European Statement of Principles on the Design of Human Machine Interaction (ESoP 2005)

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EUROPEAN STATEMENT OF PRINCIPLES ON THE DESIGN OF HUMAN MACHINE INTERFACES 2005

FOREWORD

This statement of principles summarises essential safety aspects to be considered for the Human Machine Interface (HMI) for in-vehicle information and communication systems. The principles have been produced by a group of experts representing public organisations and industry organised as a Task Force by the European Commission in support of the eSafety initiative.

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BACKGROUND

The importance of a safe human machine interface (HMI) for in-vehicle information and communication systems has been stressed many times in resolutions, opinions and conclusions of several European institutions. These include:

- the Council conclusions of 17 June 1997;
- the European Parliament resolution of 8 October 1998;
- the Opinion of the Committee of the Regions of 14 May 1998;
- the Commission Communication COM (97) 223 of 20 May 1997 (related to a Community strategy and framework for the deployment of road transport telematics in Europe);
- the Council Resolution of 17 June 1997 on the development of telematics in road transport

In December 1999, the Commission adopted a “Recommendation on safe and efficient in-vehicle information and communication systems: a European Statement of Principles on human machine interface” (OJ L19, 25.1.2000, p.64). The purpose of this last recommendation was to widely disseminate these principles, through the Member States, to the main actors in the field with the objective, that the relevant European industry would take them into account in the design of new systems. In addition, the EC published an expansion of the Principles by its expert group (dated July 2001). A voluntary agreement from European car manufacturers to fully respect the ESoP (letter from ACEA) was issued in 2001.

In 2002 the eSafety Forum[1] was established by the European Commission (EC) 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.

The eSafety Steering Group established a Working Group on Human Machine Interaction (HMI) to tackle the important issue of driver interaction with on-board devices, such that HMI does not become a barrier to deployment. Taking into account the evolution of technologies and the increasing development of nomadic devices (mobile telephones, personal digital assistants, laptops) it was necessary to establish the state-of-the-art with respect to HMI and to re-define responsibilities among the different stakeholders. The work was undertaken on a voluntary basis by a group of experts from major laboratories and institutes in Europe and from key industrial companies. A large group of specialists were kept informed and their comments were taken into account.

The HMI Working Group was extremely active during 2004 and, following a workshop in mid-2004, specific recommendations were developed[2] and discussed with Member State officials and industry representatives. The WG-HMI's final report recommended how the European Statement of Principles (ESoP) should be developed and the EC subsequently asked for the ESoP revision to be undertaken by a small group of experts, supported, in part, through the European projects HUMANIST and AIDE.

SCOPE

These principles apply to in-vehicle information and communication systems intended for use by the driver while the vehicle is in motion, for example, navigation systems, telephones and traffic information They are not specifically intended to apply to systems providing vehicle stabilization (such as ABS and ESP) or to Advanced Driver Assistance Systems (ADAS) such as adaptive cruise control, collision mitigation systems, rear view camera and night-vision. ADAS are fundamentally different and require additional considerations in terms of Human Machine Interaction.

This document concerns system design and construction and includes overall design, installation, information presentation, interaction with displays and controls, system behaviour and information about the system. It will be supplemented by a document on system use (RSU, 2005) which includes recommendations on context/definition, driver training, use by drivers, and assessment of use.

The principles apply to 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. So, "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 excludes aspects unrelated to HMI such as electrical characteristics, material properties, system performance and legal aspects. Some principles make a distinction between system use “while driving” (also called “while the vehicle is in motion”) and other use. Where no distinction is made, the principles refer only to system use by the driver while driving.

The principles apply specifically to vehicles of class M and N[3] (including passenger cars, trucks and buses) although some aspects may also be valid for other vehicle classes. The principles apply to both portable and permanently installed systems. They apply to

[1] http://www.europa.eu.int/information_society/programmes/esafety/index_en.htm

[2] Recommendations from the eSafety-HMI Working Group - Final Report

[3] Classification and definition of power-driven vehicles and trailers (UNECE TRANS/WP.29/Rev.1/Amend.2/Annex 7, 16 April 1999)

OEM systems and to after market and nomadic devices. The principles apply to HMI functionality independent of the degree of integration between systems.

The principles are not a substitute for regulations and standards and these should always be taken note of and used.

STAKEHOLDERS INVOLVED IN SYSTEM DESIGN AND CONSTRUCTION

As described in the scope, the principles are intended to apply to systems and functionalities in OEM-, after-market-, and nomadic (portable) systems. In general, a number of organisations are involved designing, producing and providing elements of such systems and devices, including, for example:

- Vehicle manufacturer offering information and communication functionality
- After-market system producers
- Providers of nomadic device functionality intended to be use by a driver while driving
- Manufacturer of parts enabling the use of nomadic devices by the driver while driving (e.g. cradle, interface connectors)
- Providers, Broadcasters of information meant to be used by the driver while driving, e.g. RDS information, radio programme information as running text

Where systems are provided by a vehicle manufacturer (OEM) it is clear that the manufacturer is responsible for the overall design. In other cases, the “Product-Responsible Organisation” is expected to be the organisation introducing a product or functionality into the market, part or all of which may have been designed and produced by different parties. Where the term “manufacturer” is used in the following text, this should be understood to be the **Product-Responsible Organisation** (PRO).

GENERAL COMMENTS

- The need for special skills or training and the suitability of a system for different driver groups is a matter of definition by the manufacturers. Such definitions should be taken into account when considering the application of the principles to a system's HMI.
- Where the manufacturer's intention has been clearly stated (such that the driver can reasonably be expected to be aware of it) and the driver subsequently uses the system in a way which is not intended by the manufacturer, this can be considered as misuse.
- The ESoP Development Group does not believe that the current state of scientific development is sufficient to robustly link compliance criteria with safety for all the principles.
- The ESoP Development Group is of the opinion that systems designed in accordance with the principles are generally expected to be safer than those that do not take account of them. However, it may be possible to meet the overall design goals even if one or more principles are violated.

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STRUCTURE OF THE PRINCIPLES

Each principle is followed by an elaboration with the following sections:

Explanation: This includes some rationale and further explanation for the principle.

Examples: "Good" and "Bad" examples provides additional explanation concerning implementation of the principle.

Application: This describes which specific systems or HMI functionality is being addressed by the principle and is a necessary first step in determining whether a particular system's HMI is in accordance with the principle.

Verification: This section provides some information to address the question of whether a system is in accordance with a principle by making explicit links with standards, regulations or codes of practice where applicable. Where possible a suitable method is outlined and interpretation of the resulting metric is given:

- Where the result can be expressed as "Yes/No" this indicates the availability of a clear identification of compliance with a principle
- In other cases the approach/methods identified do not lead to simple pass/fail criteria but offer the opportunity of increased optimisation of the HMI

1. Design Goals

1.1 Design Goal I:

The system supports the driver and does not give rise to potentially hazardous behaviour by the driver or other road users.

Explanation:

An important overall requirement can be simply stated as “Do no harm”. This means that the system should enhance or at least not reduce road safety. The approach taken by this document is to systematically guide a system’s designer by principles addressing design relevant aspects like installation, information presentation or interaction. This is because the overall effects may not be entirely predictable or measurable since they depend not only on the system design but also on the individual driver and the driving task/traffic situation.

Systems which are not designed with this principle in mind are unlikely to be in accordance with the other principles.

1.2 Design Goal II:

The allocation of driver attention to the system displays or controls remains compatible with the attentional demands of the driving situation.

Explanation:

The driver has a limited but variable attentional resource and physical capacity which can be distributed dynamically by the driver between tasks. The resources activated by the driver depend not only on personal factors but may also vary according to his motivation and state.

The relevant tasks addressed in this overall design goal are:

a) the task of driving (controlling the vehicle, participating in traffic flow and reaching a destination). This has an associated attentional demand which varies with the driving situation.

b) the task of interacting with system displays and controls. Except for very simple systems, the attentional demand of this task will also vary as the system is used.

Reaching this goal requires compatibility between the two tasks and this means that the attentional demand of the system does not cause the available resource to be less than that required to attend properly to the prevailing driving task. This means that the driver needs to be able to anticipate the attentional demand associated with both the driving task and secondary tasks.

Systems which are designed in accordance with the ESoP should be such that the attentional demand of the system can be modified by the driver by choosing to interact (or not), and by choosing when and how to interact. This also means that the driver can anticipate the attentional demand of the interaction with the system.

1.3 Design Goal III:

The system does not distract or visually entertain the driver.

Explanation:

The aim of this principle it to ensure that the driver is not distracted by the use of a driver information or communications system such that their ability to be in full control of the vehicle is not compromised. This Design Goal is also formulated to highlight the special importance of avoiding distraction caused by visual entertainment.

Distraction is defined as “attention given to a non-driving related activity, typically to the detriment of driving performance” (e.g. the ISO occlusion draft ISO TC22/SC13/WG8 CD 16673).

Visual entertainment may occur by visually displaying images which are attractive (i.e. likely to catch the attention) because of their form or content. It is of particular relevance in the driving context because of the importance of vision for safe driving.

1.4 Design Goal IV:

The system does not present information to the driver which results in potentially hazardous behaviour by the driver or other road users.

Explanation:

The content of the information should not encourage the driver to engage in behaviour which may increase the risk of an accident. A hazardous behaviour may influence other road user behaviour. An example could be the display of a race-driving-strategy in order to achieve a maximum speed while cornering.

