results (causal vs. correlational, generalization)

The discussion resulted in the following general conclusions:

- A final causal interpretation of data from naturalistic driving studies is impossible due to numerous unknown confounded variables.
- In case of a specific naturalistic driving study the relevant confounded variables have to be identified by inspection and expert check.
- The final interpretation of naturalistic driving results always has to take into account results achieved with other in particular experimental techniques.
- Usually in naturalistic driving studies only behaviour which is observable by means of video recordings and other data logging techniques is available for further processing. Subjective, physiological or other performance data are usually not collected in naturalistic driving studies.
- An interesting advantage of naturalistic driving studies in comparison to experiments lies in the fact that the relevant variables are on a continuum and not discrete treatments.
- Another advantage of naturalistic driving studies lies in the fact that they provide information about intra-individual **and** inter-individual variance.
- Correlations and descriptive statistics can be derived e.g. as input for modelling.

2.2.3 Data analysis approaches (frequencies vs. link analyses vs. multiple regressions vs. data-mining)

During the discussion it was pointed out that:

- All descriptive statistics are only usable within the limits of the vehicle sensors used.
- Pattern recognition could be used to label events in the data (online and offline).
- A video protocol is necessary as confirmation of physical constellations and in depth-understanding of context related driver behaviour.
- The usage and potentials of data-mining tools have to be further investigated.
- Detailed documentation of data and processing procedures is essential both for the exchange of data and the communication of data processing procedures and results.
- Time effects and longitudinal effects (e.g. learning) have to be taken into account when data of naturalistic driving studies are analysed.

2.3 Implications for standards and guidelines

The consequences of naturalistic driving studies as a new approach to examine driving behaviour for the development of standards and guidelines are at least twofold. First, there might be a need for some standards, guidelines or at least recommendations on methodological aspects of naturalistic driving studies. For instance, it might turn out to have standardised ways of data documentation in order to foster the exchange of data among projects. Second, the development of new standards might be inspired by the results of naturalistic driving studies, e.g. if the results help to identify safety related problems which might be encountered by means of appropriate standards or guidelines. Thus, in the future the

classical accidentology approach guided by structured documentation and analysis could be supported by naturalistic driving studies.
For this reason selected parameters and values seem to be very promising and should be recommended as basis for naturalistic driving studies. Those parameters include the status of the ADAS, distances, speeds and their development of own vehicle and if possible of surrounding vehicles. It turned out that – for most questions of accident causation - it could be of a greater value to use high sampling rates and ring-buffering instead of a continous data sampling/storing. But this leads to the requirement to supply an independent baseline or normative (non-accicent) model which is comparable to accicent data sets in a given traffic situation. Furthermore an agreement on sampling rate seems to be inevitable to be able to synchronize data from different test-sites and studies.

3 Recommendations on Standards and Guidelines regarding HMI Evaluation Methods (SP2)

A joint workshop of AIDE and ISO WG8 took place at the headquarters of the Italian Organization for Standardization (UNI) in Milano on May 17, 2007. Results of the AIDE project were be presented to ISO experts and discussed with regard to their relevance and usability for current and future standardization acitivities (see Annex). This panel gave the opportunity to present the rich yield and quality of European Research done within the AIDE IP to an international audience of experts in human factors and standardization. Every contribution was discussed and rated to the following categories :

- Informative: The input is valuable and of interest.
- Revision of document: The input is useful for the revision of an existing ISO document.
- New activity: The input should be discussed as impulse for a preliminary or new work item.

A complete tabulated overview of the discussion and rating is given in the Annex. The most relevant results and recommendations are summarised in the next paragraphs.

3.1 New activities

AIDE Definitions and glossary serve as a motivation to revive a WG for common definitions. This will be discussed within WG8. Furthermore there is an ongoing SAE activity which compiles literature and definitions and would appreciate to get the AIDE input.

Results on Peripheral Detection Task should be discussed as a NWI within WG8, but parameters have to be checked (PWI). In general the different realisations (Visual, tactile and central detection task are considered to be candidates for new evaluation methods/settings)

Driver Characteristics should be clearly and reproduceably be documented to enable the replication of results. Subject characterisations that were used within AID Ecould serve as a template here.

The contributions of AIDE partners at the Milano forum also initiated a discussion on PDT. The discussion was reopened within the ISO fall meeting 2007 in Soesterberg:

“During the discussion of the proposed 2nd *Driver Metrics Workshop* it was also mentioned that PDT has become an item of significant interest and could/should be specifically considered by WG8. No decision was taken at the meeting. Agreement was reached on the following approach: Experts/countries interested in opening up a work item / preliminary work item "PDT" should provide some substantial documentation justifying the interest and need for such HMI standardization activities.” (taken from the official R e p o r t on the 28th meeting of ISO/TC 22/SC 13/WG 8 – HMI (CEN/TC 278/WG 10 - MMI) Soesterberg, Netherlands – 31 October 2007). AIDE results and a corresponding recommendations will be a contribution to the ISO WG8 spring 2008 meeting in San Antonio.

3.2 Revision of documents

The collection and description of Driving Simulator metrics/measurements includes valuable information for the Informative Annex of the Suitability Standard. This document is an existing standard and will be reopened for revision within the next years.

The work on the Visual Demand Measurement (VDM) Tool discussed gaze pitch and gaze yaw as relevant metrics of visual behavior. These metrics should also be considered if the Standard on Measurement of driver visual behavior 15007-1 and 15007-2 will be opened for revision.

