INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

AIDE
IST-1-507674-IP

Report on the review of the available guidelines and standards

Deliverable No.		**D4.3.1**	
SubProject No.	**SP4**	SubProject Title	**Horizontal activities**
Workpackage No.	**WP4.3**	Workpackage Title	**Guidelines and Standards**
Activity No.	**T4.3.1**	Activity Title	**Review of existing HMI guidelines and standards**
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Status (F: final; D: draft; RD: revised draft):		**F**	
File Name:		**AIDE-BASt-D-WP4_3-R1-V05-Review of Standards.DOC**	
Project start date and duration		**01 March 2004, 48 Months**	

List of abbreviations

AAM	Alliance of US Automobile Manufacturers
ACC	Adaptive Cruise Control
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 Communities
CEN	Comité Européenne de Normalisation
FAA	US Federal Aviation Administration
FMEA	Failure mode and effect analysis
FHWA	US Federal Highway Administration
HMI	Human Machine Interface
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
OEM	Original Equipment Manufacturer
PWI	Preliminary Work Item
SP	Sub-project
TICS	Transport information and control system
TS	Technical specification
TR	Technical report
UN-ECE	United Nations - Economic Commission for Europe
WP	Workpackage

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Executive Summary

This report presents a review of available guidelines and standards relevant to HMI development of IVIS and ADAS.

The survey was focused on documents covering the scope of HMI in the fields of system design and message prioritisation, evaluation and assessment, and development process (see also annex: Overview of existing guidelines and standards).

It discusses the availability of AIDE relevant documents, i.e. guidelines and standards on adaptive system and integration issues.

The comments on guidelines and standards in the deliverable give overview and orientation to other partners in AIDE that are engaged in system specification and evaluation.

1 Introduction

The AIDE project is targeted at adaptive integrated HMI for ADAS and IVIS in road vehicles. The general objectives of the project are a) to model and simulate behavioural affects of ADAS and IVIS, 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 4.3.1 “Review of existing HMI design 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 new types and complexity of the HMI increase. In the AIDE project the results of this horizontal task will be needed and used within several other subprojects and workpackages. With focus on the project objectives b) and c) the review is to

- present an overview on guidelines and standards which can provide recommended principles and specifications for the development and evaluation of adaptive integrated HMI (Subproject 3),
- provide methods and procedures for the revision and development of assessment tools and a generic evaluation methodology within AIDE subproject 2, and
- to identify needs for development of guidelines for HMI integration and adaptation; this information is needed as a basis for AIDE task 4.3.2 in order to work out new guidelines and recommendations for new standards.

As mentioned in the workplan of the AIDE project the results of the review will also be relevant to corresponding activities in the HUMANIST project, especially on the further development of the European Statement of Principles (CEC, 2000).

This report first gives a short description of the approach taken for the review. In the main section of the report short comments on the reviewed documents are provided. A conclusion on the documents looked over is presented in the last section. The annex contains a look-up table which provides an overview on the reviewed documents.

2 Method

The approach to review the guidelines consisted of four main steps:

1) Definition of the review's scope
2) Searching relevant documents and structuring the outcome
3) Reviewing and commenting the documents
4) Interpretation of results

Ad 1)

- The deliverable is focused on HMI design guidelines (recommendations, recommendations in standards, regulations) that discuss aspects of "integrated" und "adaptive" HMI of integrated or nomad devices. The documents should be already published or under discussion. Documents that deal with purely technical issues (e.g. sensoring technologies, software protocols) are not included. Due to the fact that AIDE is a European project actual SAE documents or drafts are not documented but referenced in several of the guidelines and standards that are included in this deliverable.

Ad 2)
The search process was guided using a table consting of the following input values:

- Title,
- Source,
- Status of document, (draft, proposed)
- Type (guideline, recommendation)
- Availability (public, internal)

The table was filled by experts in Task 4.3.1.

Ad 3)
The review included sorting out of irrelevant documents.
Commenting again was done on the expert level using one expert from T4.3.1 per document.

Ad 4)
The interpretation of result has to be understood as a synopsis on the background of step 1 to 3. The documents´ importance for AIDE was assessed by experts involved in T4.3.1 (importance high, medium, low).

3 Comments on the reviewed documents

3.1 *Guidelines*

3.1.1 A European Statement of Principles on Human Machine Interface (CEC)

The European Statement of Principles (CEC, 2000) has the status of a recommendation and contains 35 principles on overall design, installation, information presentation, interaction with displays and controls, system behaviour and information (documentation) about the system.

The following citation from the document explains content and scope:

> "1. Definition of objectives
> 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 manfuacturers when they have to consider the safety implications of HMI design. Desgin and installation issues are the main concern of this statement of principles and they therefore relate to the following critical issues:
> - how to design and locate information and communication systems in such a way that their use is compatible with the driving task
> - how to present information so as not to impair the drivers's visual allocation to the road scene
> - how to design system interaction that the driver maintains under all circumstances safe control of the vehicle, feels comfortable and confident with the system and is ready to respond safely to unexpected occurrences.
>
> In order not to create unnecessary obstacles or constraints to the innovative development of products, the statement of principle is expressed mainly in terms of the goals to be reached by the HMI.
>
> 2. Scope
> This statement of principles is concerned with all information and communication systems intended for use by the driver while driving. In this context the principles consider that the driver's primary driving task is safely controlling the vehicle through a complex dynamic traffic environment. For the purpose of this statement of principles 'the system' refers to the functions and parts, such as displays and controls, that constitute the interface and interaction between the system and the driver.
>
> These principles have been formulated to consider the design and installation of individual systems. Where more than one system is present within a vehicle they should ideally be presented as an integrated driver interface where the complete installation also complies with this statement of principles.
> 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 statement of principles does not cover aspects of information and communication systems not related to HMI such as electrical characteristics, material properties, system performance and legal aspects."

3.1.2 Guidelines for the design and installation of information and communication systems in motor vehicles (UN/ECE)

The scope of these guidelines (UN/ECE, 1998) are systems designed to assist the driver during driving. With respect to driver attention, the objective of the guidelines is to ensure that the use of such systems does not impair road safety. The guidelines are addressed to designers, licensing experts and governmental bodies.

Similar to European Statement of Principles (CEC, 2000) the requirements in this document reflect a framework of principles on human machine interaction. The following aspects are covered:

- manual operation; avoidance of two handed operation; hands-free operation in case of communication systems; haptical input devices
- visual distraction to be minimized; use of the acoustic channel
- interference of information and communication systems with other control equipment and instruments to be avoided
- safe use by inexperienced users
- easiness of use
- possibility to switch-off output
- integrated display for visual information
- positioning of displays
- dialog (speed of interaction, interruptability)
- installation and operation instructions

3.1.3 Suggested human factors design guidelines for driver information systems (UMTRI)

This document (Green et al., 1993) is written for designers of in-vehicle information systems in order to make such systems safe and easy to use for ordinary drivers. The user of the guidelines should be familiar with automotive terms but is not assumed to be a HMI expert. The guidelines were based on experience from designing and testing a variety of driver interfaces within a project funded by FHWA.

Three types of guidelines are addressed:

- General guidelines:
  broad ergonomic design considerations which are applicable to any in-vehicle information system.
- Function specific guidelines:
  human factors design considerations that are specific to the display(s), control interface and system architecture used for a particular function.
- Integral guidelines:
  human factors design considerations when two or more functions are used together in a partial or fully integrated information system

The guidelines include general design principles and guidelines for the design of manual controls, spoken input, visual displays, auditory displays, destination entry, visual displays for navigation, auditory displays for navigation, traffic information, car phones, vehicle monitoring, hazard warning systems, interface integration, as well as an extensive reference section. For most guidelines, a commentary and examples of how they should be applied are provided.

The authors indicate that, although only passenger cars were considered in the study, the results apply to light trucks and vans as well because their driver population and likely use are similar to cars. The material is also applicable to nomad devices („retrofits“).