Other road users may be concerned if the hazardous behaviour of the driver occurs when he/she is interacting with them, as well as if the system generates signals perceptible from the exterior which may induce erroneous interpretation by other road users, and possibly dangerous manoeuvres.

1.5 Design Goal V:

Interfaces and interaction with systems intended to be used in combination by the driver while the vehicle is in motion are consistent and compatible.

Explanation:

All HMI components of individual systems should be designed according to principles for single systems and this will give a minimum level of consistency. However, consistency can still be an issue between individual well-designed products.

System use "*in combination*" occurs when more than one system is used to achieve a desired result. This includes parallel use (i.e. use of more than one system at the same time) and serial use when the systems are used one after another. So, when designing a system for use in combination with another (possibly pre-existing system), account should be taken of the existing system. When the functionality is completely different, it may be good design to have a different HMI to avoid confusion.

Consistency involves (at least) the following design issues:

- Use of common terminology between systems; e.g. "slow traffic", "next junction"
- Use of words and/or use of icons to represent concepts or functions; e.g. "Help", "Enter"
- Use of colours, icons, sounds, labels (to optimise a balance between similarity and differentiation)
- Physical dialogue channel issues; e.g. single/double-click, timing of response and time-outs, mode of feedback (depending on functionality feedback should be different in order to avoid misinterpretation)
- Grouping of concepts and similar menu structures (for related functionalities)
- Overall design of dialogue and order of concepts (see example below)

2. Installation Principles

Principle 2.1:

The system should be located and securely fitted in accordance with relevant regulations, standards and manufacturers instructions for installing the system in vehicles.

Explanation:

Manufacturers design products for an intended use. If their installation instructions are not followed, the installer may cause the system to be used by the driver in a way which was not intended by the manufacturer, and this could have safety consequences.

The system may be located (i.e. physically positioned) within the vehicle during use by the driver in the following ways:

a) Not fixed and intended for hand-held operation. This applies to devices that are intended to be used "hand-held" such as remote control devices for a garage door.

b) Not fixed but not in category a), such as a system loose on a seat (i.e. a laptop)

c) Fixed within the vehicle

d) Moveable over a pre-determined range (for systems that have an adjustable position by means of cable, stalk or bracket, for example)

e) Holder mounted with the intention that the system is used within the holder

f) Holder mounted for storage only with intended use as in a).

Devices in categories b) and f) (such as handheld telephones and remote navigation controls) should not be used by the driver while driving as use without a holder means that the driver needs to hold the device in one hand. Special attention should be given to passive safety in order to avoid an increased risk of injury in case of a vehicle crash.

Examples:

Good: A hands-free mobile phone fitted fully in accordance with all required standards, regulations and manufacturers instructions.

Bad: A traffic information display fixed to the dashboard with a poor quality temporary fastening (such as adhesive tape) rather than the holder recommended by the manufacturer.

Applicability:

The principle applies to all in-vehicle systems, and is very important to be considered for after-market systems and nomadic devices.

Verification/Applicable Methods:

This principle requires the location and fitting of category c) to e) systems to be undertaken in accordance with:

- location of hand controls, indicators and tell-tales (ISO 4040)

- interior fittings of motor vehicles (Council Directive 74/60/EEC of 17 December 1973, Council Directive 78/316/EEC of 21 December 1977)
- Instructions provided by the product-responsible organisation (i.e. the formal written instructions provided by the manufacturer)

Inspection whether the relevant requirements have been taken into account.

Result = Yes/No.

Comment by WG: Installation Recommendation and Test Procedure for aftermarket systems and nomadic devices need to be considered and developed by ISO or WP29

Principle 2.2:

No part of the system should obstruct the driver's view of the road scene.

Explanation:

Successful performance of the driving task is mainly based on the acquisition of visual information about the local road and traffic environment. Consequently, construction regulations ensure that each road vehicle provides the driver with an adequate external field of view out of the vehicle from the driver's seat. Additional systems must not compromise this basic design provision. This principle is likely to be particularly important for the installation of after-market and nomadic systems.

The driver's view is that mandatory minimum requirement in accordance with EEC Regulations. It should be interpreted as pertaining to the forward view directly through the windscreen, side views and rear view either directly or indirectly.

If the physical position of a component of the system can be modified by the driver and can (as part of its intended range of movement) obstruct the driver's vision, then the driver should be informed, through the system instructions (see section 6) about the use as intended by the manufacturer. If no such information is provided to the driver, then the principle should apply throughout the range of adjustment of the system or its component.

Examples:

Good: A display mounted within the instrument panel such that it can be easily viewed by the driver but does not interfere with the driver field of view requirements.

Bad: A display mounted on a long flexible stalk from the upper surface of the instrument panel which can be adjusted such that the display obscures a substantial part of the external road scene.

Applicability:

The principle applies to all in-vehicle systems, and is very important to be considered for after-market systems and nomadic devices.

Verification/Applicable Methods:

A system is in compliance with this principle if any parts of it are correctly located taking into account:

- 71/127/EEC - Rearward field of view
- 77/649/EEC amended by Directive 90/650/EEC - Field of vision of motor vehicles drivers
- 90/630/EEC – Adaptation to technical progress of Council Directive 77/649 relating to the field of vision of motor vehicle drivers

When installed in a vehicle no part of the system should be in a physical position such that the driver's view of the road scene is obstructed to such an extent that the Regulations cannot be complied with.

Verification is by measurement.

Result = Yes/No.

Principle 2.3:

The system should not obstruct vehicle controls and displays required for the primary driving task.

Explanation:

The aim of this principle is to ensure that the drivers ability to use mandatory displays and controls and other displays and controls required for the primary driving task is not compromised by the physical presence of a system (such as a display). This ensures that the driver's ability to be in full control of the vehicle is not affected by installation of the system.

Obstruction of controls in this context means to prevent operation, or render significantly more difficult to identify, reach and/or operate the relevant controls throughout their intended range of movement.

Obstruction of displays in this context means to render not visible some portion (any portion) of the relevant displays from the drivers' normal seating position.

The required controls and displays are those relevant for undertaking the primary driving task and all those which are mandatory. Required controls include: accelerator, brake, (clutch, if fitted), steering wheel, gear changer, parking brake, horn, light switches, turn indicators, washers and wipers (all modes and speeds), hazard flashers, de-mister controls. Required displays include the speedometer, all warning lights, mandatory control labels and mandatory tell-tales.

Obstruction or impairment of other controls and displays should be balanced against the additional benefits provided by the system.

Examples:

Good: A route-guidance display integrated into the dashboard in a high central position which does not obstruct any other displays or controls.

Bad:

1. An after-market route guidance system which obstructs the light switches;
2. A display that covers the hazard flasher control
3. An additional control on the exterior of the steering wheel rim which could make the steering wheel more difficult to use during cornering.

Applicability:

The principle applies to all in-vehicle systems, and is very important to be considered for after-market systems and nomadic devices.

Verification/Applicable Methods:

Verification is by inspection whether the driver can see all displays and controls required for the primary driving task, taking into account:

ISO 4513 Road Vehicle – Visibility, method for establishment of eye-ellipse for driver's eye location (ISO 4513 Road Vehicle)

Result = Yes/No.

Principle 2.4:

Visual displays should be positioned as close as practicable to the driver's normal line of sight

Explanation:

For a driver to be in full control of the vehicle and aware of the dynamic road scene there is a broad consensus that, apart from brief glances at mirrors or instrumentation, the driver's gaze should be directed towards the road scene. Visual displays positioned close to the normal line of sight reduce the total eyes-off-the-road time relative to those which are positioned further away and maximises the possibility for a driver to use peripheral vision to monitor the road scene for major developments while looking at a display. The further away from the driver's normal line of sight the display is positioned, the more difficult it is to obtain information and the greater the possible impact on driving performance.

It is recommended that the most important or safety critical information be closest to the normal line of sight. For passenger cars (type M) it is recommended that displays containing information relevant for driving and all displays requiring long sequences of interaction be placed within 30° of the driver's normal forward view. A display position beyond 30° should neither carry information relevant for driving nor provide information necessary for long sequences of interactions.

This principle therefore requires the designer/installer to make an explicit, but essentially qualitative, trade-off between practicability and closeness. Important factors include:

- The requirement not to obstruct the road scene (see principle 1.2)
- The requirement not to obstruct other controls or displays (see principle 1.3)
- The requirement that the display should not itself be substantially obstructed by, for example, controls such as the steering wheel or gear change lever.

Examples:

Good: Displays for navigation are installed within 30° because the information is related to driving.

Bad: Displays for communication, e.g. of a PDA or Phone, are positioned below 30° in spite of long sequences of interactions necessary to enter or search for a telephone number.

Applicability:

The principle applies to all in-vehicle systems equipped with visual display and for situations of use that involve forward vision. Displays that support specific driving condition such as reversing as a separate issue.

Verification/Applicable Methods:

In general, the best compromise in allocation of dashboard space should be aimed at, which can be assessed by designers and ergonomics specialists.

For passenger cars (type M) displays containing information relevant for driving and all displays and controls requiring long sequences of interaction should be placed within 30° of the driver's normal forward view. For a discussion on long sequences of interaction refer to principle 4.2. Once the relevant displays have been identified, the verification is a matter of precise measurement taking into account ISO 4513 Road Vehicle – Visibility, method for establishment of eye-ellipse for driver's eye location (ISO 4513 Road Vehicle).