4 Recommendations on Standards and Guidelines regarding HMI Architectures (SP3)

Today more and more IVICS and ADAS are integrated in vehicles which individually interact with the driver and which sometimes use dedicated I/O devices. Consequently the systems and the communication between the driver and the individual systems are designed independent from each other. Frequently the design process of each individual system takes into account human factor aspects and the HMI is optimised in terms of distraction and usability. But much too less effort is spent on the interdependence of the individual systems. This problem has been addressed by AIDE SP3.

4.1 General approach for architectures of IVICS and ADAS

Within AIDE SP3 functional reference architecture has been developed, which is the technical basis for a combined handling of IVICS and ADAS interactions within vehicles. Even more, the implementation of the AIDE functional reference architecture forces the overall handling of the driver interaction and forces to define and implement rules with respect to the interdependences of the individual application interactions.

In addition to the combined handling of IVICS and ADAS, the main feature of the architecture is to enable adaptive management of the driver interaction in terms of implementing adaptive strategies based on the driver-vehicle-environment state. Thus the actual situation and the status of the driver is the basis for designing the interaction e.g. in terms of modality, physical layout or temporal sequence.

Within AIDE the communication between driver and in-vehicle system is managed by a central intelligence to avoid critical effects of interdependences. This intelligence is called the Interaction and Communication Assistant (ICA). It ensures that information is given to the driver at the right time and in the right way and that only functions that are relevant in the present driving context are active. ICA is responsible for managing all the interaction and communication between the driver and the vehicle, based on the assessment of the driver-vehicle-environment (DVE) state provided by appropriate monitoring modules (DVE module). This includes the selection of modality for presentation, the message prioritisation and scheduling and the general adaptation of the driver-vehicle interface (e.g. display configuration and function allocation). The HMI management is based on “meta”-functions. Examples of such meta-functions include:

- I/O action coordination based on priorities, e.g. termination, interruption, retardation, resumption or suppression of output messages, according to DVE data or due to other running system output.
- Change of output format according to DVE data and/or due to other running system output.
- Change of output channel according to DVE data and/or due to other running system output.
- Change of the physical layout (colour, font, format, etc.) according to DVE data.

The AIDE architecture considers the software "application layer" mainly, i.e. not the hardware structure or driver software. In Figure 1 the principle functional structure of the AIDE reference architecture is presented.

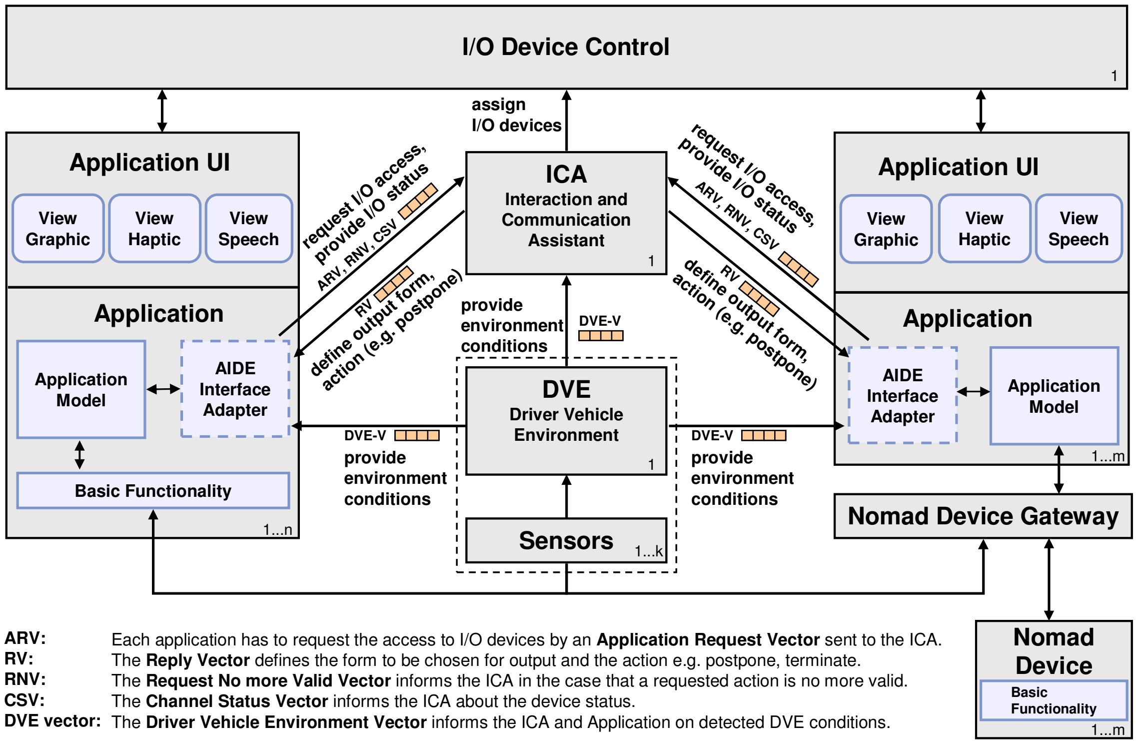

Figure 1: Functional reference architecture.