3.1.4 Statement of principles, criteria and verification procedures on driver interactions with advanced in-vehicle information and communication systems (AAM)

The AAM Statement of Principles (Alliance of Automobile Manufacturers, 2003) is a voluntary industry guideline for HMI of IVICS which are used by a driver while the vehicle is in motion. The main concern of this Statement of Principles are safety aspects to be taken into account for design and installation. The document will be of particular use to light vehicle and telematics manufacturers.

In large part, the list of principles was based on the European Commission recommendations on safe and efficient invehicle information and communication systems (2000/53/EC) and then, by seeking input from experts and interested parties, was developed into a more comprehensive document including more fully defined performance criteria and verification procedures.

The document is organized according to twenty-four principles divided into the following five sections:

- installation,
- information presentation,
- interaction with displays and controls, including reasonably foreseeable misuse,
- system behaviour and
- information about the system.

The elaborations on these principles include specific criteria, technical justification, verification procedures, and illustrative examples on how they satisfy the principles.
The principles are mainly expressed in terms of performance-based goals to be reached by the HMI. A comprehensive glossary of terms is available at the end of the document.

The principles are applicable to:
- “new” information and communication technology and devices with visual and manual/visual interfaces,
- features and functions designed to be used by a driver while driving under “routine driving conditions”, whether or not the system is directly related to the driving task,
- whether the system is stand-alone or integrated into another system,
- whether the system is portable or permanently installed and

- original equipment as well as to aftermarket devices, software, and data intended to be usable by the driver while the vehicle is in motion.

At this time the principles are not intended to apply to:
- traditional information or communication systems
- head-up displays
- voice-activated devices
- haptic displays and cues
- purely cognitive distraction (e.g., conversation)
- driver assistance systems (e.g., new collision warning or vehicle control systems

The document does not cover aspects of information and communication systems not related to HMI, such as electrical characteristics, material properties, system performance, and legal aspects.

3.1.5 Human Factors Guidelines for Information Presentation by ATT Systems (HARDIE)

The principal aim of this handbook (Ross et al., 1996) is to provide advanced transport telematic system designers and ergonomists with appropriate human factors knowledge to support the development of safe and user friendly systems for the presentation of information to drivers.

For the development of the guidelines existing guidelines have been reviewed and new ones have been generated on the basis of empirical research.

The handbook consists of an introduction and five chapters providing design guidelines for specific ATT systems:
- traffic and road information - including RDS-TMC
- route guidance and navigation
- collision avoidance
- autonomous intelligent cruise control
- variable message signs (road infrastructure system)

The guidelines within each chapter refer to:
- information presentation only (i.e. not input devices or dialogue design, except where the latter is relevant)
- information targeted at drivers only (i.e. not passengers, although they may see it).
- information presented whilst “on the move” only (i.e. not whilst stationary, e.g. during system set-up).
- information presented inside the vehicle and externally.
- the specific application areas covered within that chapter.

The handbook covers only those design issues which are judged to be safety critical, of high priority to designers and vital to the function of the particular application. Guidelines for integrated systems are not covered.

3.1.6 Design guidelines for safety of in-vehicle information systems (TRL)

This document (Stevens et al., 2002) is intended to provide designers, manufacturers and others in the supply chain of IVIS with a summary of legal and ergonomic issues relevant to safety and ease of use.

The systems addressed in this guidelines are those, which provide the driver with information to his journey such as accident warning, congestion, navigation. The guidelines are not intended for entertainment systems and ADAS, but many of the requirements raised will be similar for these systems and the principles behind will thus be transferable. The guidelines are primarly aimed at systems designed for private cars but will of course be largely applicable to systems used in fleet cars.

The guidelines are based on current understanding of ergonomic good practice and on existing design guidelines and standards and give a synthesis of current knowledge.

The document presents both generic principles and objective and measurable solutions on the following design issues:

- description of the design process and how to include system assessment
- documentation and user instructions to be provided with the system
- system installation, including compatibility with other systems and integrative aspects
- controls, visual displays and auditory information
- information presentation and dialogue issues, including setting to individual preferences
- general safety aspects of IVIS, e.g. driver distraction, risk compensation by behavioural adaptation, system fault, accurate and timely information

Additional information on the legal situation and type approval with regard to IVIS, focusing on the United Kingdom, is given in the last chapter. From the liability perspective this information is not only addressed to OEM but also to aftermarket suppliers.

While this document primarily deals with design concerns it refers to the TRL safety checklist for the assessment of IVIS (see chapter 3.1.9) and gives some additional information how to integrate assessment as a continuous issue of the design process.

3.1.7 Guideline for in-vehicle display systems (JAMA)

The scope of these guidelines (Japan Automobile Manufactures Association, 2000) are in-vehicle display systems which are installed in cars and visible to the driver. The guidelines provide some ergonomic and safety related issues which are voluntary in Japan but followed by all OEMs and sometimes by aftermarket suppliers. Some aspects are particular to Japan.

The recommendations take up the following aspects:
- display location
- display requirements while the vehicle is in motion
- operational requirements while the vehicle is in motion
- software provided by third parties

The guideline applies to systems designated by the OEM, whether installed by the OEM or by dealers. It is limited to passenger cars with ten or fewer occupants.

3.1.8 ADAS QuickCheck (ADVISORS)

ADAS QuickCheck (ADVISORS, 2002) is a checklist for experts assessing the HMI of ADAS. It has been worked out within the EU-project ADVISORS. ADAS QuickCheck is mainly based on the AutoErgo ergonomic checklist for the driver's place inside cars and takes the "European Statement of Principles on Human Machine Interface for In-Vehicle Informartion and Communicartion Systems" (...) into account.

It includes anthropometrical, biomechanical and perceptive/cognitive aspects. The checklist consists of 3 sections

- general criteria
- criteria related to control (input) functions
- criteria related to display (output) functions

Due to its nature as a quick check, ADAS QuickCheck includes rather high level and general items. ADAS QuickCheck does not strictly define the checking procedures. This gives flexibility to its users. However this will result in limited test-retest-reliability.

ADAS QuickCheck is intended to be used in all phases of the product lifecycle. It is applicable for system concepts, virtual prototypes, physical prototypes, products on the markets, and generic products. In some cases not all items can be answered. However there will always be hints on imminent or potential deficiencies of the systems evaluated.

3.1.9 A safety checklist for the assessment of in-vehicle information systems (TRL)

This checklist (Stevens et al., 1999) provides a structured aid to experts for the assessment of the safety related features of IVICS, especially of potential driver distraction. The technical content is based on emerging international standards and existing codes of practice, such as the European statement of principles on human machine interface (CEC, 2000).

The checklist is part of an assessment manual that contains:
- Scenario description proforma
- Detailed assessment scoring sheets
- Assessment summary table
- Supporting technical information
- References, glossary and abbreviations

It is recommended by the authors that the checklist should be completed only after reading the comprehensive supporting technical information. The supporting technical information explains how the checklist should be applied and provides the background and rationale to the assessment questions.

3.1.10 Preliminary Human Factors Guidelines for Crash Avoidance Warning Devices (NHTSA)

This document (NHTSA, 1996) contains guidelines for crash warning devices and comments got from experts in the field of ITS. The guidelines deal specifically with the design of the man machine interface.

The following topics are covered by the recommendations:

- *General guidelines* – contains generic guidelines common to all warning devices (system activation and testing; warnings and display features). The same topic is reported in more details in the succeeding sections.
- *Blind spot warning devices* – reports guidelines concerning the interface of devices supporting the driver when monitoring the lateral areas to the vehicle.
- *Backup warning devices* – refers to devices that warn the driver about the risk of backing encroachment collision;
- *Driver alertness monitoring devices* – includes guidelines about devices that warn the driver in case of driver impairment due to drowsiness or other lapses of alertness.
- *Headway warning devices* – refers to systems that alert the driver when objects are in the path of the vehicle.
- Appendices A and B contain comments on guidelines by experts in the field of In-Vehicle Highway Systems.