Result = Yes/No.

Principle 2.5:

Visual displays should be designed and installed to avoid glare and reflections.

Explanation:

Glare and reflections are likely to make it more difficult to extract information from the display and may also cause distraction from the driving task or other tasks performed while driving. This is likely to lead to increased driver frustration and may evoke behavioural adaptations such as squinting, closing of the eyes for brief periods and head movements to obtain a more comfortable view. All of these effects are likely to reduce driver comfort and, therefore, may compromise road safety to some extent.

Glare is the distracting (and potentially disabling) effect of bright light in an otherwise relatively dark scene which interferes with visual attention and selection. In the in-vehicle context, this can occur in a number of ways:

a) External light (usually sunlight) falls on the visual display reducing display contrast and makes the information on the screen more difficult to see from the driver's normal viewing position.

b) The display is itself too bright and causes distraction from the road scene and other in-vehicle displays and controls. This is most likely to be apparent to the driver in low ambient light conditions.

Reflection is the generation of a secondary image of an object as a result of light from the object bouncing off intermediate surfaces. This is relevant in a number of ways:

a) Light from a light emitting display travels to another surface (or via several surfaces) producing a secondary image of the display screen; for example, on the windscreen. This is most likely to be perceived by the driver when there is high contrast between the secondary image and its background, such as against the windscreen during darkness.

b) Light from an external source (e.g. the sun, streetlights, or other bright objects) is reflected by the display surface into the driver's eyes (see also glare above).

The effects should be considered (and evaluated) during and after installation. Issues that could be considered include provision of a (manual or automatic) display brightness control, choice of display technology, choice of display surface texture and finish, choice of colour and gloss of surfaces being reflected in the display surface, choice of image polarity, sighting of the display and adjustability, the use of a recess or cowl.

Examples:

Good: A screen with an automatic brightness control which does not produce secondary images on the vehicle's glass an which has a display front surface which can be easily read under all normal lighting conditions.

Bad: A display which is so bright at night that it is significant in the driver's peripheral vision when looking at the forward road-scene and whose information is difficult to read in sunlight because the contrast is so low.

Applicability:

The principle applies to all in-vehicle systems equipped with visual display.

Verification/Applicable Methods:

The location of screen should be chosen based upon procedure to determine glare and reflections available in ISO 15008. Specific criteria depend on the vehicle concept.

3. Information Presentation Principles

Principle 3.1:

Visually displayed information presented at any one time by the system should be designed such that the driver is able to assimilate the relevant information with a few glances which are brief enough not to adversely affect driving.

Explanation:

Visual processing by the driver to take account of the traffic environment forms the basis for completion of vehicle control and manoeuvring tasks. Therefore, demand to detect and acquire visually presented relevant information at any one time should be limited. Increasing the frequency and/or duration of glances required to detect and acquire visually displayed information may increase the risk for potentially dangerous traffic situations caused by driver preoccupation with non-primary driving-related tasks. Relevant information is the portion of all visually displayed information sought by the driver to satisfy a particular need.

Examples:

Good: Easily legible and well structured graphics on a well positioned visual display which allows identification of the relevant menu item with one single glance of 1 second.

Bad: A display rich in detail, which needs full and lengthy attention of the driver to identify a target on a moving map.

Applicability:

The principle applies to all in-vehicle visual displays presenting information from information and communication systems intended to be viewed by the driver while driving

Verification/Applicable Methods:

Compare design alternatives for the presentation of information: the number and duration of glances needed to detect and acquire relevant information presented at a time should be minimized.

ISO 15007-1: Measurement of driver visual behaviour - Definitions & metrics

ISO 15007-2: Measurement of driver visual behaviour - Equipment and procedure

ISO 15008: Visual presentation of information

ISO FDIS 16673: Occlusion method to assess visual distraction

Result: Optimized design of a single screen.

Additional Methods/Scales are under development in ISO TC22./SC13/WG8 for quantification of visual distraction; e.g. revision of ISO 15008, display legibility and WG8/PWI on the Lane Change Test, method to measure driver distraction.

Principle 3.2:

Internationally and/or nationally agreed standards relating to legibility, audibility, icons, symbols, words, acronyms and/or abbreviations should be used.

Explanation:

Standards related to legibility, audibility and symbols prescribe geometrical and/or physical characteristics for information which is displayed visually and/or aurally and are intended to give information the highest probability of being easily comprehended by drivers in a large range of circumstances and environments.

The continuously increasing number of functions available to the driver makes it necessary to adopt the most common practice in the selection of symbols, icons, abbreviations and words for function identification.

Examples:

Good: Road signs are used on in-vehicle displays to augment traffic information

Bad: Symbols and icons used in a navigation system are unique to a particular manufacturer and are not comprehended by a majority of drivers.

Applicability:

The principle applies to all cues used to identify functionality and functions provided by an information or communication systems in a vehicle.

Verification/Applicable Methods:

Verification by inspection, whether the driver understands the symbols and graphics used, taking into account the main relevant standards which include:

- ISO 15008 - Road Vehicles - Traffic Information and Control Systems (TICS) - Ergonomic Aspects of In-Vehicle Information Presentation (under revision)
- ISO15006 - Road Vehicles - Traffic Information and Control Systems (TICS) - Auditory Presentation of Information
- ISO 2575 - Road Vehicles - Symbols for Controls, Indications and Telltales

Result = Yes/No.

All Standards are subject to revision. Their most recent edition should be used during the design process.

In general, assessment can determine if common practice has been applied to symbols, icons, words, acronyms and abbreviations where standards do not exist.

Principle 3.3:

Information relevant to the driving task should be accurate and provided in a timely manner.

Explanation:

Information relevant to the driving task should be provided to the driver at the most appropriate moment and be sufficiently accurate to assist the driver in dealing adequately with the situation.

The driving task requires the driver to continuously monitor the environment to select relevant stimuli and to concentrate and focus attention on those stimuli which require an adjustment of the his/her behaviour. This adjustment depends on which action is most suitable for the situation and on the goals and priorities of the driver. The actions may involve changing speed, changing lane, warning others, etc.

Correctly timed and accurate information reduces uncertainty by giving valid and clear answers to questions such as: What? When? Where? For How Long? Etc. The requirement of accuracy and timing of information also implies that it is necessary for the displayed message to match the driver's judgement of the environment. Therefore, information should not conflict with, for instance, road signs. Systems providing ill-timed and/or incorrect information may create safety critical driver distraction and frustration.

Examples:

Good: The distance to the next manoeuvre is provided exactly at the point where the driver needs to know if a manoeuvre is to be undertaken and which manoeuvre it should be. The system recognises the type of road, the lane the vehicle is occupying and takes account of the vehicle's speed.

Bad: Direction instructions from a navigation system are displayed well after the manoeuvre needs to be performed.

Applicability:

The principle applies to all auditory and visual time-critical information from information and communication systems.

Verification/Applicable Methods:

Verification by inspection, whether the information provided by the system is sufficiently correct and presented at the expected point of time.

Result: Yes/No

Principle 3.4:

Information which has the highest safety relevance should be given priority.

Explanation:

The driver may need to perceive and act on safety-relevant information within a short timescale. Such information therefore needs to be presented as rapidly as possible and should not be delayed by more routine information.

Information priority from the point of view of safety-relevance depends on its urgency and criticality (i.e. severity of the consequences if the information is not acted upon). These factors, in turn, also depend on the driving situation as explained in ISO/TS 16951. Where information is generated off-board (from the roadside or remote system) prioritisation cannot take account of the driving situation and only a more generic priority allocation is possible. Where information is derived from autonomous vehicle systems, or where external and on-board information can be combined, the possibility of appreciating the driving situation exists and message priority can be refined.

For off-board information, the dynamic information providers (service providers) should implement an information dissemination strategy which ensures - apart from actuality and reliability - transmission priority to messages with highest importance. In-vehicle systems need to recognise incoming high-priority messages and treat them accordingly.

Examples:

Good: Information concerning manoeuvring around a complex intersection is given priority over an incoming telephone call

Bad: A high-priority message concerning ice at the current location is prevented from immediate delivery because the information screen is in the process of displaying a message concerning distant traffic congestion.

Applicability:

The principle applies to systems that provide dynamic information (i.e. information that changes as a result of conditions immediately surrounding the vehicle or traffic conditions more generally).

Verification/Applicable Methods:

Verification by inspection whether the information with the highest safety relevance is given priority.

Result = Yes/No.

Additional Information can be found in:

ISO/TS16951 Road Vehicles – Ergonomic aspects of transport information and control systems – Procedure for determining priority of on-board messages presented to drivers.

Principle 3.5:

System generated sounds, with sound levels that can not be controlled by the driver, should not mask audible warnings from within the vehicle or the outside.

Explanation:

Auditory information at a sound level which is too high may affect driving or road safety by masking significant and important warning sounds concerning road and vehicle safety. In addition, improperly designed sounds might result in driver distraction and annoyance. Therefore, auditory information needs to be designed such that it does not mask warning sounds from the interior or exterior to the driver.

This can be achieved in a number of ways including

1) The sounds produced by the system are not at such a level that warning sounds are likely to be masked.
2) The duration of the sounds is sufficiently short that warnings are not missed.
3) Intermittent sounds are such that the interval between them is long enough for warnings to be received by the driver.