The architecture contains the following components:

- Applications: These are components offering a specific functionality to the user like navigation, phone, lane departure warning, music player, radio, etc. The application should be as independent as possible and should, in principle, work independently of the HMI management functions. The application is designed with a model-view-control pattern and includes an AIDE interface adapter offering the AIDE specific functionality like communicating to the ICA and the DVE or performing a priority mechanism. It has to be stressed that this module is only separated to highlight the AIDE specific addition to ordinary applications.
- I/O device control: This includes the specific I/O devices like LCD displays, head-up displays, haptic input/outputs, loudspeakers or buzzer, but also pre- or post processing units like speech recognition, text-to-speech engine, etc.
- Interaction and communication assistant (ICA): This is the component with the main responsibility for the centralised HMI management functionality. It contains the rules determining the global system behaviour towards the user.
- Driver-vehicle-environment (DVE) modules: This component is responsible for providing a real-time representation of the DVE state. This is used by ICA to adapt the driver-system-interaction. It is also used by the applications to adapt application specific functionalities like, for example, the dynamic change of message priorities or the adaptation of warning strategies.

- Nomad device gateway: This gateway constitutes the link between nomadic devices and the onboard vehicle systems. The general purpose of the gateway is to enable a seamless exchange of data, global access to I/O devices in the vehicle and on the nomadic device respectively and enable HMI I/O management also for the nomadic device applications.

In case of having different vendors for applications or including nomadic devices transparently within the system, the usage of common protocols and interfaces between the application, the ICA, the DVE modules and the nomadic devices is essential. Especially the integration of nomadic devices indicates the highest demand of standardised protocols as defined within the AIDE functional reference architecture.

As a conclusion from the AIDE experiences it can be stated, that the HMI architecture based on the two core elements ICA and DVE proved to be successful to enable adaptive integrated HMIs for various applications. More general, in order to adapt the HMI of ADAS and IVICS applications, it provides requirements for a central management intelligence and the perception of vehicle state, driver state and environmental situation. This AIDE approach is recommended to be considered for future guidelines on integrated adaptive HMI and should therefore be further discussed as a basic approach for specific solutions e.g. in the continued nomadic device forum.

4.2 Architectures for nomadic devices

When bringing a nomadic device into the car, different stages of integration can be realized. They vary in the amount of I/O devices shared of the nomadic device and the in-vehicle system. The maximum integration is realized, when the I/O devices of the nomadic device are fully integrated into the vehicle system, referred to as the “full integration”. The degree to which the nomadic device driver interaction is controlled by the integrating vehicle gateway, determines where the responsibility for this integration is located (OEM, nomadic device manufacturer, 3rd party). AIDE controls the nomadic device according DVE & ICA operation through the nomadic device gateway.

In case of an integration limited to physical/mechanical and basic electrical (power-) connection of the nomadic device with the vehicle system, the term “installation” shall be used. Such an installation does not change originally the HMI of the nomadic device. So responsibility for safe operation remains with the nomadic device manufacturer. The AIDE architecture can provide the ICA commands to the nomadic device by a simple interface within the basic electrical connection. Of course nomadic devices have to provide such an interface. In reality, installation is and probably will be the majority of nomadic device usage in cars.

This difference (installation vs. integration) in architectural requirements and responsibility shall be reflected in future standards and guidelines and is to be discussed with ISO TC204 WG17. In case of integration it has to be taken care for a clear and distinctive separation of on-board and nomadic software modules responsible for integration and a related protocol description which enables clarification of responsibilities in case of malfuncition and/or testing. Here different distributions of responsibility between OEM and nomadic device manufacturerer are possible and viable, as a to static description might prohibit progressive solutions in this area. Most important is that questions of testing and evaluation can finally be decided based upon the integration architecture.

4.3 Integration of warnings

Within the AIDE experimental program empirical research was conducted on the structure of warnings integration. The results were presented in several sessions of the Warnings Integration Task Force of WG 8. This lead to the following recommendation in respect of the Warnings Integration activities of WG8:

The state of the art has progressed and the topic should be revisited. There is enough new information from AIDE and other research that the technical standard should be revised and updated.
The AIDE program has apparently developed a new method for classifying and potentially prioritizing warnings that should be considered.
(Comments from the USA; details see N 581).

The recommendation shows that it was able to introduce recent results and approaches to international standardization bodies which will take them up for their further work.

5 Recommendations on the future development of the European Statement of Principles on HMI (SP4)

5.1 Background

The importance of a safe HMI for in-vehicle information and communication systems has been stressed for many times in the past. On 21 December 1999, the European Commission adopted a recommendation incorporating the "European Statement of Principles" (ESoP) (cf. Commission of the European Communities, 2000). In addition, the CEC published the "Expansion of the Principles" elaborated by its expert group in 2001. The ESoP summarises essential safety aspects to be considered for the design of the HMI for in-vehicle information and communication systems. More precisely, the documents contain three overall design principles on human machine interaction and 32 principles covering the topics of system installation, information presentation, interaction with displays and controls, system behaviour and information about the system. In order to avoid unnecessary obstacles or constraints to the innovative development of products, the statement of principles is expressed mainly in terms of the goals to be reached by the HMI design (cf. Haller, 1999).

The purpose of this CEC Recommendation was to widely disseminate the principles, through the Member States, to the main actors in the field. A voluntary agreement from European car manufacturers to fully respect the ESoP was issued in 2001 by ACEA (the European Automobile Manufacturers' Association). Within the AIDE project ESoP 2001 served as a starting point to define work packages and activities on method development as well as requirements on solutions to be developed in SP3.