3.1.11 Human Factors Design Guidelines for Advanced Traveler Information Systems and Commercial Vehicle Operations (FHWA)

This handbook (Campbell et al., 1997) summarizes data, guidelines and principles for the development, design and evaluation of computer-based traveler information systems applied in commercial vehicles. It is recommended to be used by human factors experts.

The first section of the document offers an overview of information systems and functions. The other chapters provide guidelines about the following topics:

- display features (e.g. symbols, use of colour, contents)
- controls (e.g. control types, control design and coding)
- routing and navigation (information features and presentation)
- motorist services (driver convenience, communications)
- safety/warning (emergency and non-emergency information presentation)
- augmented signage information (guidance, notification and regulatory information)
- presentation of specific information for commercial vehicle operators.

A set of design tools is also provided to aid step-by-step developers in addressing the most critical design parameters. A number of 75 design parameters are taken into account. These concern mainly the use of visual/auditory information, the identification of the conditions in which specific information have to be provided, the definition of criteria for assessing the criticality and priority of in-vehicle information.

3.1.12 Checklist for theoretical assessment of advanced driver assistance systems (RESPONSE)

This document (Kopf et al., 1999) contains recommendations for system design and testing of ADAS. A checklist is provided to analyse the compatibility between system functionality, driver performance and situational demands. The checklist is addressed to systems supporting the main driving tasks (information acquisition, processing and actions). The non dedicated after-market systems are excluded.

It should be used in early system development and functional specification. The checklist is intended to support designers, HMI experts, legal advisors, marketing experts and behavioural psychologists involved in the design of ADAS.

The checklist includes two sections:
- Part A contains categories for system specification (system users; user needs; supported task; functional description; level of automation; human-machine interface; compliance to standards and traffic law; situational boundaries; system failures; product information; maintenance; price).
- Part B includes questions related to some of the above-mentioned categories (human machine interface and system layout; system comprehension; behavioural aspects; misuse; operability; interaction with traffic environment; economy).

3.2 *Standards*

3.2.1 ISO 2575: Road vehicles - Symbols for controls, indicators and tell-tales

This standard (ISO 2575:2004) provides symbols for use on controls, indicators and telltales to ensure identification and facilitate use of these devices. It applies to passenger cars, light and heavy commercial vehicles and buses. It also indicates the colours of possible optical tell-tales, which inform the driver of either correct operation or malfunctioning of the related devices.

The standard contains images of symbols for the following fields of application:
- Lighting and signalling devices
- Braking systems
- Visibility (wiper, washer, defroster, mirror adjustment)
- Cab environment and comfort
- Maintenance and load functions
- Engine
- Fuel system
- Transmission
- Power drive
- Vehicle handling and cruise control
- Active and passive safety systems
- Security
- Electric functions in general and electric road vehicles

- Information and communication

For the right application of this standard it is considered as indispensable to use ISO 15008 in parallel. A reference to further standards on symbols is given in the bibliography of ISO 2575.

ISO 2575 has relevance for type-approval because both EC directive 78/316/EEC and the planned UN/ECE regulation (UN/ECE, 2003) require symbols designed according to this standard.

3.2.2 ISO 3958: Passenger cars - Driver hand-control reach

This standard describes extensively hand-reach envelopes for passenger cars. The standard is based on experiments, where subjects had to conduct different grasping tasks within a variety of simulated vehicle configurations. Therefore the standard applies to three-finger grasping reach to a knob and other types of forward controls. The given characteristic data are applicable for both left-hand-drive vehicles and right-hand-drive vehicles. A procedure for using hand-reach envelopes and 42 tables of restrained and unrestrained hand-reach envelopes are described.

3.2.3 ISO 4040: Road vehicles - Location of hand controls, indicators and tell-tales in motor vehicles

Since there is an increasing opportunity for drivers to change between different vehicles the objective of this standard is to standardize control locations in order to increase safe operations.

The space that is in reach of the driver is subdivided into specific zones. Specific controls that are essential to safe driving, are assigned to these zones. Furthermore the standard also deals with the combination of functions and tell-tales. The three main zones that are accurately defined are located on and around the steering wheel. Specific requirements for the location of controls are given with respect to these three zones. As an example headlamp beam switching, headlamp optical warning and turn signal direction indicator shall be located in the zone on the left side of the steering wheel.

3.2.4 ISO 4513: Road vehicles – Visibility: Method for establishment of eyellipses for driver’s eye location

The purpose of this standard is to specify a method for establishing an eyellipse for locating the driver’s eyes in order to determine the driver’s field of view. Eyellipse models for two and three dimensions are used to represent 95^{th} and 99^{th} percentiles of driver’s eye locations. The standard applies to both passenger cars and busses (as well as to heavy trucks). Different procedures for these vehicle types are presented. In Annex A of the standard the development of the eyellipse is described. Annex B of the standard provides 2-D eyellipse templates.

3.2.5 ISO 7731: Ergonomics - Danger signals for public and work areas: Auditory danger signals

This final draft standard specifies the physical principles of design, ergonomic requirements and the corresponding test methods for danger signals for public and work areas. It may also be applied to other appropriate situations. Furthermore it gives guidelines for the design of the signals.

It does not apply to verbal danger warnings (e.g. shouts, loudspeaker announcements) which are covered by ISO 9921. Special regulations such as those for public transport are not affected by this standard.

Definitions are given to clarify the difference between an auditory emergency signal, auditory emergency evacuation signal and an auditory warning signal.

3.2.6 ISO 9241: Ergonomic requirements for office work with visual display terminals (VDTs)

ISO 9241 deals with the definition and evaluation of usability mainly related to visual display terminals used for office work. In particular, the standard offers a guide for defining ergonomic requirements, developing visual displays and software products, and evaluating usability of software products. It consists of 17 parts available as separate documents.

The standard covers relevant aspects of usability, related to hardware, software and usability processes. Detailed requirements can be found for the following topics:

- task design
- visual display design (performance specifications)
- keyboards and other input devices (e.g. mice, joysticks, touch screen)
- workstation design
- work environment
- screen reflections
- use of colours
- dialogue principles
- presentation of information (organisation, graphical objects and coding techniques)
- user guidance (advice, prompts, feedback, status information, error and on-line help)
- menus (structure, navigation, selection and presentation)
- command line interfaces
- direct manipulation interfaces
- form filling interfaces.

A section is dedicated to usability definition and provides guidelines for measuring usability of products and for planning and executing of usability evaluations. Usability is specified in measurable attributes related to effectiveness, efficiency and satisfaction.

3.2.7 ISO 9921: Ergonomics - Assessment of speech communication

This final draft standard specifies the ergonomic requirements for the performance of speech communication for verbal alert and danger signals, information messages, and speech communication in general. Methods to predict and to assess the subjective and objective performance in different applications are described and examples are given.

The quality of speech communication is assessed for the following cases:
- warning of hazard,
- warning of danger,
- information messages for work places, public areas, meeting rooms, and auditoria

In order to obtain optimal performance in a specific application, three stages can be considered:
- specification of the application and definition of the corresponding performance criteria;
- design of a communication system and prediction of the performance;
- assessment of the performance for in-situ conditions.

The use of auditory warning signals other than speech and messaging is not included in this standard but is covered by ISO 7731.

3.2.8 ISO 11429: Ergonomics - System of auditory and visual danger and information signals

This standard specifies a system of alarm, warning and information signals taking into account the different degrees of urgency. It is applicable to all danger and information signals which have to be clearly perceived and differentiated, even though it is focused on machine safety. In those cases where visual signals are complemented by auditory signals, the recommended characteristics of both signals are given.

3.2.9 ISO 13407: Human centred design processes for interactive systems

This generic standard describes the human centred design approach throughout the life cycle of interactive systems. It can be applied to a wide range of computer-based interactive systems.