Examples:

Good: Auditory signals from the system are set at a level that is below the sound level of warnings from within and outside the vehicle.

Bad: An incoming telephone call is at a very high sound level liable to mask warnings, and out of the driver's control.

Applicability:

The principle applies to all audible warnings with sound levels that can not be controlled by the driver, either from in-vehicle systems, after-market or nomadic devices, or as a result of information received through communication with the outside world.

Verification/Applicable Methods:

Verification by inspection, whether warnings are still clearly perceptible while the system produces uncontrollable sound levels.

Result = Yes/No.

ISO 15006 - Road Vehicles - Traffic Information and Control Systems (TICS) - Auditory Presentation of Information.

4. Interaction with Displays and Controls

Principle 4.1:

The driver should always be able to keep at least one hand on the steering wheel while interacting with the system.

Explanation:

This Principle is concerned with interactions which require the driver to provide manual control inputs (e.g. using buttons or knobs).

There are driving situations which require the driver to have precise control of the vehicle's steering and this can be achieved most effectively with both hands on the steering wheel. For other driving situations, one hand on the steering wheel is acceptable as long as the other hand is immediately available for steering if circumstances demand it. That leads to the consideration that handheld devices are not recommended for use whilst driving.

To be in accord with this Principle, the system should be designed such that only one hand is needed away from the steering wheel to interact with the system leaving one hand remaining on the steering wheel. In addition, if one hand must be removed from the steering wheel to undertake the interaction, the other hand should not simultaneously be needed for interaction (e.g. for operating fingertip controls).

Examples:

Good: A control device that is securely mounted in a conveniently positioned holder and can be used one-handed without removal from the holder.

Bad: An unfixed control device that the driver needs to hold in his hand while interacting.

Applicability:

All information and communications systems.

Verification/Applicable Methods:

Verification by inspection whether the driver can operate the system with only one hand.

Result = Yes/No.

Principle 4.2:

The system should not require long and uninterruptible sequences of manual-visual interactions. If the sequence is short, it may be uninterruptible.

Explanation:

The Principle allows for uninterruptible sequences of interactions as long as they are short whereas long sequence of interactions should be interruptible by the driver. This means that the system should not delete any driver input during interruption unless the sequence of interactions is short or a sufficiently large time-out period has passed.

If a driver is aware that a sequence of interactions is “interruptible”, there will be a greater tendency to attend to developing traffic situations in the knowledge that the system interaction can be completed when the traffic situation has been attended to.

On the other hand an interaction may be uninterruptible if it is short in order to avoid an additional input for returning the system’s state to normal. A well established example is a two- or three-step interaction for changing the sound settings of a conventional radio.

Examples:

Good: An uncompleted three-step interaction for setting display parameters automatically terminates after a 10-second time-out period, in order to present driving-relevant information in its normal state.

Bad: Key presses when entering a telephone number must not be more than 5 seconds apart or all previously entered numbers are cancelled.

Applicability:

The principle applies to systems with manual-visual sequences of interactions, i.e. the function requires more than one input (by inspection). It does not apply to speech-based systems.

Verification/Applicable Methods:

1. Analyse whether the sequence of interactions can be considered as short taking into account the following dimensions of an interaction:
    - the number of individual control inputs (e.g. less than 4-5 button presses)
    - the complexity of the interaction (e.g. less than 2 menu changes)
    - the time to make the control inputs (e.g. less than 5 seconds)
    - the visual intensity of the interaction (refer to ISO CD 1xxx on occlusion)
2. Inspection whether system state changes when interrupting short sequences of interactions

Result: Documentation of all uninterruptible sequences of interactions.

Principle 4.3:

System controls should be designed such that they can be operated without adverse impact on the primary driving controls.

Explanation:

This principles addresses the relationship between the primary driving controls and the system controls in order to avoid an unintended interference of operation. This means that the location, kinematics, control forces and control travel of a system control should be designed such that its operation does neither hinder nor facilitate an unintended primary control input.

Examples:

Good: The most frequently used controls are located within fingertip reach from the steering wheel.

Bad: A rotary control with concentric axis on the steering wheel, which requires a momentum for operation that may also induce a change in steering angle.

Applicability:

All Systems intended to be used while driving, especially nomadic devices and aftermarket systems.

Verification/Applicable Methods:

Verification by inspection whether system operation interferes with operation of primary driving controls resulting in an unintended effect on vehicle motion.

Result = Yes/No.

Additional Information can be found in:

ISO 4040 Road vehicles – Location of hand controls, indicators and tell-tales.

Principle 4.4:

The driver should be able to control the pace of interaction with the system. In particular the system should not require the driver to make time-critical responses when providing inputs to the system.

Elaboration:

Interaction with the system refers here to make input by a control action, or by voice, into the system, either at the driver's initiative or as a response to displayed information initiated by the system itself. The provision of an appropriate response usually requires the driver to perceive and process information before deciding on the correct action. This pre-supposes that the situation develops such that the driver has sufficient time and mental resources available. As systems are not actually available which can predict the level of driver workload in a continuous and reliable manner, for the sake of safety and convenience it should be for the driver alone to decide when he/she is ready to respond to the system.

Time critical responses are responses which must be made by the driver within a short imposed time window. The driver is able to control the pace if he always remains in command of the time before which an input must be provided and the time for which the output is displayed.

Exceptions:

- If the information displayed is directly related to the immediate driving situation (e.g. the precise speed of the vehicle, the distance to the next turn - which determines the time for which a displayed route direction is valid, etc.)
- if the system provides assistance to help the driver escape from hazards or avoid mistakes and requires the driver to react within a specific time.
- The second click on an input device, which requires a double click, as a specific signal is acceptable.
- Inputs provided by the same control giving different results depending on the duration of the control activation (e.g. a button kept pressed for several seconds for radio station storage) are not within the scope of this principle.

Examples:

Good: The driver can choose to listen to incoming traffic messages when the situation permits and messages are not automatically presented to the driver when they arrive.

Bad: Confirmation or rejection of a re-routing proposal of a navigation system due to traffic problems is available only for a few seconds before re-routing automatically starts.

Applicability:

Systems which provide information not directly related to the immediate driving situation. (compare exceptions under explanation)

Verification/Applicable Methods:

Inspection, whether the driver can interact with the system at his own pace, i.e. can he decide when to provide an input and how long information is displayed?

Result: Yes/No

Principle 4.5

The driver should be able to resume an interrupted sequence of interactions with the system at the point of interruption or at another logical point.

Explanation:

If partly entered data disappears when an input sequence is interrupted, the driver may be incited to achieve the full sequence even if the driving situation requires full attention.

The principle requires that the driver is given the possibility of continuing an interrupted sequence of interactions (with no need to restart it) either from the point of interruption, or from another previously completed step.

When the driver resumes the sequence, it may happen that some events have made the point of interruption no longer relevant. In such cases, the logical point provided by the system will simplify the task and lessen the workload.

Examples:

Good: The driver can interrupt entering a phone number, look for several seconds at the road scene and then complete the partly entered number.

Bad: When the driver is reading a list of traffic messages and interrupts viewing half way through the list, the system cancels the list after a short time-out period. Consequently the driver needs to "call" the list again in order to resume reading.

Applicability:

All systems with sequences of interactions

Verification/Applicable Methods:

Inspection, whether the system state changes after interrupting a sequence of interactions.

Result: Yes/No.

If not, justify and check that the resuming point is logical to the driver in order to efficiently complete the interaction. Verification of this requires assessment and judgement.

Principle 4.6

The driver should have control of the loudness of auditory information where there is likelihood of distraction.

Explanation:

To have control of auditory information means that the driver can turn the sound on and off. In addition the driver may be able to adjust the volume or other auditory characteristics.

Distraction is the capture of significant driver attention by stimulations which can arise from non driving relevant information, or from driving relevant information presented in such a way that the stimulation attracts more driver attention than strictly necessary just to obtain the relevant information. This undesirable capture of driver attention may be caused by the frequency of the stimulus, its duration, its intensity and, more generally, by its irrelevance to the driving task and may subsequently cause irritation.

Since some important information may have to be conveyed to the driver while the sound is off or while the sound level has been turned down to an inaudible level, the system should include a visual telltale close to the normal line of sight (see principle 2.4).

Examples:

Good: The driver may control the “incoming phone call” acoustic signal and select a mode where only a visual signal is displayed.

Bad: An obsolete traffic message is repeated many times and cannot be switched off.

Applicability:

All systems which provide non-safety relevant auditory information.

Verification/Applicable Methods:

Inspection, whether the system´s auditory output can be switched off and on by the driver.

Result = Yes/No.

Additional information can be found in ISO 15006.

Principle 4.7

The systems response (e.g. feedback, confirmation) following driver input should be timely and clearly perceptible.

Explanation:

The system's response applies at two levels:

- The control activation feedback level, e.g. button displacement, auditory beep.
- The dialogue level, which is the system's response to the driver's input, e.g. recommended route.

The system's response is timely if it is perceived as quite instantaneous, i.e. within a time of 250 ms. For control activation feedback timing should be from the moment at which the system recognises each driver input. For the dialogue level response (which may be either the requested information, or an indication that processing is underway) the timing should be from the end of the driver's input.

When the system's processing time requires longer than 250 ms, some signal should be displayed after 250 ms to inform the driver that the system has recognised the input and is preparing the requested response.