In 2003 the eSafety Forum was established by the CEC in close collaboration with the industry, industrial associations and public sector stakeholders to address both safety and market issues in the implementation of driver information and assistance systems as a contribution to European road safety improvement targets. Following the recommendations of the "eSafety Working Group on Road Safety" (November 2002) the eSafety Steering Group established a "Working Group on Human Machine Interaction" to tackle the important issue of driver interaction with on-board devices, such that HMI does not become a barrier to deployment.

The „eSafety Working Group on Human Machine Interaction" was extremely active during 2004 analysing issues and discussing approaches to promoting safe deployment. Following a workshop in mid-2004 specific recommendations were developed and discussed with Member State officials and industry representatives. The application of the ESoP by car manufacturers and suppliers of original equipment was judged positive, but the impact of the ESoP could be improved for other stakeholders, e.g. "nomadic" device manufacturers and service providers. Information from the EC Member States concerning impact of the ESoP was also studied.

The "eSafety Working Group on Human Machine Interaction" finalised its report to the CEC in early 2005. Based on responses and further reflection, the Working Group recommended to revise the ESoP based on the "Expansions of the Principles" (2001) and formulated a number of specific recommendations concerning ESoP revision:

- Explicitly address information presentation by service providers (e.g. running text on displays).
- Explicitly address manufactures of specific systems (e.g. medical vehicle systems, express delivery systems).
- Enhance the ESoP with additional principles that apply to Fleet Managers and Employers who have responsibilities in design, installation and use of systems by their employees.
- Clarify and adequately incorporate the distribution of responsibilities.
- Enhance the ESoP by precise criteria, where possible, on the combination of several systems during retrofit and for context specific applications.

The full text of the final report and the recommendations is available for download in the Internet: http://ec.europa.eu/information_society/activities/esafety/forum/hmi/index_en.htm

The official presentation of the WG final report and discussion with Member States representatives was undertaken during February 2005. The Member States were, in general, positive towards the ESoP and agreed with the recommendations of the eSafety "Working Group on Human Machine Interaction" concerning its development. The AIDE project understood itself as a dissemination platform for ESoP 2. The document and its philosophy was disseminated within:

- The report from member states within WG8 meetings.
- The user forum, nomadic device forum.
- Conferences and meetings (national and international).

5.2 Experiences on the Application of ESoP 1 within the AIDE IP

The European Statement of Principles in its version of 1999 (ESoP 1) served as an important guideline to structure the activities within the AIDE project. Furthermore it initiated and helped to structure the discussions within the nomadic device forum applying the principles to third party systems and nomadic devices. Philosophy, structure and content of the document were disseminated and discussed within the AIDE project, ISO-WG8 and national meetings. These dissemination activities lead to valuable input given by the delegates from the AIDE project to the working group on the second version of the European Statement of Principles. The focus and motivations for the realizations within SP3 were mainly guided by the spirit of the ESoP 1.

Like proposed in the AIDE system, in the ideal case the nomadic device is fully integrated into the vehicle system, and both the nomadic device and the embedded in-vehicle system share the I/O devices. This means an operation of the nomadic device is performed via an input device of the vehicle and the output of the nomadic device is visualized on an in-vehicle system, as well.

In case of the nomadic device performs an output message – whether to be output on the nomadic device or on an in-vehicle device – it has to ask the ICA in advance for permission and informs the ICA about the output form and desired output devices. The ICA takes the information of the DVE (information about the driver and the driving state) and decides about the suited output strategy. After informing the applications about that decision they perform the output and access the I/O devices.

There are several aspects of the ESoP 1 which are not met when using non-integrated nomadic devices, e.g., visual displays should be positioned as close as practicable to the driver's normal viewing direction. When nomadic devices are used, their location often is far away from optimal in terms of driving safety. Integrated nomadic devices can be operated through the in-vehicle I/O devices so their location does not influence the driving safety any longer.
The ESoP1 proclaims that a system should be designed in a way that the allocation of driver attention to the displays or controls remains compatible with the attention demand of the driving situation. This is the case when a vehicle is equipped with a system like the ICA module. In a demanding driving situation, the ICA will take away some available information which leads to a decrease in driver distraction.

Another requirement of the ESoP 1 is: "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 unintended use." This is already realized in some extent, as the screen of the television turns black when the vehicle is in motion. A driver interaction on a nomadic device during a ride can be avoided by the ICA module, which blocks heavily distracting functions.

The integration of a nomadic device is seen as a joint task of several partners (i.e. stakeholders in the sense of the ESOP II). A full integration in the vehicle system requires the adaptation of the HMI strategies of the vehicles to the nomadic device or vice versa. Problems can arise in this point due to fundamental differences between these two systems:

Generally the resolution of displays for nomadic devices is higher than that of displays for in-vehicle information systems. The visualization of content from the nomadic device must be adapted to the in-vehicle display with a lower number of pixels.
Another design related difference is the number of control devices, which is in general greater in nomadic devices than in in-vehicle information systems. Thus drivers have fewer available input devices when controlling the nomadic device via in-vehicle control elements.
The working temperature of nomadic devices is lower than that of in-vehicle systems thus limiting the use of nomadic devices in vehicles. In the wintertime, it may happen that these systems do not work properly.

A lesser vibration tolerance of nomadic devices could as well limit the use in vehicles.
The viewing distance for nomadic devices is generally shorter in nomadic devices than for in-vehicle information systems. The driver's eyes have to adapt more when a focused object is closer to the driver. In such case, the output on the nomadic device is seen problematically due to a longer time the driver cannot look at the road. Apart from this, a worse contrast and more reflections on glare-type displays of nomadic devices contribute to a longer eye off-road time compared to in-vehicle systems. More new and innovative technologies are implemented in nomadic devices than in in-vehicle information systems. The implementation often takes place to an earlier point of time in nomadic devices than in in-vehicle information systems. Especially a more complex menu structure on nomadic devices compared to an in-vehicle display contributes to a higher visual and cognitive distraction.