The following principles of human centred design are discussed in details:
- active involvement of customers
- appropriate allocation of function
- iteration of design solutions
- multi-disciplinary design

The human centred design approach recommends four basic steps that have to be carried out starting from early stages of the development process to the final ones:
- understand and specify the context of use, including users, tasks and environment aspects
- specify the user and organisational requirements, related to business, technical and legal issues
- produce design solutions through use of existing knowledge to produce design proposals, development of models and simulations, and testing of design solutions with real users
- evaluate designs against requirements.

3.2.10 ISO 15005: Road vehicles - Ergonomic aspects of transport information and control systems: Dialogue management principles and compliance procedures

This standard deals with the ergonomic design of TICS by providing principles for dialogue design. The objective of the standard is to reduce driver workload and ensure effective and efficient use of TICS while driving. The standard does not provide recommendations for TICS without dialogues or TICS malfunctions or other displays and controls that are not related to TICS.

For the following principles the document provides requirements and examples:

- Appropriate for use while driving
  - compatibility with driving
  - simplicity
  - timing/priorities
- Appropriate for the TICS task
  - consistency
  - controllability
- Appropriate for the driver
  - self-descriptiveness
  - conformity with driver expectations
  - error tolerance

For example a requirement and an example for the compatibility principle is that a TICS dialogue shall not require the removal of both hands from the steering wheel. Therefore, such systems will not be designed for use while driving.

It is recommended by ISO 17287 to pay attention to ISO 15005 when assessing suitability for use while driving

3.2.11 ISO/DIS 15006: Road vehicles - Ergonomic aspects of transport information and control systems: Specifications and compliance procedures for in-vehicle auditory presentation

This draft standard focuses on TICS applications and provides ergonomic specifications for the design and installation of auditory displays presenting speech and tonal information while driving. By using auditory and speech information the visual workload of the driver can be reduced. The aim of these specifications is to help designers to meet usability, comfort and safety criteria when designing auditory presentation.

Specifications are provided for

- message characteristics,
- message intelligibility,
- utility,
- prevention of auditory or mental overload.

3.2.12 ISO 15007-1: Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 1: Definitions and parameters

This standard defines key terms and parameters for the assessment of impact on driver visual behaviour when using TICS or operating on other on-board systems during driving.

3.2.13 ISO/TS 15007-2: Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 2: Equipment and procedures

ISO/TS 15007-2 supports ISO 15007-1 in a more technical sense. It is a technical specification which provides information on the setup and execution of experiments. The specifications how to measure driver visual behaviour can be used in practical TICS evaluation.

It gives recommendations on how to
- plan evaluation trials,
- specify (and install) data capture equipment, and
- analyse, interpret and report visual-behaviour metrics (standards of measurement).

This technical specification is applicable to both road trials and simulator experiments. It is not applicable to the assessment of head-up displays.

3.2.14 ISO 15008: Road vehicles - Ergonomic aspects of transport information and control systems: Specifications and compliance procedures for in-vehicle visual presentation

This standard provides ergonomical specifications for displays of in-vehicle systems. The recommendations do not depend on the display technology applied with the system.

The standard covers design aspects such as image quality, legibility of characters and color recognition for displays that contain dynamic visual information. The standard is not intended to cover superimposed information on the external field (e.g. head-up displays), pictorial images, maps (like available in navigation systems) and static information (control labels).

In the appendix a daylight contrast measurement method, a sunlight contrast measurement technique and instructions for measuring character dimensions are given. The document also gives recommendations which color combinations are useful for information presentation and how to deal with image stability and blinking.

3.2.15 ISO 15622: Adaptive cruise control systems

ISO 15622:2002 specifies the basic control strategy, minimum functionality requirements, basic driver interface elements, minimum requirements for diagnostics and reaction to failure, and performance test procedures for ACC systems. ACC is fundamentally intended to provide

longitudinal control of equipped vehicles while travelling on highways under free-flowing traffic conditions. ACC may be augmented with other capabilities, such as forward obstacle warning.

3.2.16 ISO 15623: Forward vehicle collision warning system

This standard specifies performance requirements and test procedures for systems capable of warning the driver of short inter-vehicle distance and closing speed which may cause a rear-end collision with other vehicles, including motor cycles, ahead of the subject vehicle while it is operating at ordinary speed. ISO 15623:2002 is applicable to operations on roads with curve radii over 125 m as well as higher radius curves.

3.2.17 ISO/CD TR 16352: Road vehicles - Ergonomic aspects of in-vehicle presentation for transport information and control systems: Warning systems

This document contains the draft version of a non-normative ISO technical report. The scope of this report is to survey literature about warning systems. It includes experimental experiences about the efficiency and acceptance of different modalities and combinations of warnings, the design of the sensorial, code and organisational parameters of visual, auditory and tactile warnings, as well as concluding recommendations.

The document covers the following aspects:

- General discussion of warning signals and definitions; alarm theories
- Basic psychological and physiological aspects of warnings in vehicles; behavioural aspects
- Sensorial modalities and their importance
- Visual warning displays and related sensorial parameters; symbols, icons and text; coding and organisational features (colour, blinking, structures, etc.)
- Auditory warning displays. Basic differences and the respective benefits of tonal signals, auditory icons and speech output
- Tactile warning displays
- Aspects of redundant presentation of warnings; experimental results (combinations visual/auditory, visual/auditory/tactile); master alertings; transfer from the avionic environment into the automobile environment; graded sequence of warnings
- Experimental results on different warning types, codes and modalities; benefits of visual, auditory and tactile warnings depending on content (objects, spatial relations or abstract information; verbal or non-verbal transmission)
- Recent experimental results on different assistance systems (distance warning systems, side obstacle warning systems) and discussion of system characteristics
- Warning systems in other domains (esp. Avionics) are described and discussed (time criticality, information overload)

3.2.18 ISO/CD 16673: Occlusion method to assess visual distraction due to the use of in-vehicle information and communication systems

This working paper is in the status of a committee draft in July 2004. For the assessment of TICS concerning visual distraction the standard shall provide an easy-to-use and cheap method for measuring visual demands and aspects of interruptability.

The method should be used for the assessment of applications that include visual or visual-manual interfaces and which are accessible to the driver while the vehicle is in motion. It applies to both OEM and after-market in-vehicle systems, whether they are permanently installed or portable.

The recommended procedure does not depend on a specific type of implementation of occlusion method. In the sense of the standard occlusion means intermittent vision to a display with the interrupting interface operated by the subject. Various means are possible to achieve intermittent vision, e.g. occlusion goggles, display blanking, shutter between subject and display. During the occlusion intervals, neither displays nor controls shall be visible, but operation of the controls is allowed (though most input will occur when vision is available). Thus the method allows to simulate driver´s looking at the road but continuing to operate on the in-vehicle system via manual controls.

The experiments can be devided into three main types:
- glance time measurements which are generally difficult and very costly to measure
- interruptabilty of a task using intermittent viewing to the in-vehicle system
- system operability without excessive use of long duration glances.

The method can be applied as soon as an interactive prototype of the driver interface exists and does not require extensive resources.

3.2.19 ISO/TS 16951: Road vehicles - Ergonomic aspects of transport information and control systems: Procedures for determining priority of on-board messages presented to drivers

In this technical specification a prioritization scheme for different kinds of messages is provided. In case of simultaneous or overlapping messages the method allows to determine which message should be given priority. The standard covers system initiated messages as well as driver requested messages and is appropriate to OEM systems and after-market add-on TICS.

To achieve prioritization among messages a priority index has to be calculated that combines criticality and urgency of each specific message. Subjective ratings from experts for criticality (4 levels) and urgency (4 levels) are collected and integrated by ranking. Urgency is defined as the time within which a driver action has to occur to benefit from a message. Criticality is defined as severity of the worst possible accident or malfunction that may occur if the driver ignores the message.

Examples on how to evaluate as well as a recommendations for the number of evaluators are given.