The systems response is clearly perceptible if it is obvious for the driver that a change has occurred in the system and that this change is the consequence of the input.

A system which reacts as expected by the driver contributes to the reliability of the driver-system interaction. Any delayed, ambiguous or uncertain system response may be misinterpreted, may be taken as an error by the system or by the driver, and may lead to the driver making a second input.

Uncertainty about whether input has been completed also reduces driver attention to the road scene.

Examples:

Good: A message "BUSY" is displayed immediately following a driver request to change the area shown on a map.

Bad: The last RDS message displayed on driver request differs only from the previous one by one item: the number of km. This item is not enhanced, which creates doubt about whether the input has been acknowledged by the system or not.

Applicability:

All systems with manual input.

Systems controlled by voice are not currently considered as within the scope of this principle because the nature and structure of speech is such that mid-sentence pauses often exceed 250ms. There is insufficient experience to properly define "timely" for voice controlled systems at this time.

Verification/Applicable Methods:

Verification by measurement of system response time: The system should respond within 250 ms upon a manual control input or display a "system busy" message.

Result = Yes/No.

Principle 4.8

Systems providing non-safety related dynamic visual information should be capable of being switched into a mode where that information is not provided to the driver.

Explanation:

Dynamic visual information is visual information which changes as a result of system initiation. Non-safety related information is information which is not relevant to the driver in avoiding or reducing the risk of an immediate or imminent hazardous situation.

Examples of non-safety related information include navigation map, freight and fleet data, banking services.

Since an unacceptable distraction from the driving task may be caused by a dynamic presentation of non-safety related information the driver should be able to switch the information off.

Examples:

Good: The driver can select from a menu whether non-safety related dynamic visual information is displayed or not.

Bad: A navigation map, which is updated every second, cannot be switched off without losing complete guidance support.

Applicability:

Systems providing non-safety related dynamic visual information.

Verification/Applicable Methods:

Inspection whether the system can be switched into a mode where non-safety related dynamic visual information is not provided to the driver.

Result = Yes/No.

5. System Behaviour Principles

Principle 5.1:

While the vehicle is in motion, visual information not related to driving that is likely to distract the driver significantly should be automatically disabled, or presented in such a way that the driver cannot see it.

Explanation:

This principle emphasises the importance of the visual modality for safe driving and seeks to limit visual information from within the vehicle which can provide a distraction from the primary driving task Likelihood of significant distraction refers to modes of presentation where the information has a dynamic and unpredictable component such that the entirety of information presented cannot be obtained by the driver with a few brief glances *(*e.g. TV, video and automatically scrolling images and text).

One example is automatically scrolling images and text that cover a variety of forms of dynamic presentation where the driver is not able to pace the presentation and where the entire information is not available at any one time. Any other specific modes of presentation, e.g. “Internet pages”, should be examined within the context of these examples. Scrolling lists under the control of the driver, such as navigation system destinations, are not within the scope of this principle as the driver can always interrupt and resume the interaction.

Even after a vehicle ceases motion, it is recommended that a time delay of a few seconds be included before one of the visual presentation modes covered by this principle is activated. This deals, at least partially, with the situation of divided attention of the driver in “stop-and-go” traffic conditions.

Examples:

Good: A TV picture which goes blank as soon as the vehicle begins to move and does not re-appear for several seconds after the vehicle has stopped.

Bad: A passenger entertainment system which can be seen by the driver while the vehicle is in motion.

Applicability:

This principle refers to visual information only which is not related to driving. Therefore it does not apply to non-visual information, like tonal or verbal information, or to visual information related to driving.

Verification/Applicable Methods:

Verification by inspection whether information which is not intended to be seen by the driver while the vehicle is in motion is not shown or cannot be seen by the driver. For details see ISO 15005 “Dialogue Management”, requirement 5.2.2.2.4 and for drivers eye location see ISO 4513

Result = Yes/No.

Principle 5.2:

The behaviour of the system should not adversely interfere with displays or controls required for the primary driving task and for road safety.

Explanation:

This principle is intended to ensure that the driver's ability to be in full control of the vehicle is not affected (in a way which decreases safety) by the behaviour of the information and communication system. This means that the system should not override information or controls relevant for the safe operation of the vehicle. In this context, interference is any influence or interaction which modifies the performance, characteristics or behaviour, of existing displays or controls.

Adverse interference with displays or controls results in an overall impairment of performance (from that intended) of the display or control. Examples include changes to mandatory displays or controls. In addition, the behaviour of a system should not obstruct or render inoperative other systems which are specifically intended as safety systems.

Examples:

Bad: On a multipurpose display, mandatory information is overlaid by radio station identification information.

Applicability:

Refers to systems which can be reasonably foreseen to induce display and control interference.

Verification/Applicable Methods:

Verification by inspection whether the system's behaviour does not interfere with the use of displays and controls required for the primary task of driving.

Result = Yes/No.

Principle 5.3:

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, as a less preferred option, clear warnings should be provided against the unintended use.

Explanation:

This principle seeks to ensure clarity, particularly for the driver, in terms of the manufacturer's intention for use of the system. If this principle is complied with, subsequent use of the system not within the envelope of intended use can be considered as misuse.

Impossible in this context means that the designated system function is not operable by the driver during normal use or during reasonably foreseeable misuse. In this context, it would not be reasonable for a manufacturer to anticipate that a driver would undertake sophisticated technical measures to defeat the manufacturer's intentions. The manufacturer's rationale may be based on regulation or their own judgement.

A clear warning gives information or advice about the negative consequences of a situation or action in sufficient detail. The warning is available in such a way or form that the driver can readily perceive it. It can be written information or an automatic display by the system. Reasonable drivers should be in no doubt concerning the use of the system intended by the manufacturer after taking account of the clear warning.

There are a number of ways of conveying warnings. A continuously displayed warning is one option. If the warning is not continuously displayed, then it should remain available for a sufficient duration to ensure that the driver has the opportunity to become aware of it. One suitable solution is for the driver to acknowledge the warning by pressing a button.

Examples:

Good: The handset component of an in-vehicle telephone becomes inoperable when the vehicle is moving and the handset is not in the holder for dialling.

Bad: A television facility is designated as an unavailable function while the vehicle is in motion as detected by a hand-brake position sensor. The sensor on the hand brake can be deactivated by a partially engaged hand brake. (This is an example of misuse which is reasonably foreseeable and should, therefore, have been designed out, or clear warnings provided.)

Applicability:

This principle applies only to system functions intended by the manufacturer not to be used by the driver while driving.

Verification/Applicable Methods:

Verification by inspection whether system functionality not intended to be used while driving is inaccessible by the driver while the vehicle is in motion (this is the preferred option) or a clear warning is provided to the driver.

Result = Yes/No.

Additional information may be found in:

ISO 15005 "Dialogue management", and ISO 17287 "Suitability for use while driving".

Principle 5.4:

Information should be presented to the driver about current status, and any malfunction within the system that is likely to have an impact on safety.

Explanation:

There can be safety implication when there is a divergence between the actual function of a system and the driver's reasonable expectations based on previous information and/or experience. Therefore a change in status or a malfunction which modifies system performance needs to be made apparent to the driver.

The information to be presented should be designed to be readily perceived by the driver (i.e. easily understood and meaningful) in terms of the consequences of the current status or system malfunction, particularly on vehicle control and manoeuvring with respect to other traffic and the road infrastructure.

Examples:

Good: An in-vehicle speed advice system informs the driver that the system is unable to provide dynamic information rather than continuing to show the prevailing inter-urban speed even on entry to an urban area.

Bad: A route guidance system displays the information "Illegal Entry Mode 31" before each turn instruction. The implications of this message are not readily perceived by the driver.

Applicability:

This principle applies only to information about status and malfunctions of the system which are likely to have an impact on safety.

Verification/Applicable Methods:

Verification by inspection, whether information is presented to the driver in an appropriate way about status and malfunction of the system which is likely to have an impact on safety.

Result = Yes/No.

Additional information can be found in ISO 15008 and 15005.

Principle 5.5:

In the event of a partial or total failure of the system, the vehicle should remain controllable, or at least should be capable of being brought to a halt in a safe manner.

Explanation:

The aim of this principle is to ensure that the driver's ability to use mandatory displays and controls and other displays and controls required for the primary driving task is not compromised by the information and communications system within the vehicle, even when that system is not operating as intended by the manufacturer.

It is expected that the system will be designed to provide information about its status to the driver who therefore will be aware of system malfunctions or failures. If the system has no connection or interaction with any driving controls no negative influence on vehicle controllability is expected. Exceptionally, either prompted by the change in system status or because of external factors, the driver may have to stop the vehicle. This should, of course, be possible with the driver having full use of all primary driving controls.

Examples:

Good: A navigation system failure is reported and it provides no further information to a display screen concerning navigation. All vehicle handling remains unchanged.

Bad: A failure in a GSM emergency call system automatically activates a security sub-system which locks all doors and cuts power to the engine (and hence power assisted steering and braking).

Applicability:

This principle applies only to systems which have connection or interaction with any driving controls and actuators.

Verification/Applicable Methods:

Verification is by experiment and inspection;

Result = Yes/No.

6. Information about the System

Principle 6.1:

The system should have adequate instructions for the driver covering use and relevant aspects of installation and maintenance.

Explanation:

This principle aims to ensure that instructions are available to as many drivers as possible so that they can easily become aware of the capabilities and limitations of the system, its context of use proper installation and maintenance. Drivers should rarely need to seek information beyond that provided in the instructions.