Irrespective of the above mentioned problems, the nomadic device architecture will change much more often as a result of a significantly shorter product life cycle compared to in-vehicle information systems.

In the case of low level integration, i.e. the installation of the nomadic devices the car manufacturer provides only basic mechanical an electrical interface (plus AIDE ICA command output. The HMI (including an ICA command input) remains fully with the naturalistic driving and therefore has to be carried out by the manufacturer of these systems. As the OEM/vehicle producer has no influence on the design of a nomadic device, he can only provide and be responsible for a safe mechanical integration – this as well has to be accomplished by the nomadic device manufacturer.

HMI functions of in-vehicle systems as well as those of nomadic devices must be adaptive in order to reach a higher safety level. Therefore, in the context of the DVE module, the driver as well as the driving situation is monitored which delivers information about the driver, the vehicle and the environment. The ICA adapts the HMI strategies to the actual driving task demand. When driving in a challenging situation, e.g. incoming phone calls may be re-routed to a voice mail message system.

5.3 Compilation of the ESoP 2, 2006

The CEC accepted the report and responded quickly by announcing that a new updated version of the ESoP would be produced during 2005 and become part of an CEC Communication on HMI issues towards the end of the year. The CEC made some funding available through the existing HMI-related projects HUMANIST and AIDE and invited a small group of HMI specialists – the "ESoP Development Group" - to implement the eSafety "WG-Human Machine Interaction" recommendations concerning the ESoP. Members of the "ESoP development group" were: Alan Stevens (TRL, UK), Anders Hallen (Volvo Cars, S), Annie Pauzie (INRETS, F), Bénédicte Vezier (Renault, F), Christhard Gelau (Bast, D), Lutz Eckstein (BMW, D), Trent Victor (Volvo Technology, S) and Winfried Koenig (Bosch, D). The group facilitators were Valérie Moutal and Wolfgang Hoefs from the CEC (DG INFSO).

The AIDE project supported members with information on specific methodological questions and actual information on e.g. nomadic device developments. The „ESoP Development Group" worked intensively from April to September 2005 (including an information workshop at the end of June to solicit feedback) and submitted a draft version of the revised ESoP for further processing by the CEC in October 2005. The CEC adopted the update of the ESoP on 22 December 2006 which was then published in the Official Journal of the European Union on 6 February 2007 (L 32/200). Moreover, the ESoP in its version of 2006 (EsoP 2) is available in the Internet in English, French and German language e.g. on the eSafety website (http://ec.europa.eu/information_society/activities/esafety/library/index_en.htm) .

The principles of the ESoP 2 are short statements summarising specific and distinct HMI issues (e.g. Interaction principle I: *"The driver should always be able to keep at least one hand on the steering wheel when interacting with the system."*). Following each statement is an explanation of the rationale and meaning of the principle including examples. Where possible a practical means of verifying that the principle has been followed is provided. Nevertheless, the "ESoP Development Group" was convinced that the current state of scientific development is not sufficient to robustly link compliance criteria with safety for all the principles.

The ESoP 2 applies to In-Vehicle Information and Communication Systems (IVICS) intended for use by the driver while the vehicle is in motion, for example, navigation systems, telephones and traffic information. It has to be stressed that the principles are not specifically intended to apply to systems providing vehicle stabilization (such as ABS and ESP/ESC) or to Advanced Driver Assistance Systems (ADAS) such as e.g. ACC because these systems are fundamentally different and require additional considerations in terms of Human Machine Interaction.

Furthermore, the scope of the ESoP 2 covers all components and aspects of a system that the manufacturer intends that the driver will interact with while driving and also to certain other components and aspects that should not be used while driving. This means that "the system" refers to the functions and parts, such as displays and controls, which constitute the interface and interaction between the system and the driver. The scope of the ESoP 2 explicitely excludes aspects unrelated to Human Machine Interaction such as electrical characteristics, material properties, system performance and legal considerations.

The ESoP 2 applies specifically to vehicles of class M and N vehicles (including passenger cars, trucks and buses) although some aspects may also be valid for other vehicle classes. Most important, the principles are valid for both portable and permanently installed systems as well as to OEM systems and to after market and nomadic devices. Finally, the principles apply to HMI functionality independent of the degree of integration between systems. In addition to making individual system design as good as possible, the driver can be supported in the safe operation of IVICS while driving by making other aspects of the context of use as benign as possible. These aspects which are unrelated to non-system design but which define the context of use can be called the “Human Machine Environment”.
In the same way that the design principles are formulated to inform and influence those organisations responsible for (or contributing to) system design and construction, the principles concerning use are formulated to inform and influence those organisations that are responsible for (or contribute to) the “Human Machine Environment”. This includes:

- The combined use of systems to complete a task.
- The knowledge and skill of the driver (in terms of the systems and tasks).
- The driving task/situation.
- The social environment (including time pressure).

For a professional driver, the “Human Machine Environment” also includes:

- Tasks that are required as part of the job (in addition to the driving task).
- Company instructions and practices.