3.2.20 ISO 17287: Road vehicles – Ergonomic aspects of transport information and control systems: Procedure for assessing suitability for use while driving

This standard (ISO 17287:2003) aims at assisting the manufacturers and ergonomic experts when evaluating the fitness for purpose of transport information and communication systems (TICS). It is meant for systems which are to help the driver performing the primary driving task and thus are used during driving. The standard can be used for any type of vehicle, any type and any complexity of TICS, both for simple and high integrated systems.

It provides recommendations on the
- user-oriented description of TICS and of the field of application, including improper use, reasonably foreseeable misuse and system faults,
- analysis of tasks for which the TICS is used,
- evaluation process and
- documentation of analysis and the evaluation results.

The standard contains no recommendation on specific criteria but provides information on how to identify relevant aspects of fitness for purpose and how to derive criteria out of them. Besides some examples the annexes give an overview on methods which can be used for measuring and evaluation of workload, performance of the primary task, driver behaviour and usability.

For the right application of this standard it is recommended to use ISO 15005 and ISO 15008, too.

3.2.21 ISO PWI MMI: Road Vehicles - Ergonomic aspects of transport information and control systems: Simulated lane change test to assess driver distraction

This ISO document proposes a simple laboratory method to measure driver distraction. It is in the status of a preliminary work item (PWI) in July 2004. Driver distraction is defined as drawing attentional resources away from the primary driving task to a secondary task. The rationale of this PWI is to measure driver distraction by a simple driving simulation that requires the subject to perform lane-change maneuvers according to specific road-signs. Subjects are told to maintain a constant speed and to change lanes as soon as road signs appear. Driver distraction is measured by comparing performance in lane keeping between a baseline condition and a condition with a secondary task.

The PWI covers details of the simulated driving scenario, measurement procedures, a proposed experimental plan and how results shall be processed. The method is cheap and simple and does not require sophisticated and expansive equipment. It is applicable to manual, visual and auditory tasks and their combinations.

3.2.22 Human Factors Design Standard (FAA)

This document (Ahlstrom and Longo, 2003) contains the Human Factors Design Standard (HFDS) which replaces and expands upon the FAA Human Factors Design Guide (HFDG) published in 1996 and all HFDG chapter updates. The HFDS broadens the focus to include both air traffic and airway facilities systems and has been modified into a set of standards instead of a set of guidelines, providing a common source of FAA-specific design requirements. The resulting set of standards can be tailored to meet the needs of the system or program at hand.

The HFDS is an an exhaustive compilation of human factors practices and principles integral to the procurement, design, development, and testing of FAA systems, facilities, and equipment. The purpose of the HFDS is to provide a single easy-to-use source of human factors design criteria, oriented to the needs of the FAA mission and systems. An additional goal is to facilitate use of appropriate design criteria by organizing the document so that users can easily locate the needed information.

It covers a broad range of human factors topics that pertain to input devices, automation, maintenance, controls, computer-human interface, workplace design, documentation, system security, safety, the environment, anthropometry, alarms, audio, and voice.

Many of the topics covered are also relevant for road vehicle design, e.g. recommendations on computer-human interface in chapter 8. The main focus is on computer-human interface software and screen elements. Covered aspects are screen design, text entry and display, graphical information, concealed information, dynamic information update, coding and colour, interaction and interactive techniques, user-initiated interrupts, selection methods, controls, windows, system operations, help, data communication, accommodating people with disabilities.

3.2.23 AMI-C 4002: Requirements and specifications for human machine interfaces

This technical specification describes the AMI-C's HMI strategy for presenting user interface information to a specified type of displays or controls and in a form that is controlled by vehicle manufacturer. The AMI-C architecture permits any AMI-C compatible vehicle to add any AMI-C compliant multi-media device at any time throughout it's life. The HMI strategy uses a content-based approach with a HMI manager, an AMI-C XML schema and HMI API's.

The HMI manager is the central mechanism between the displays/controls and AMI-C devices. It is used to control the look-and-feel of the user interface. It is implemented by the car manufacturer to translate device content into a form best suited for controls and display characteristics of the intended vehicle. There is no restriction as to the physical location of the HMI manager, but vehicle displays and controls shall be under the direct control of the HMI manager. The XML schema defines messages that flow between an AMI-C device and the HMI manager. The AMI-C API's are implemented in an AMI-C host as interfaces by which applications in the host communicate with the HMI manager. The specification also contains a principle mechanism for the priorization of the messages which is included in the XML-messages.

AMI-C developed two sets of HMI specifications: the XML schema as a network-agnostic HMI protocol for AMI-C networks and HMI API's for AMI-C host platforms. The details of the XML-schema are included in the mentioned document including general purpose messages and navigation-specific messages. The details of API's are included in AMI-C 5001.

4.2.24 DOT/FAA/AM-01/17: Human Factors Design Guidelines for Multifunction Displays

This document covers an introduction to displays in general as well as human factors guidelines from research but most importantly the document contains MIL- and Aviation-Standards. As these standards serve as valuable source for many automotive standards they appear as reference in some of the other cited documents (cf. ISO/CD TR 163529).
The given document (Human Factors Design Giudelines for Multifunction Displays (DOT) 2001) presents a commented survey on relevant MIL-Standards on information presentation together with samples of each guideline. For example MIL-STD-1787B (1996) describes symbols, symbol formats and information content for aircrew members with respect to e.g. take-off and navigation. A sample Guideline from this standard asks for consistency of map orientation or under control of the user. The reader may notice that the domain handled by MIL-Standards is different regarding the user and equipment, but basic ergonomic requirements may also be respected by an automotive application. Examples of the documentsDocuments covered by the document are

3.3 *Regulations and directives concerning type approval in Europe*

In Europe currently two systems of type approval exist:

- the EC Whole Vehicle Type Approval (WVTA) system is based on directives of the EC and provides for the approval of whole vehicles, vehicle systems, and separate components within the European Community, and
- the global regulations based on the Revised 1958 Agreement of the United Nations Economic Commission for Europe (UN/ECE) provide for approval of vehicle systems and separate components, but not for vehicles as a whole.

The European Community is a contracting party to the UN-ECE Agreement and there are close parallels between both types of type approval. Over 45 of the UN-ECE regulations are equivalent to EC directives. Therefore type approval conformity to an EC directive is considered equivalent to the corresponding UN-ECE regulation. A list of corresponding directives/regulations is enclosed in the council directive 70/156/EEC.

3.3.1 78/316/EEC, 93/91/EEC, 94/53/EC: Interior fittings of motor vehicles (identification of controls, tell-tales and indicators)

These directives relate to the interior fittings of motor vehicles and provide requirements for symbols which have to be used for the identification of controls, tell-tales and indicators. The Council Directive 78/316/EEC has been adapted to technical progress by Commission Directive 93/91/EEC which has been amended by Commission Directive 94/53/EC.

Requirements relevant for HMI design are covered in the following annexes of the directives:

- Annex I: scope, definitions (control, tell-tales, indicators, information display device)
- Annex II: mandatory identification and corresponding symbols to be used
- Annex III: optional identification and corresponding symbols to be used
- Annex IV: basic pattern of the symbols

The symbols mentioned in the annexes must be designed according to ISO 2575. In connection with information display devices some requirements regarding aspects of function integration are provided.

UN/ECE is working on an equivalent regulation (UN/ECE, 2003).

3.3.2 74/60/EEC, 78/632/EEC, 2000/4/EC: Interior fittings of motor vehicles

These directives harmonise the provisions on the interior fittings of motor vehicles to reduce the risk or the severity of injuries in case of frontal head impact. The Council Directive 74/60/EEC has been adapted to technical progress and amended by Commission Directive 78/632/EEC and by Parliament and Council Directive 94/53/EC.

Among other interior parts “Interior fittings” apply also to control handles, levers and knobs. Specifications on the layout and the arrangement of controls are made. For example, the annexes specify that forward interior parts within a defined reference zone of the passenger compartment must not contain any dangerous roughness or sharp edges likely to increase the risk of serious injury to the occupants.