Adequate instructions are sufficient for the purpose of the driver that is reasonable for the manufacturer to anticipate. This will depend on the intended use of the system (functionality, context etc.). One indication of adequacy is the size and quality of any text or diagrams. For example, print is not expected to be smudged or in a font style which is too small or difficult to read. For written instructions "adequate" relates to the physical media of presentation. For example, printed material should be on paper (or other material) providing a reasonable durability and the printing should be permanent on that material. Instructions which are only on packaging material are not considered adequate as packaging is likely to be discarded rather than being passed to subsequent owners. In the case that instructions are only available in form of "help functions" these should be designed in a way that allows their operation without prior reading of written material.

Examples:

Good: Good quality printed colour manual on A5 pages with text and illustrations which fits within the glove box.

Bad: No instructions; sketchy instructions just on the packaging material; instructions on poor quality paper; instructions that are so small that they can be easily mislaid.

Applicability:

This principle applies to system instructions in all forms.

This principle refers to system instructions intended for the driver, not a full workshop manual as might be required by garage or maintenance institutions.

The principle applies to all aspects of systems which it is reasonable for the manufacturer to anticipate that drivers will require at some time within the expected life of the system. The principle excludes aspects of systems specifically designated by the manufacturer as not intended for use while driving.

Verification/Applicable Methods:

Verification requires assessment and judgement.

Principle 6.2:

System instructions should be correct and simple.

Explanation:

Design of user instructions is an HMI issue in itself. Instructions are typically ignored by drivers and this is exacerbated by poor design of the instructions. This principle is intended to promote high acceptance of instructions by drivers.

Instructions should be factually accurate in all important aspects. Each element of the instructions (group of words, diagram, function-described etc.) should be correct for the actual system to which it relates.

Simple has to be interpreted in the context of the system being described and will vary with the complexity and functionality of the system. The instructions should be unambiguous and easy to understand, if possible by all members of the intended user population. (e.g. documents in “Plain Language”). Instructions should not be overly technical and should use user-oriented language. It is important that the instructions are simple even if the system is complex.

Examples:

Good: Good examples might be expected to have some of the following features: well presented manual with factually accurate text and diagrams, contents page, page numbers, good use of colour, written in a plain language style using common words. Good Index. Use of different fonts, italics, bold, underlines etc. to distinguish portions of the text.

Bad: Instructions which refer to a previous model with different functions and controls

Applicability:

This principle applies to system instructions in all forms.

Verification/Applicable Methods:

Assessment of correctness is a matter of comparison between the actual system and the system instructions. Assessment of simplicity is a matter of judgement taking driver knowledge and expectations into account. A system instruction can conform with this principle even if small errors are present as long as these can be shown to be unimportant and are not too numerous.

Verification requires assessment and judgement.

Principle 6.3:

System instructions should be in languages or forms designed to be understood by the intended group of drivers.

Explanation:

The aim of this principle is to ensure that instructions are of use to as many drivers as possible and that drivers are aware of the capabilities and limitations of the system, its context of use etc.

Different forms of instructions may exist which could be presented in different modalities: Auditory instructions may be spoken or presented by noises or earcons. Visually presented information includes diagrams, photographs, highlighting of the next element, programmed tutorials etc.

Spoken instructions and written instructions (either printed or within a system) will be in one or a number of languages (e.g. English, Finnish etc.)

This principle requires that when instructions are being devised, consideration is given to the intended and most likely driver population and that instructions are designed which can reasonably be expected to be understood and used by as many drivers as possible.

Manufacturers should consider the driver population and the likely and intended use of the system as well as the native languages and other languages spoken and read. Published statistics on language proficiency by country could be used as reference. At minimum, the majority language of the country in which the system is sold should be considered. Diagrams often provide additional clarity. Where used these should follow accepted stereotypes and conventions for the intended population.

Examples:

Good: For a system sold in Sweden, instructions are formulated in easily understandable Swedish and incorporate pictorial help at relevant passages.

Bad: Written instructions (without diagrams or photographs) automatically translated from Japanese (unedited) for a system presented for sale in the European market.

Applicability:

This principle applies to instructions in all forms.

Verification/Applicable Methods:

Verification requires assessment and judgement.

Principle 6.4:

The instructions should clearly state which aspects of the system are intended to be used by the driver while driving and those aspects (e.g. specific functions, menus etc.) which are not intended to be used by the driver while driving.

Explanation:

Instructions that are in accord with this principle allow the driver the opportunity to be fully aware of the use of the system intended by the manufacturer and to make clear the responsibilities in the case where the driver uses the system beyond the manufacturer's intentions. Aspects which are specifically not intended by the manufacturer to be used by the driver while driving should be explicitly designated as such whether disabled while the vehicle is in motion or not.

After becoming aware of the instructions, reasonable drivers should be in no doubt about which aspects of the system have been designed to be used by the driver while driving (i.e. the intended use of the system). They should also be in no doubt about those aspects which have not been designed for use while driving.

A specific recommendation is that if drivers need to equip themselves before using a hands-free communication system, they should be instructed to do so while the vehicle is not in motion.

Examples:

Good: Instructions for a mobile phone which states that the hand-set is not intended for use in a moving vehicle (and the hand-set is disabled and switches to hands free microphone/speaker when the vehicle is in motion).

Bad: A feature-rich driver information and communications system which has additional functionality for use by a passenger, or driver while stationary, but whose instructions make no clear distinction concerning the features intended for use by the driver while driving.

Applicability:

This principle applies to instructions in all forms.

Verification/Applicable Methods:

Verification is by inspection; **Result = Yes/No.**

Principle 6.5:

All product information should be designed to accurately convey the system functionality.

Explanation:

The aim of this principle is to encourage good design of all product information and to assist potential or current user of the system in appreciating the benefits and limitations of the system.

All product information should be factually correct and presented transparently and without ambiguity. Information does not have to be comprehensive to be accurate.

Functionality is concerned with what the system does and, by implication, the benefits that the functionality provides to the driver. Functionality should distinguish between that which is designed to be used by the driver while driving and that which is not; i.e. the information should not claim or imply that a function which has not been designed to be used while driving can be so used. The product information should make it clear if additional software of hardware is required (other than that with the base model) for specific functionality.

This principle is also in line with consumer protection requirements, EC Regulations and existing codes concerning advertising and all product information should conform to the report on advertising[4].

Examples:

Good: A communications system which is not designed to store telephone numbers while driving provides the information that “pre-stored numbers can be selected using a single button”.

Bad: The same communications system provides the information “Telephone numbers can be stored for later use” adjacent to a picture of a driver and vehicle in motion. This association implies that number storage is designed for use while driving.

Applicability:

This principle refers to product information intended for the driver, not a full workshop manual as might be required by garage or maintenance institutions.

Verification/Applicable Methods:

Verification requires assessment and judgement.

[4] Advertising in the context of road safety. Final Report VII/671/1995, High Level Working Party of Representatives of the Government of the Member States.

Principle 6.6:

Product information should make it clear if special skills are required to use the system as intended by the manufacturer or if the product is unsuitable for particular users.

Explanation:

This principle is intended to ensure that the design population intended by the manufacturer is made clear to potential and actual users of the system. The normal presumption is that a system can be used by all drivers. However, initial training may be required; for example, for systems designed for specialist professional use. Although all drivers are required to have a minimum level of (far) vision, other capabilities may vary considerably and this includes the capabilities of drivers with special needs.

This principle is also designed to encourage compliance with consumer protection requirements, EC Regulations and existing codes concerning advertising.

Product information refers to any information that the driver has access to concerning the system. It includes system instructions, technical specifications, promotional materials, packaging etc. However, full workshop and technical manuals are excluded from the scope of this principle.

The need for special skills and the unsuitability for particular user groups are matters for definition by the manufacturers. If any special skill requirement or initial training is envisaged by the manufacturer, then all product information should make this clear. Similarly, any restriction on use intended by the manufacturer should be described in the product information.

Examples:

Good: The product information makes it clear that routing instructions are provided exclusively using the auditory modality and the system is therefore unsuitable for drivers with a hearing impairment.

Bad: A voice input system only works reliably with deep male voices, but this limitation is not made clear in the product information.

Applicability:

This principle refers to product information intended for the driver, not a full workshop manual as might be required by garage or maintenance institutions.

Verification/Applicable Methods:

Verification is by inspection; **Result = Yes/No.**

Principle 6.7:

Representations of system use (e.g. descriptions, photographs and sketches) should neither create unrealistic expectations on the part of potential users nor encourage unsafe use.

Explanation:

The aim of this principle is to assist the driver in appreciating the functionality, benefits and limitations of the system before (and during) use. It is also intended to promote road safety and compliance with existing traffic regulations and codes of road and vehicle use as well as consumer protection requirements, EC Regulations and existing codes concerning advertising.

Unrealistic expectations are expectations held by reasonable potential users (based on their own knowledge and experience and any product information available) which are false, partial, too high, or overly general.

Unsafe use covers a range of behaviours but includes any behaviour which is in conflict with the road code of the EC Member States where the system is used.

Examples:

Good: Photographs of the system being used as intended by the manufacturer and following all relevant codes and Regulations.

Bad: A photograph showing a hand-held telephone being used while driving.