5.4 Future Perspectives

An eSafety conference was organised on June 5-6, 2007 in Berlin during the German EU Council Presidency. Among Real Time Traffic Information (RTTI), Vehicle-to-Vehicle and

Vehicle-to-Infrastructure-Communication and legal issues of driver assistance systems, Human-Machine-Interaction was one of the key topics. Six presentations were given by speakers from governmental authorities, industry and research institutes which all addressed issues concerning the revised ESoP:

- André Vits (CEC): "Current state of the Recommendations on HMI"
- Wiel Janssen (TNO): "It is the HMI that counts: Lessons learned from European projects."
- Alan Stevens (TRL): " In-vehicle information systems: Ensuring a positive contribution to road safety."
- Andre Seeck (BASt): ""eSecurity in the context of Human-Machine-Interaction"
- Lutz Eckstein (BMW/ACEA): "How can the ESoP become effective and what does it mean for other system types?"
- Björn Stafboom (SRA): " Recommendations for the implementation of the European Statement of Principles from a governmental view."

As a result of the presentations given at the thematic sessions and the following discussions several conclusions were adopted and sent via as an official communication from the German Federal Government to the European Commission, with the request to take them into consideration when taking future action (see "Communication of the Government of the Federal Republic of Germany to the European Commission from 27 June 2007" download: http://www.bmvbs.de/EU-Ratspraesidentschaft-,2618.997814/Moeglichkeiten-der-Nutzung-ele.htm).

The conclusions on HMI concerned the implementation of the ESoP, Nomadic Devices, the prevention of manipulation and misuse and the future development of the ESoP. These can be summarised as follows:

- Implementation:Voluntary self-commitments by all addressees of the ESoP is the *"preferred option among other possibilities (e.g. regulations, consumer protection requirements)"*. However, special care has to be taken in order to *"achieve equal and balanced participation of all stakeholders."*
- Nomadic Devices: Special attention has *"to be paid to issues relating to the safe integration and use of portable systems"*.
- Manipulation and Misuse: The ESoP is not sufficient to ensure the prevention of manipulation and misuse on a sustained basis. The need for further measures for the prevention of manipulation and misuse was stressed and related activities of the European Commission in the field of eSafety were expressly supported.
- Future development of the ESoP: It was recommended that the ESoP is updated again in the future. However, before the next update of the ESoP, sufficient experiences with the current version should be gathered.

As the current and future driver assistance and in vehicle information systems will be more complex and powerful, the driver interaction must not be so complex and distracting that it counteracts the safety enhancement of ADAS & IVICS. So the design of an adaptive driver vehicle interface, which reduces and adapts the interaction to a safe and comfortable, not overloading level, will be essential. AIDE set the basics and developed prototypes in SP 3. Guidelines based on scientific evaluations will set the direction for the development of adaptive integrated driver vehicle interface in future vehicles (cars & trucks).
Currently ESoP II is in a phase of implementation in the European Member States which

means that indications about the future of the ESoP only make sense when the experiences from the implementation phase have been evaluated. The technical decision about the scope (e.g. to include ADAS) cannot be taken before the political decision about the need and the nature of an ESoP III.

6 Conclusions

The research which was conducted within the AIDE project was strongly linked to the standardization work within ISO WG8 and the related parties (CEN, SAE, national standardization bodies). The link was established bidirectional and with outstanding actuality. This means that information was exchanged with very low delays and in both directions between the parties.

Thus the AIDE IP and its results are well known in its beneficial contributions to human factors standardization on an international level. The AIDE IP could serve as a platform to dissemination, application and development of the European Statement of Principles as central document for the work of in-vehicle human-machine interaction. These facts prove that the mission that was formulated in the SP4 tasks on standards and guidelines has been fulfilled and that the associated activities provided important impulse and benefit to the whole project structure. It turned out that workshops and meetings with international third parties and bodies are the most productive organizational approach to reach these results. On the other hand travel expenses and organizational efforts on this level were not foreseen in the planning. Therefore it is recommended to following projects to forecast this in a realistic range in future project plans.

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8 Annex

Agenda and summary of the joint workshop ISO WG 8 - AIDE SP4 on May 17, 2007, Milano

INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

AIDE
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Authors:	Klaus Bengler
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Workshop Participants

No	Partner/Company	Name
1.	BMW	Klaus Bengler
2.	Volvo Cars	Anders Hallen
3.	Daimler	Stefan Mattes
4.	Univ Leeds	NatashaMerat
5.	Bast	Christian Gelau
6.	Bosch	Winfried König
7.	TNO	Richard van der Horst
8.	Scania	Gunnar Lanstad
9.	Scania	Robert Friberg
10.	JARI	Akira Ohtani
11.	JARI	Hiroshi Uno
12.	Toyota	Kenji Marunaka
13.	Yazaki	Ching Fong
14.	AIST	Moto Akamatsu
15.	Renault	Jean-Phillipe Alexander
16.	LAB	Laurence Rognin
17.	PSA	Estelle Chin
18.	DRI	Dean Chiang
19.	DRI	Dave Weir
20.	Transport Canada	Joanne Harbluk
21.	Toyota	Dave Benedict
22.	Ford	John Shutko
23.	SAE	Dave Hoffmeister
24.	SAE	Gary Rupp