The equivalent UN/ECE regulation is Regulation No. 21 – Uniform provisions concerning the approval of vehicles with regard to their interior fittings (UN/ECE, 1993).

3.3.3 2003/97/EC: Mirrors and supplementary systems for indirect vision

The objective of this directive is to propose measures aimed at reducing accidents caused by the blind spots around vehicles, and to improve the safety of the more vulnerable road users. Mainly larger vehicles such as trucks or buses are to use more effective mirrors and new technology to help improve the field of indirect vision, e.g. camera-monitors.

The annexes contain requirements concerning the design and the fitting of the devices, e.g. adjustability, dimensions, reflecting surface. With effect from January 2005 type-approval of devices for indirect vision is possible if the devices comply with the requirements of this directive.

It is intended by the commission to initiate the aligning of 2003/97/EC and UN/ECE Regulation No. 46.

4 Discussion and conclusions

This report gives a review of available guidelines and standards which are relevant to HMI development of IVIS and ADAS. It provides an overview on documents covering the scope of HMI in the fields of design and message prioritisation, evaluation and assessment, and development process. With regard to the objectives of the AIDE project the results of this report can be used for the development of a generic evaluation method of HMI (SP2) and the design and evaluation of ADAS with adaptive and integrative HMI implemented (SP3). The following documents have been rated with high importance for AIDE (see also table in the annex):

- A European Statement of Principles on Human Interface (CEC, 2000)
- Statement of principles, criteria and verification procedures on driver interactions with advanced in-vehicle information and communication systems (AAM, 2003)
- ISO 15005. Road vehicles - Ergonomic aspects of transport information and control systems: Dialogue management principles and compliance procedures
- ISO 15007-1. Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 1: Definitions and parameters.
- ISO/TS 15007-2. Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 2: Equipment and procedures.
- ISO 15008. Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and compliance procedures for in-vehicle visual presentation.
- ISO/CD 16673: Occlusion method to assess visual distraction due to the use of in-vehicle information and communication systems.
- ISO 17287. Road vehicles - Ergonomic aspects of transport information and control systems: Procedure for assessing suitability for use while driving.
- ISO PWI MMI. Road Vehicles - Ergonomic aspects of transport information and control systems: Simulated lane change test to assess driver distraction.
- AMI-C 4002: Requirements and specifications for human machine interfaces.

Most of the guidelines and standards which have been reviewed are focused to HMI design. Documents containing principles present basic requirements, whereas documents containing more detailed specifications are meant for direct use by the designer. Design requirements on controls, visual displays, auditory output devices, dialogue management of existing IVIS are well covered by recommendations found in the documents.

The amount of guidelines providing recommendations on methods and criteria which can be used for the evaluation, is much lower than the number of design guidelines. Furthermore, guidelines presenting design principles generally provide no information on how to check the compliance with the recommendations. A helpful approach how to connect design principles and appropriate tests principles to check the compliance may be one which is similar to that given in the AAM guidelines (AAM, 2003). But this document provides no further information on evaluation methods. On the other hand, there is another type of evaluation guidelines aimed to describe a single method, but give only little information on the whole evaluation process, e.g. draft standard on occlusion method (ISO/CD 16673). A very helpful overview of some common assessment methods and criteria is presented in ISO 17287:2003. It describes an approach which proposes to identify and analyse the context of use in a first step, i.e. tasks for which the IVIS or ADAS should be used while driving. This standard is to be applied in the case, that devices of several manufacturers are available and a comparison of

those devices has to be made. It is not recommended as a generic evaluation methodology for the whole development process, especially not for the early stages of the process. In ISO 13407:1999 a generic standard for user-centred design applicable to a wide range of computer-based interactive systems is provided. It may serve as a basis for the development of a generic evaluation methodology for adaptive integrated HMI in road vehicles.
Summarizing the information gained from the reviewed documents concering evaluation, it seems that more detailed information and guidelines are needed
(1) as an overview on suitable assessment methods and, based on generally accepted quality factors, how to select the adequate method with regard to the various stages of the development process
(2) describing accepted experimental assessment methods, presenting new tools and methods and detailling how to use them
(3) providing a generic evaluation methodology including how to interprete results to come to an overall conclusion when several methods have been bundled to a battery of tools and methods.

To identify the needs of further guidelines in terms of new and further technologies it is of interest whether the reviewed documents also meet the key features of IVIS and ADAS as addressed in the AIDE workplan, i.e. adaptivity, integration of functions and systems, nomad devices.

Adaptivity
Some recommendations are given on adaptivity, e.g. recommendation to enable setting to individual preferences (TRL, 2002).
Problems that may arise with automatically adapting devices and nomad devices are currently not adressed in a sufficient manner. On the other hand important input for standardization and guidelines is missing and should be available after AIDE.

Integration
Integration aspects are covered within many of the guidelines and questions of message priorisation are dealt within ISO WG8. In the future recommendations on dialogue management could be provided more detailed and updated to meet the requirements for all types of information and modalities handled by an AIDE system,

Nomad Devices
Only few recommendations could be found to discuss one of the basic problems of nomad devices, i.e. aftermarket devices may be retrofitted by the user, thus creating an unfavourable combination of single devices which do not match the HMI design recommendations (Gail et al., 2002). This may have negative consequences to the safety of the system as a whole, even though the single devices comply with the recommendations. Also the link between vehicle and device (e.g. speed signal) is not adressed by the documents specifically for nomad devices but in general for integrated systems.

Improper use
Some design principles on improper use of IVIS and ADAS, i.e. misuse unintended by the user and abuse intended by the user, are presented in the documents, e.g. in connection with risk compensation by behavioural adaptation (TRL, 2002), principles refering to information about the system (AAM, 2003) or as a requirement for evaluation (ISO 17287:2003). But with the exception of instructions or warning labels, detailled recommendations on strategies how to avoid improper use are lacking. Reasons for that may be both insufficient research findings

on those aspects and an increasing amount of possibilities for misuse of new devices with new functions unknown so far.

To identify the potential of improper use some methodes are available, e.g. usability test, worst-case-scenarios, FMEA (Gail et al., 2002). But there are only little recommendations on the selection of the appropriate method refering to system, functions or development process (AAM, 2003; ISO 17287:2003). Moreover, for some of the methods only weak information on the evaluation criteria is available.

General

Most of the guidelines deal with many HMI aspects in general and thus cover a broad scope of devices and functions. But these general guidelines often repeat well known traditional knowledge on HMI design and do not fully apply to specific new devices. To meet the specific requirements of the new systems and functions the question arises, whether it would be useful to have more system-specific or function-specific guidelines in addition to the general guidelines. This approach is covered by some ISO standards which contain recommendations on specific types of ADAS, e.g. ISO 15622 (adaptive cruise control) and ISO 15632 (forward vehicle collision warning system), and by the UMTRI guidelines (Green et al., 1993), e.g. navigation input guidelines, car phone guidelines.

But it has to be avoided that detailled specifications which are not scientifically justified enter the field of binding regulations and thus obstruct the development and employment of better solutions which can be expected with rapid appearance of new technologies. Detailled specification should enter regulations not until tests have shown that safety may be decreased by the system function. On the other hand, a high number of system-specific guidelines might lead to contradictions between single documents. Thus a suitable ratio has to be kept between system-specific and general documents.

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ISO 15007-1:2002. *Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 1: Definitions and parameters.* International standard, International Organization for Standardization.

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ISO 15008:2003. *Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and compliance procedures for in-vehicle visual presentation.* International standard, International Organization for Standardization.

ISO 15622:2002. *Transport information and control systems - Adaptive Cruise Control systems - Performance requirements and test procedures.* International standard, International Organization for Standardization.

ISO 15623:2002. *Transport information and control systems - Forward vehicle collision warning systems - Performance requirements and test procedures.* International standard, International Organization for Standardization.

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ISO/CD 16673. *Road vehicles - Ergonomic aspects of transport information and control systems: Occlusion method to assess visual distraction due to the use of in-vehicle information and communication systems.* Committee draft standard, International Organization for Standardization.