Applicability:

This applies to all representations of system use include those provided by the manufacturer in instruction manuals (diagrams etc.), photographs, films computer animations, sound clips and any form of product information or advertising that users or potential users of the system may be exposed to.

Verification/Applicable Methods:

Verification requires assessment and judgement.

DEFINITIONS

For the purposes of this ESoP and to aid understanding, the following terms and definitions are offered. Where the text has been taken from other documents, the source is noted.

Context of use: Users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used (ISO 9241-11:1998)

Display (noun): Device capable of presenting information to the driver

EXAMPLES: Visual displays (such as LCD screens), auditory displays (such as tones) and tactile displays (such as pedal vibration).

Driving: Activity of the primary driving task and secondary tasks associated with or supporting the primary driving task

Employer: Person or organisation that has a contract with an employee

NOTE: Those employers addressed by these principles require the employees to drive as part of their job.

EXAMPLES: fleet managers, taxi companies, delivery companies, emergency service organisations

Hands-free: With no need to permanently hold with the hand any component of the system

Information related to driving: Information on aspects of the vehicle which are mandatory or which are related to safety or which are related to the road and traffic environment and driver related infrastructure services

NOTE: the information will be presented by means of a display; e.g. a visual or auditory display

EXAMPLES: tyre and brake parameters, proximity of other vehicles, route guidance, congestion information, ice warning, speed limits, parking information

EXAMPLES of information not related to driving include news, entertainment and advertising

Installation: Fitting of systems and sub-systems within the vehicle including loading of software

NOTE: Systems which are fully pre-installed do not require these operations

Maintenance: Action(s) to enhance or continue the product's operation

NOTE: Surface dusting and cleaning (which may apply to other in-vehicle equipment) is not included within the term “maintenance”.

EXAMPLES: replacement of sub-systems (e.g. batteries, licenses, software) periodic cleaning and checking and calibration procedures

Malfunction: Departure from the expected range of operation during system use as intended by the manufacturer

EXAMPLE: External signal loss or loss of sensor calibration data reducing the accuracy of a route guidance system.

Point-of-sale: Access point for the potential buyer to the person or organisation offering systems for sale

EXAMPLES: Car dealer (for OEM equipment); shop (for after-market equipment) website, helpline or telephone sales point

Primary driving task: Activities that the driver has to undertake while driving in navigating, manoeuvring and handling a vehicle including steering, braking and accelerating

Priority: Relative importance of two or more entities which determines their ranking in a time sequence or emphasis of presentation (ISO/TS 16951)

Product information: All information that the driver has access to concerning the system

EXAMPLES: system instructions, technical specifications, promotional materials, packaging

Product-responsible organisation (PRO): Organisation introducing a product into the market

NOTE 1: Part, or all, of the product may have been designed and produced by different parties.

NOTE 2: Where the term “manufacturer” is used in the principles, this should be understood to be the product-responsible organisation

Reasonably foreseeable misuse: Use of a product, process or service under conditions or for purposes not intended by the manufacturer, but which can happen, induced by the product, process or service in combination with, or as a result of, common human behaviour.

Sequence of interactions: Related set of successive inputs/outputs also called a dialogue

EXAMPLE: Entering a new destination or a phone number

Status: Available and/or active system mode(s)

EXAMPLE: “processing”

System instructions: Information about the system intended to teach the driver about the system and assist in using it for specific purposes.

NOTE: Instructions may be in a printed form using text or pictorial information or may be integrated within the system in the form of “help” functions or a tutorial.

Stationary: Having a non-zero speed relative to the vehicle’s supporting surface

System failure: State of non-operation or malfunction of the system

NOTE 1: Partial failure may involve some component, sub-function or mode of operation of the system becoming inoperable or performing outside of the specifications intended by the manufacturer.

NOTE 2: Total system failure renders all aspects of the system inoperative.

Visual information: Graphical, pictorial, textual or other messages presented to the driver using the visual modality

Vehicle in motion: Vehicle with a non-zero speed relative to its supporting surface

Vehicle-hire Company: Person or organisation that offers a contract to hire a vehicle equipped with an in-vehicle information or communication system

RECOMMENDATIONS ON SAFE USE (RSU) 2005

FOREWORD

This document summarises essential safety aspects concerning use of, and influencing use of, in-vehicle information and communication systems. It is a supplement to the European Statements of Principle concerning system design and construction (ESoP, 2005) and has been developed by the same group of experts responsible for the ESoP. The group was convened as a Task Force by the European Commission in support of the eSafety initiative and this RSU document adopts a similar style involving “principles”.

Following a discussion of the context of use, principles are presented relevant for Employers, Point-of-sale, Vehicle Hire Companies and drivers themselves.

The principles are not a substitute for regulations and standards and these should always be taken note of and used.

SCOPE

These principles apply to in-vehicle information and communication systems intended for use by the driver while the vehicle is in motion, for example, navigation systems, telephones and traffic information. They are not specifically intended to apply to systems providing vehicle stabilization (such as ABS and ESP) or to Advanced Driver Assistance Systems (ADAS) such as adaptive cruise control, collision mitigation systems, rear view camera and night-vision. ADAS are fundamentally different and require additional considerations in terms of Human Machine Interaction.

This document includes a discussion of the context of use and principles covering assessment of use, driver training and use by drivers. It is a supplement to the European Statements of Principle concerning system design and construction (ESoP, 2005).

The principles apply to all components and aspects of a system that the driver will interact with while driving and also to certain other components and aspects that should not be used while driving. So, "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 excludes aspects unrelated to HMI such as electrical characteristics, material properties, system performance and legal aspects.

The principles apply specifically to vehicles of class M and N[5] (including passenger cars, trucks and buses) although some aspects may also be valid for other vehicle classes. The principles apply to both portable and permanently installed systems. They apply to OEM systems and to after market and nomadic devices. The principles apply to HMI functionality independent of the degree of integration between systems.

[5] Classification and definition of power-driven vehicles and trailers (UNECE TRANS/WP.29 /Rev.1/Amend.2/Annex 7, 16 April 1999)

STAKEHOLDERS INVOLVED IN SYSTEM USE

The driver can be supported in the safe operation of in-vehicle systems while driving by:

- Making individual system design as good as possible (installation, information presentation, interaction, system behaviour, user documentation)
- Making other aspects of the context of use as benign as possible. These non-system design aspects of the context of use can be called the “Human Machine Environment”

In the same way that the principles in the ESoP have been formulated to inform and influence those organisations responsible for (or contributing to) system design and construction, the use principles here in the RSU have been formulated to inform and influence those organisations that are responsible for (or contribute to) the human-machine environment of system use. This environment 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, this environment also includes:

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

1. Principles on Influencing Use

Principle 1.1:

Employers should ensure that all in-vehicle information systems are maintained in accordance with the manufacturer's instructions.

Explanation:

It is expected that the product-responsible organisation will, according to ESoP principle 6.1, produce instructions concerning how the information systems should be maintained (physical issues, hardware, replaceable parts, software and software updates etc.)

The employer should ensure (by direct action, contract or instruction) that all recommended maintenance actions are carried out. This is to help ensure that the product supports the driver as much as possible.

Examples:

Good: The route guidance system's map CD is updated regularly (e.g. annually) as recommended by the manufacturer.

Bad: The employer has no records of their vehicles' information systems and undertakes no maintenance. As a result digital maps become progressively out-dated.

Applicability:

The principle applies to in-vehicle information and communication systems that, based on the product responsible organisation's recommendations, require maintenance.

Verification/Applicable Methods:

The employer should maintain a permanent record of maintenance actions. These records should be in accordance with the manufacturer's instructions.

Verification is by inspection; **Result = Yes/No**.

Principle 1.2:

Employer's procedures and incentive schemes should not cause or encourage system misuse. There should be a clear distinction between systems or functions that are intended (by the employer) to be used while driving and those that are not.

Explanation:

Employers are expected to have procedures concerning the conduct of their employees. Those related to use of in-vehicle information and communication systems should support safe driving practice. Therefore, the procedures should discourage listening to, or reading, complex information while driving. They should not put the employee in a position where they are required to make difficult business decisions 'live' on the phone.

Similarly, company reward (incentive) or punishment schemes should not encourage system misuse by implicitly encouraging time saving by inappropriate use of systems while driving.

For each system, the employer should make it clear, by specific written instructions and procedures, whether a system (or functions of a system) may be used while driving or whether such us is not permitted by them to be used. This removes the situation where individual drivers make personal (and often not well-founded) decision concerning system use.

Where multiple (non-integrated) systems are available to drivers, restrictions for use of multiple systems should be documented (e.g. do not use system A simultaneously with system B while driving).

Examples:

Good: Company policy forbids all mobile phone use while driving

Bad: The company reward scheme is related to the number of deliveries completed in a fixed time period and this encourages use of a system not designed for use while driving to be so used.

Applicability:

The principle applies where there is an employer-employee relationship, where driving is part of the task, and where the information systems are supplied by the employer.

Verification/Applicable Methods:

1. Clear permanent instructions are provided to the drivers that list any systems or functions of a system that should not be used simultaneously with driving

2. The employer periodically checks the employee's knowledge and understanding of company procedures and which functions or systems should not be used while driving

Verification of the adequacy of the procedures requires judgement. Adequacy can also be assessed from the point of view of the employees.

Principle 1.3:

Adequate training should be given on all in-vehicle systems that drivers are required to use by employers while driving. Employers should ensure that employees can use the systems without endangering themselves or other road users.