Agenda

Date		
Time	**Topic**	**Presenter**
9.30-10:00	**Welcome** Introduction of AIDE-Project to Participants	**Winfried König**
10:00-10:30	**Definitions and glossary** The presentation will introduce the glossary that has been developed in AIDE. The starting point was the existing glossary developed in the EAST project which primarily included terms related to electronics architecture. In AIDE, a number of new definitions for key human factors-related terms have been added, largely based on existing ISO definitions.	**Johan Engström**
10:30-11:00	**Results on Peripheral Detection Task** This talk will outline the results of experiments conducted in Sub Project 2 of AIDE: Evaluation and Assessment Methodology. Results will discuss the suitability of the Peripheral Detection Task (PDT) for the safety assessment of IVICS and ADAS during driving.	**Natascha Merat**
11:00-11:30	**Visual Demand Measurement (VDM) Tool** The talk will introduce the VDM Tool, a software tool for quick and efficient analysis of automatically recorded eye movement data. The tool, which was partly developed in the AIDE project, supports data management, basic signal processing, data visualisation as well as computation of a range of different visual demand metrics (including the ISO 15007 metrics). The current, first version, of the tool is optimised for the Seeing Machines Facelab system. However, in principle the tool is compatible with most modern eye tracking devices.	**Johan Engström**
11:30-12:00	**Driving Simulator metrics/measurements** In a series of driving simulator experiments several metrics were compared and evaluated regarding their sensitivity to measure distraction effects. The second presentation will present work on more detailed operational definitions of driving performance metrics developed within AIDE. In particular, the work has focused on (1) a modified version of standard deviation of lateral position which takes into account the effect of task duration and (2) a new metric for steering wheel reversal rate which showed enhanced sensitivity to existing versions.	**Klaus Bengler** **Johan Engström**
12:00-13:00	**Lunch break**	
13:00-13:30	**Subjective workload measurement** Work conducted was to recommend the most suitable workload subjective method to evaluate IVICS and ADAS, and AIDE system, among existing methods.3 experiments were achieved on road or in simulator to evaluate the sensitivity, the advantages, the drawbacks and the limits of three existing tools (questionnaires) dedicated to evaluate several components of workload of different natures: the PSA-TLX (PSA-Task Load index), the DALI questionnaire - (Driving Activity Load Index), the BMDMW (Behavioural Markers of Driver Mental Workload)	**Estelle Chin**
13:30-14:00	**Warnings integration** Technological developments as well as experimental results from the AIDE project related to warnings integration will be presented. This includes results from short-/long term experiments demonstrating the importance of integration, as well as the information management architecture developed in the project to enable efficient HMI integration.	**Johan Engström**
14:00-14:30	**Information on European Statement of Principles**	**Christhard Gelau**

14:30-15:00	**Occlusion – EOT** Experimental research is presented which examines the so called Enhanced Occlusion Technique (EOT). Starting from the "conventional" occlusion technique (ISO 16673) the basic hypothesis was that the sensitivity of the occlusion metrics could be improved by the requirement of additionally performing an acoustic tracking task during an occlusion experiment. Our results confirm this expectation, i.e. EOT actually resulted in increased sensitivity of TTT, TSOT and the occlusion index R for IVICS tasks with differing levels of complexity.	**Christhard Gelau**
15:00-15:30	**I-TSA** The increasing number and complexity of IVICS and ADAS require an accurate and timely assessment of their impact on traffic safety already during the development process. The I-TSA evaluation tool, developed within the German research consortium INVENT, offers a standardized procedure for the assessment of traffic safety based on the driving error occurrence in up to 10 categories of parameters (e.g. the category "longitudinal control" includes the errors in speed, time headway and time to collision). It has been applied in several simulator and real traffic experiments with consistent results and high discrimination power. Its flexibility of application make it interesting for different environments and development stages.	**Winfried König**
15:30-16:00	**Results on Lane Change Test (LCT)** Three studies on the LCT are presented. A study on "Origins of workload" was carried out to test whether a refined analysis on LCT would allow to distinguish cognitive distraction from visual distraction. A second study employed a modified version of the LCT to assess adaptive IVICS interfaces. Another study investigated the effects of scenarios and simulators. The results are discussed in the light of other related work.	**Stefan Mattes**
16.00 – 17:00	**Summary and adjourn**	**Klaus Bengler**

Table of Results

Topic	Discussion	INFORMATIVE	REVISION of DOCUMENTS	NEW ACTIVITY
Definitions and glossary The presentation will introduce the glossary that has been developed in AIDE. The starting point was the existing glossary developed in the EAST project which primarily included terms related to electronics architecture. In AIDE, a number of new definitions for key human factors-related terms have been added, largely based on existing ISO definitions.	SAE compiles literature and definitions cf. Prometheus	The glossary is a helpful merge of the variety of definitions The provided glossary structure could serve as a tool for future projects Interesting approach for current ongoing SAE activity and should be merged with SAE information	Could be helpful during the revision of existing ISO documents	Good idea to revive a WG for common definitions To be discussed within WG8
Results on Peripheral Detection Task This talk will outline the results of experiments conducted in Sub Project 2 of AIDE: Evaluation and Assessment Methodology. Results will discuss the suitability of the Peripheral Detection Task (PDT) for the safety assessment of IVICS and ADAS during driving.	VDT ADT TDT Is it also usable for visual IVICS? Should be no difference between visual vs. cognitive 2nd tasks No effect of PDT on driving performance? this means on Lateral Performance Were the results consistent among Labs There were differences in different realizations of TDT and differences in the size of the effect	Should be considered in the context of TF calibration		To be discussed as a NWI within WG8 But parameters have to be checked (PWI) Possibility for auditory/cognitive 2nd tasks Value of this approach: ADT TDT do not affect visual behaviour Could be applicable to ADAS systems