ISO/TS 16951: 2004. *Road vehicles - Ergonomic aspects of transport information and control systems: Procedures for determining priority of on-board messages presented to drivers.* Technical specification, International Organization for Standardization.

ISO 17287:2003. *Road vehicles - Ergonomic aspects of transport information and control systems - Procedure for assessing suitability for use while driving*. International standard, International Organization for Standardization.

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United Nations Economic Commission for Europe (2003). *Proposal to develop a global technical regulation concerning uniform provisions for location and identification of motor vehicle hand controls, tell-tales and indicators.* Working document, TRANS/WP.29/AC.3/2, 10 April 2003. http://www.unece.org/trans/doc/2003/wp29/TRANS-WP29-AC3-02e.doc

Annex: Overview of existing guidelines and standards

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
A European Statement of Principles on Human Interface (CEC)	Commission of the European Communities (2000). Annex to Commission Recommendation of 21 December 1999 on safe and efficient in-vehicle information and communication systems: A European statement of principles on human machine interface. Official Journal of the European Communities L19, 25.1.2000, p. 64 ff, Brussels, Belgium: European Union.	recommendation	HMI design and message prioritisation	high	public	Official Journal of the European Communities L19, p. 64 ff, 25.1.2000	pdf	chapter 3.1.1
Guidelines for the design and installation of information and communication systems in motor vehicles (UN/ECE)	UN/ECE (1998). Annex 16 to consolitated resolution on the construction of vehicles (R. E. 3): Guidelines for the design and installation of information and communication systems in motor vehicles. UNECE TRANS/WP.29/78/Rev.1/Amend.1, 3 September 1998	recommendation	HMI design and message prioritisation	medium	public	http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29re3.html	pdf	chapter 3.1.2
Suggested human factors design guidelines for driver information systems (UMTRI)	Green, P., Levison, W., Paelke, G., and Serafin, C. (1993). Preliminary Human Factors Guidelines for Driver Information Systems (Technical Report UMTRI-93-21), Ann Arbor, MI: The University of Michigan Transportation Research Institute (also published as FHWA-RD-94-087, McLean, VA: U.S. Department of Transportation, Federal Highway Administration, December, 1995).	recommendation	HMI design and message prioritisation	medium	public	http://www.umich.edu/~driving/guidelines.html	pdf	chapter 3.1.3

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
Statement of principles, criteria and verification procedures on driver interactions with advanced in-vehicle information and communication systems (AAM)	Alliance of Automobile Manufacturers (2003). Statement of Principles, Criteria and Verification Procedures on Driver Interactions with Advanced In-Vehicle Information and Communication Systems, version 3. Washington, D.C., USA: Alliance of Automobile Manufacturers.	recommendation	HMI design and message prioritisation; HMI evaluation and assessment	high	public	http://www.umich.edu/~driving/guidelines.html	pdf	chapter 3.1.4
Human Factors Guidelines for Information Presentation by ATT Systems (HARDIE)	Ross, T.; Midtland, K.; Fuchs, M.; Pauzie, A.; Engert, A.; Duncan, B.; Vaughan, G.; Vernet, M.; Peters, H.; Burnett, G. and May, A (1996). HARDIE Design Guidelines Handbook: Human Factors Guidelins for Information Presentation by ATT Systems. Deliverable No. 20, HARDIE project, EC programme "Telematics Systems in the Area of Transport (DRIVE II), V2008.	recommendation	HMI design and message prioritisation	medium	public	http://www.umich.edu/~driving/guidelines.html	pdf	chapter 3.1.5
Design guidelines for safety of in-vehicle information systems (TRL)	Stevens, A.; Quimby, A.; Board, A.; Kersloot, T. and Burns, P. (2002). Design guidelines for safety of in-vehicle information systems. (Project report PA3721/01), Crowthorne, UK: Transport Research Laboratory.	recommendation	HMI design and message prioritisation HMI evaluation and assessment HMI development process	medium	public			chapter 3.1.6
Guideline for in-vehicle display systems (JAMA)	Japan Automobile Manufactures Association (2000). Guideline for in-vehicle display systems - Version 2.1. English version, Dec.13, 2000.	recommendation	HMI design and message prioritisation	medium	public	http://www.umich.edu/~driving/guidelines.html	pdf	chapter 3.1.7

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ADAS QuickCheck (ADVISORS)	ADVISORS (2002). An integrated methodology and pilot evaluation results. Deliverable D 4/5.2 v8, ADVISORS project, EC programme „Competitive and Sustainable Growth“, GRD 1-2000-10047.	recommendation	HMI evaluation and assessment	medium	public	http://www.advisors.iao.fhg.de/	web	chapter 3.1.8
A safety checklist for the assessment of in-vehicle information systems (TRL)	Stevens, A.; Board, A.; Allen, P. and Quimby, A. (1999). A safety checklist for the assessment of in-vehicle information systems: Scoring Proforma (Project report PA3536/99), Crowthorne, UK: Transport Research Laboratory.	recommendation	HMI evaluation and assessment	medium	public	http://www.umich.edu/~driving/guidelines.html	pdf	chapter 3.1.9
Preliminary Human Factors Guidelines for Crash Avoidance Warning Devices (NHTSA)	National Highway Traffic Safety Administration (1996). Preliminary Human Factors Guidelines for Crash Avoidance Warning Devices. Project No. DTNH22-91-C-07004	recommendation	HMI design and message prioritisation	medium	public			chapter 3.1.10
Human Factors Design Guidelines for Advanced Traveler Information Systems and Commercial Vehicle Operations (FHWA)	Campbell, J.L., Carney, C., and Kantowitz, B.H. (1997). Human Factors Design Guidelines for Advanced Traveler Information Systems (ATIS) and Commercial Vehicle Operations (CVO) (Technical Report FHWA-RD-98-057), Washington, D.C., USA: U.S. Department of Transportation, Federal Highway Administration.	recommendation	HMI design and message prioritisation	medium	public	http://www.umich.edu/~driving/guidelines.html http://www.itsdocs.fhwa.dot.gov/edldocs/7424/index.html	web	chapter 3.1.11

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
Checklist for theoretical assessment of advanced driver assistance systems (RESPONSE)	Kopf, M.; Allen, P.; Becker, S.; Cieler, S.; Dilger, E.; Krautter, W. (1999): Checklist for theoretical assessment of advanced driver assistance systems - Methods, results and assessment of applicability. EU-project RESPONSE, contract no. TR 4022, Deliverable No. D4.2	recommendation	HMI evaluation and assessment	medium	public	http://docs.adase2.net/response/	pdf	chapter 3.1.12
ISO 2575: Road vehicles - Symbols for controls, indicators and tell-tales	International Standardization Organization (ISO)	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.1
ISO 3958: Passenger cars - Driver hand-control reach	ISO	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.2
ISO 4040: Road vehicles - Location of hand controls, indicators and tell-tales in motor vehicles	ISO	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.3
ISO 4513: Road vehicles – Visibility: Method for establishment of eyellipses for driver's eye location	ISO	international standard	HMI evaluation and assessment	medium	public with costs			chapter 3.2.4

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ISO 7731: Ergonomics - Danger signals for public and work areas: Auditory danger signals	ISO	draft international standard	HMI design and message prioritisation; HMI evaluation and assessment	medium	public with costs			chapter 3.2.5
ISO 9241: Ergonomic requirements for office work with visual display terminals (VDTs)	ISO	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.6
ISO 9921: Ergonomics - Assessment of speech communication	ISO	draft international standard	HMI design and message prioritisation; HMI evaluation and assessment	medium	public with costs			chapter 3.2.7
ISO 11429: Ergonomics - System of auditory and visual danger and information signals	ISO	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.8
ISO 13407: Human centred design processes for interactive systems	ISO	international standard	HMI development	medium	public with costs			chapter 3.2.9