Explanation:

The principle requires employers to identify which information systems their drivers need to use and to provide training such that principles for safe use are fully explained to them. It also requires some assessment of whether, in practice, each employee can undertake the dual task of system use and safe driving at the same time.

The need for this principle arises from the different physical and cognitive abilities of drivers and the need to assess, on an individual basis, that they are capable of undertaking the required job. The job in this case involves driving and simultaneous use of an information or communication system. The rationale is that training improves performance and safety.

Where multiple (non-integrated) systems are involved, training and documentation should describe how tasks can be achieved using multiple systems; training on individual systems is not a complete solution.

Note that the driver will always be expected to attend to safe driving as the primary task (as required by the 1968 Vienna Convention) and may, therefore, abandon or suspend use of an in-vehicle information or communications system as external circumstances require.

A relevant EC directive exists:

Directive 2003/59/EC of the European Parliament and of the Council of 15 July 2003 on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC) No 3820/85 and Council Directive 31/439/EEC and repealing Council Directive 76/914/EEC.

Examples:

Good: The Employer has an ongoing monitoring and assessment programme that includes expert assessor observation of driving performance whilst simultaneously using the information system. It also solicits feedback from drivers.

Bad: The employer states that a system may (or should) be used while driving, but does not monitor in any way the impact that this has on driving performance and safety.

Applicability:

The principle applies where there is an employer-employee relationship and where driving is part of the task and where the information systems supplied by the employer need to be used while driving, or may be used while driving according to the employers procedures.

Verification/Applicable Methods:

1. Employer identifies systems that their drivers are required to use as part of their job.

2. Drivers are trained on system use

3. Employer periodically checks the employee's knowledge and understanding of the system's operation and functionality

4. Employer periodically checks that the employee can use the system safely while driving.

Verification requires assessment and judgement.

Principle 1.4:

Employers should ensure that a copy of the manufacturer's instructions for use is available in every equipped vehicle.

Explanation:

Since some information and communication systems are rich in features and some of the functions are used rarely, there are often situation when a driver needs to refer to some instructions in order to undertake a task. Without instructions, the driver may be more frustrated or distracted by the system or may be unable to complete their task.

The principle requires the employer to ensure that there are user instructions available and that a copy is provided in each vehicle used by their employees.

Where multiple (non-integrated) systems are involved, training and documentation should describe how tasks can be achieved using multiple systems; one instruction manual per system is not a complete solution.

Examples:

Good: The telephone manufacturer provides user instructions and the employer places a copy in each vehicle and periodically checks that it is present.

Bad: No user manual is provided or no system is in place to ensure that a copy remains in each equipped vehicle.

Applicability:

The principle applies where there is an employer-employee relationship and where driving is part of the task and where the information systems are supplied by the employer.

Verification/Applicable Methods:

The test is presence within each relevant vehicle of the correct user instructions.

Verification is by inspection; **Result = Yes/No**.

Principle 1.5:

Point of sale promotion (e.g. advertising) should not encourage unsafe use.

Explanation:

This principle is intended to assist the driver in appreciating the functionality, benefits and limitations of the system before (and during) use and to promote road safety. It is also designed to encourage compliance with consumer protection requirements, EC Regulations and existing codes concerning advertising.

Promotional materials include those provided by the point-of-sale in instructions (diagrams etc.), photographs, films computer animations, sound clips and any form of product information or advertising that users or potential users of the system may be exposed to.

Unsafe use means anything which is in conflict with these principles or with safe driving codes.

Examples:

Good: Photographs of the system being used as intended by the manufacturer and following all relevant codes and Regulations.

Bad: A photograph showing a hand-held telephone being used while driving.

Applicability:

The principle applies to any product related information provided by the point-of-sale for all in-vehicle information and communication systems.

Verification/Applicable Methods:

The test is accordance with the advertising code of practice.

Verification is by inspection; **Result = Yes/No.**

Principle 1.6:

Point of sale information should inform vehicle purchasers of the safety issues associated with in-vehicle information systems.

Explanation:

Drivers are influenced in their use of in-vehicle information and communication systems according to their knowledge about the system and their appreciation of the risks of use. In order to promote risk-aware driving, and hence contribute to safety, drivers need to be well informed concerning the systems that they use.

In addition to user experience and the manufacturer's user instructions, drivers should be able to obtain information from the point-of-sale.

Therefore, this principle requires that suitable information exists and/or that point-of-sale personnel to have adequate knowledge in order to inform purchasers of the safety issues.

Examples:

Good: At the point-of-sale all personnel involved with customers have basic knowledge concerning safe use of information and communication systems. In addition, certain personnel have more in-depth knowledge and can advise drivers concerning safe practice.

Bad: No-one at the point-of-sale is aware of the information systems, how they function and the safety issues associated with their use. There is also no information available to potential purchasers.

Applicability:

The principle applies to first sale of all in-vehicle information and communication systems.

Verification/Applicable Methods:

1. Undertake a risk assessment concerning use of the system

2. For major risks, develop suitable material for the purchasers

Verification of the adequacy of the procedures requires judgement. Adequacy can also be assessed from the point of view of the purchasers.

Principle 1.7:

Vehicle hire companies should ensure that all information and communication systems are maintained in accordance with the manufacturer's instructions.

Explanation:

It is expected that the product-responsible organisation will, according to principle 6.1, produce instructions concerning how the information systems should be maintained (physical issues, hardware, replaceable parts, software and software updates etc.)

The vehicle hire company should ensure (by direct action or contract) that all recommended maintenance actions be carried out.

Examples:

Good: The route guidance system's map CD is updated annually as recommended by the manufacturer.

Bad: The hire company has no records of their vehicles' information systems and undertakes no maintenance. As a result digital maps become progressively out-dated.

Applicability:

The principle only applies to in-vehicle information and communication systems that, based on the product responsible organisation's recommendations, require maintenance.

Verification/Applicable Methods:

The test is:

1. The vehicle hire company should maintain a permanent record of maintenance actions.

2. These should be in accordance with the manufacturer's instructions.

Verification is by inspection; **Result = Yes/No.**

Principle 1.8:

Vehicle hire companies should ensure that a copy of the manufacture's instructions for use is available in every equipped vehicle.

Explanation:

Since some information and communication systems are rich in features and some of the functions are used rarely, there are often situation when the driver needs to refer to some instructions in order to undertake a task. Without some instructions, the drivers may be more frustrated or distracted by the system or may be unable to complete their task.

The principle requires the hire company to ensure that there are user instructions available and that a copy is provided in each vehicle used by their customers.

Examples:

Good: The telephone manufacturer provides user instructions and the hire company places a copy in each vehicle and periodically checks that it is present.

Bad: No user manual is provided or no system is in place to ensure that a copy remains in each equipped vehicle.

Applicability:

The principle applies where there is a hire relationship and where the information systems are supplied with the vehicle.

Verification/Applicable Methods:

The test is presence or absence within each relevant vehicle of the correct user instructions. Verification is by inspection; **Result = Yes/No**.

Principle 1.9:

Vehicle hire personnel should have adequate knowledge concerning in-vehicle information systems within the vehicles they make available and should offer instructions in their safe use.

Explanation:

Drivers are influenced in their use of in-vehicle information and communication systems according to their knowledge about the system and their appreciation of the risks of use. In order to promote risk-aware driving, and hence contribute to safety, drivers need to be well informed concerning the systems that they use.

In addition to user experience and the manufacturer's user instructions, drivers should be able to obtain information from their point of rental of the vehicle.

Therefore, this principle requires vehicle hire personnel to have adequate knowledge in order to inform purchasers of the safety issues.

Examples:

Good: At the rental outlet all personnel involved with customers have basic knowledge concerning safe use of information and communication systems. In addition, certain personnel have more in-depth knowledge and can advise drivers concerning safe practice.

Bad: No-one at the point of vehicle hand-over is aware of the information systems, how they function and the safety issues associated with their use.

Applicability:

The principle applies where there is a hire relationship and the vehicle is equipped with in-vehicle information and communication systems.

Verification/Applicable Methods:

1. Undertake a risk assessment concerning use of the system
2. For major risks, develop suitable material for the hirers

Verification of the adequacy of the procedures requires judgement. Adequacy can also be assessed from the point of view of the hirers.

2. Principles for Drivers

According to the Vienna Convention (1968), the driver must always be in full control of the vehicle and consequently has full responsibility for system use while driving. In addition, the following principles can be expressed to promote the safe use of in-vehicle information and communication systems:

- **2.1** Drivers should ensure that nomadic systems and after-market systems are installed in accordance with the manufacturer's instructions.

- **2.2** Drivers should ensure that all in-vehicle systems are maintained in accordance with the manufacturer's instructions.

- **2.3** Drivers are responsible for modifications to any system. These need to be in accordance with technical descriptions and should not contradict the information provided by the manufacturer.

- **2.4** Drivers should only use in-vehicle equipment as recommended by the manufacturer. This may require a period of familiarisation or training.

- **2.5** Drivers should only use information and communication systems while driving if it is safe to do so.

- **2.6** Nomadic systems should not be used hand-held or unsecured within the vehicle while driving.

- **2.7** All instructions associated with in-vehicle equipment should be retained with the vehicle and passed to the next vehicle owner or user.

Further information is available from:

http://www.europa.eu.int/information_society/programmes/esafety/index_en.htm

and from the

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