Topic	Discussion	INFORMATIVE	REVISION of DOCUMENTS	NEW ACTIVITY
Visual Demand Measurement (VDM) Tool The talk will introduce the VDM Tool, a software tool for quick and efficient analysis of automatically recorded eye movement data. The tool, which was partly developed in the AIDE project, supports data management, basic signal processing, data visualisation as well as computation of a range of different visual demand metrics (including the ISO 15007 metrics). The current, first version, of the tool is optimised for the Seeing Machines Facelab system. However, in principle the tool is compatible with most modern eye tracking devices.	Automated Analysis Tool Estimation of the individual road centre instead of AOI (as simplification) PRC percent road centre As Quality Metric for availability New metrics STD of gaze pitch / yaw Meta analysis: SafeTE visual demand metric (penalties for long and eccentric [pitch and yaw] glances) Is it possible to analyse visual patterns – No Practical limits	Valuable tool realization for standardized values/parameters Road centre approach needs further investigation	15007 STD of gaze pitch / yaw SafeTE as a further metric to be discussed	
Driving Simulator metrics/measurements In a series of driving simulator experiments several metrics were compared and evaluated regarding their sensitivity to measure distraction effects. The second presentation will present work on more detailed operational definitions of driving performance metrics developed within AIDE. In particular, the work has focused on (1) a modified version of standard deviation of lateral position which takes into account the effect of task duration and (2) a new metric for steering wheel reversal rate which showed enhanced sensitivity to existing versions.	Steering performance metrics Filtering by gap sizes and cut-off values Sensitivity		Includes valuable information considering the Informative Annex of the Suitability Standard	

Topic	Discussion	INFORMATIVE	REVISION of DOCUMENTS	NEW ACTIVITY
Subjective workload measurement Work conducted was to recommend the most suitable workload subjective method to evaluate IVICS and ADAS, and AIDE system, among existing methods.3 experiments were achieved on road or in simulator to evaluate the sensitivity, the advantages, the drawbacks and the limits of three existing tools (questionnaires) dedicated to evaluate several components of workload of different natures: the PSA-TLX (PSA-Task Load index), the DALI questionnaire - (Driving Activity Load Index), the BMDMW (Behavioural Markers of Driver Mental Workload)	DALI (TLX Adaptation to Automotive): HMI design comparison PSA-TLX: Subjective Impact on driving safety/workload on road BMDMW: mental workload driver state on road and Simulator Input on Scale construction Workload often used as a reference Producing consistent results	Input for Calibration TF in connection with the SAE rating scale Standard, as subjective ratings are used during development of the Calibration Task		
Warnings integration Technological developments as well as experimental results from the AIDE project related to warnings integration will be presented. This includes results from short-/long term experiments demonstrating the importance of integration, as well as the information management architecture developed in the project to enable efficient HMI integration.	Long-term effects of systems warnings Comparison of different warning modalities X systems Experimental Scenarios Prioritisation scheme, Architecture and design scenarios/use cases	Long-term effects of systems warnings Comparison of different warning modalities X systems Experimental Scenarios (➔ Annex) to test ISO Warnings integration approach Prioritisation scheme, Architecture and design scenarios/use cases as a source of ideas for TF Warnings integration		

Topic	Discussion	INFORMATIVE	REVISION of DOCUMENTS	NEW ACTIVITY
Occlusion – EOT Experimental research is presented which examines the so called Enhanced Occlusion Technique (EOT). Starting from the "conventional" occlusion technique (ISO 16673) the basic hypothesis was that the sensitivity of the occlusion metrics could be improved by the requirement of additionally performing an acoustic tracking task during an occlusion experiment. Our results confirm this expectation, i.e. EOT actually resulted in increased sensitivity of TTT, TSOT and the occlusion index R for IVICS tasks with differing levels of complexity.	Filling the gap between occlusion and field results by filling the occlusion interval Validity Additional workload What about effect sizes	Interesting for a future revision of 16673 but further research is needed.		
ESop on HMI	Detailed Presentation given by C. Gelau http://www.europa.eu.int/information_society/activities/esafety/hmi/forum/index_en.htm			
I-TSA The increasing number and complexity of IVICS and advanced driver assistance systems (ADAS) require an accurate and timely assessment of their impact on traffic safety already during the development process. The I-TSA evaluation tool, developed within the German research consortium INVENT, offers a standardized procedure for the assessment of traffic safety based on the driving error occurrence in up to 10 categories of parameters (e.g. the category "longitudinal control" includes the errors in speed, time headway and time to collision). It has been applied in several simulator and real traffic experiments with consistent results and high discrimination power. Its flexibility of application make it interesting for different environments and development stages.	Publications available ? via W. König, M. Rimini-Döring, F. Kuhn			

Topic	Discussion	INFORMATIVE	REVISION of DOCUMENTS	NEW ACTIVITY
Results on Lane Change Test Three studies on the LCT are presented. A study on "Origins of workload" was carried out to test whether a refined analysis on LCT would allow to distinguish cognitive distraction from visual distraction. A second study employed a modified version of the LCT to assess adaptive IVICS interfaces. Another study investigated the effects of scenarios and simulators. The results are discussed in the light of other related work.	Basic Information on LCT Additional dependent variables and Analysis software No input for adaptive system testing Different Settings (small scale – large scale) tested	Continuous Contribution to TF LCT Presentation includes bibliographical input to LCT document (➔ D225)		