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ISO 15005: Road vehicles - Ergonomic aspects of transport information and control systems: Dialogue management principles and compliance procedures	ISO	international standard	HMI design and message prioritisation	high	public with costs			chapter 3.2.10
ISO/DIS 15006: Road vehicles - Ergonomic aspects of transport information and control systems: Specifications and compliance procedures for in-vehicle auditory presentation	ISO	draft international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.11
ISO 15007-1: Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 1: Definitions and parameters	ISO	international standard	HMI evaluation and assessment	high	public with costs			chapter 3.2.12

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ISO 15007-2: Road vehicles - Measurement of driver visual behaviour with respect to transport information and control systems - Part 2: Equipment and procedures	ISO	draft international standard	HMI evaluation and assessment	high	public with costs			chapter 3.2.13
ISO 15008: Road vehicles - Ergonomic aspects of transport information and control systems: Specifications and compliance procedures for in-vehicle visual presentation	ISO	international standard	HMI design and message prioritisation	high	public with costs			chapter 3.2.14
ISO 15622: Adaptive cruise control systems	ISO	technical specification	HMI design and message prioritisation; HMI evaluation and assessment	medium	public with costs	web	pdf	chapter 3.2.15
ISO 15623: Forward vehicle collision warning system	ISO	technical specification	HMI design and message prioritisation; HMI evaluation and assessment	medium	public with costs	web	pdf	chapter 3.2.16

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ISO/CD TR 16352: Road vehicles - Ergonomic aspects of in-vehicle presentation for transport information and control systems: Warning systems	ISO	technical specification	HMI design and message prioritisation; HMI evaluation and assessment	medium	public with costs			chapter 3.2.17
ISO/CD 16673: Occlusion method to assess visual distraction due to the use of in-vehicle information and communication systems	ISO	working paper on international standard	HMI evaluation and assessment	high	public with costs			chapter 3.2.18
ISO 16951: Road vehicles - Ergonomic aspects of transport information and control systems: Procedure for determining priority of on-board messages presented to drivers	ISO	international standard	HMI design and message prioritisation	medium	public with costs			chapter 3.2.19

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
ISO 17287: Road vehicles – Ergonomic aspects of transport information and control systems: Procedure for assessing suitability for use while driving	ISO	international standard	HMI evaluation and assessment	high	public with costs			chapter 3.2.20
ISO PWI MMI: Road Vehicles - Ergonomic aspects of transport information and control systems: Simulated lane change test to assess driver distraction	ISO	working paper on international standard	HMI evaluation and assessment	high	internal			chapter 3.2.21
Human Factors Design Standard (FAA)	Ahlstrom, V.; Longo, K. (2003). Human Factors Design Standard (HFDS) - For Acquisition of Commercial Off-The-Shelf Subsystems, Non-Developmental Items, and Developmental Systems. Report No. DOT/FAA/CT-03/05, HF-STD-001. Atlantic City, USA: U.S. Department of Transportation, Federal Aviation Administration Technical Center	recommendation	HMI design and message prioritisation	medium	public	http://www.hf.faa.gov/Portal/Default.aspx	pdf	chapter 3.2.22

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
AMI-C 4002: Requirements and specifications for human machine interfaces	Automotive Multimedia Interface Collaboration (2003). AMI-C 4002. AMI-C requirements and specifications for human machine interfaces, v1.00.	technical specification	HMI design and message prioritisation	high	public	http://www.ami-c.org/publicspecrelease.asp	pdf	chapter 3.2.23
Human Factors Design Giudelines for Multifunction Displays (DOT) 2001	DOT/FAA/AM-01/17 Offiice of Aerospace Medicine Washingtin, DC 20591	Report on directives	Information presentation (visual and acoustical)	medium	public	National Technical Information Service; Springfield, VA 22161	pdf	chapter 3.2.24
78/316/EEC: Interior fittings of motor vehicles (identification of controls, tell-tales and indicators)	Council Directive 78/316/EEC of 21 December 1977 on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (identification of controls, tell-tales and indicators).	directive (binding)	HMI design and message prioritisation	medium	public	Official Journal L 081, 28/03/1978 p. 3 - 26. http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=31978L0316&model=guichett	html	chapter 3.3.1

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
93/91/EEC: Interior fittings of motor vehicles (identification of controls, tell-tales and indicators)	Commission Directive 93/91/EEC of 29 October 1993 adapting to technical progress Council Directive 78/316/EEC relating to the interior fittings of motor vehicles (identification of controls, tell-tales and indicators).	directive (binding)	HMI design and message prioritisation	medium	public	Official Journal L 284, 19/11/1993 p. 25 - 44. http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=31993L0091&model=guichett	html	chapter 3.3.1
94/53/EC: Interior fittings of motor vehicles (identification of controls, tell-tales and indicators)	Commission Directive 94/53/EC of 15 November 1994 amending Article 2 of Commission Directive 93/91/EEC adapting to technical progress Council Directive 78/316/EEC on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (identification of controls, tell-tales and indicators). Official Journal L 299, 22/11/1994 p. 26.	directive (binding)	HMI design and message prioritisation	medium	public	http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=31994L0053&model=guichett	html	chapter 3.3.1

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
74/60/EEC: Interior fittings of motor vehicles (interior parts)	Council of the European Communities (1973). Council Directive 74/60/EEC on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (interior parts of the passenger compartment other than the interior rear-view mirrors, layout of controls, the roof or sliding roof, the backrest and rear part of the seats). Official Journal L 038 , 11/02/1974 P. 0002 - 0021	directive (binding)	HMI design and message prioritisation HMI evaluation and assessment	medium	public	http://europa.eu.int/comm/enterprise/automotive/directives/vehicles/dir74_60_cee.html http://www.unece.org/trans/main/wp29/wp29regs/r021r2e_1.pdf	html	chapter 3.3.2
78/632/EEC. Interior fittings of motor vehicles (interior parts)	Commission of the European Communities (1978). Commission Directive 78/632/EEC of 19 May 1978 adapting to technical progress Council Directive 74/60/EEC on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (interior parts of the passenger compartment other than the interior rear-view mirrors, layout of controls, the roof or opening roof, the backrest and rear part of the seats). Official Journal L 206 , 29/07/1978 P. 0026 – 0042.	directive (binding)	HMI design and message prioritisation HMI evaluation and assessment	medium	public	http://europa.eu.int/comm/enterprise/automotive/directives/vehicles/dir74_60_cee.html	html	chapter 3.3.2

Title	Source	Type / Status	HMI scope	Importance for AIDE	Availability	Access to document	Format	Comment
2000/4/EC: Interior fittings of motor vehicles (interior parts)	European Parliament and the Council of the European Union (2000). Directive 2000/4/EC of the European Parliament and of the Council of 28 February 2000 amending Council Directive 74/60/EEC on the approximation of the laws of the Member States relating to the interior fittings of motor vehicles (interior parts of the passenger compartment other than the interior rear-view mirrors, layout of controls, the roof or sliding roof, the backrest and rear part of the seats). Official Journal L 087 , 08/04/2000 P. 0022 – 0031.	directive (binding)	HMI design and message prioritisation HMI evaluation and assessment	medium	public	http://europa.eu.int/comm/enterprise/automotive/directives/vehicles/dir74_60_cee.html	pdf	chapter 3.3.2
2003/97/EC: Mirrors and supplementary systems for indirect vision	European Parliament and the Council of the European Union (2003). Directive 2003/97/EC of the European Parliament and of the Council of 10 November 2003 on the approximation of the laws of the Member States relating to the type-approval of devices for indirect vision and of vehicles equipped with these devices, amending Directive 70/156/EEC and repealing Directive 71/127/EEC (Text with EEA relevance.). Official Journal L 025 , 29/01/2004 P. 0001 – 0045.	directive (binding)	HMI design and message prioritisation	high	public	http://europa.eu.int/comm/enterprise/automotive/directives/vehicles/dir2003_97_ce_.htm	pdf	chapter 3.3.3