VOLVO

Document Number	Issue Number	Date	Page
6980-02941-01-04	1.0	14-Aug-2009	1 (19)
Author Company	Author Department, Name		Author Phone
Volvo Technology	Paul Piamonte, 6980		+1 (336) 393-3509
Customer Company	Customer Name		Customer Phone
New York State DOT	Rick McDonough		+1 (518) 457-5871
Customer Contract Number	Customer Contract Start/Finish Dates		
C030588	1-Jan-2009 to 31-Dec-2010		

Report

State of the art Review on Information and Warning Strategies for the CVII Program

Responsible	Tom Richter
Established Date	20-Aug-2009
Archived until	14-Aug-2019
Classification	OPEN

VOLVO

Document Number	Issue Number	Date	Page
6980-02941-01-04	1.0	14-Aug-2009	2 (19)
Author Company	Author Department, Name		Author Phone
Volvo Technology	Paul Piamonte, 6980		+1 (336) 393-3509
Customer Company	Customer Name		Customer Phone
New York State DOT	Rick McDonough		+1 (518) 457-5871
Document Title		Type of Document	
State-of- the-Art Review on information and warning strategies		Report	

Contents

1 General Information

This document contains the state-of-the-art review on information and warning strategies related to the NYS CVII Project. The main focus of the review is on information and warning strategies ranging from in-vehicle information (where majority of the recent work has been done) to those concerning vehicle-vehicle and vehicle-infrastructure. This task will look on existing usability and safety interface design guidelines and recommendations, as well as latest researches performed in the US, Europe and Japan. Aside from an updated knowledge on information presentation and warning strategies relevant to V2I work, another output of the review will be a practical V2I driver interface specifications and requirements guidelines, to minimize driver distraction, information overload and annoyance.

1.1 Document Contacts

Company	Name	Phone	Email
VTEC	Paul Piamonte	+1 (336) 393-3509	paul.piamonte@volvo.com
VTEC	Tom Richter	+1 (336) 393-2371	thomas.richter@volvo.com

1.2 Revision History

Issue	Date	Author	Changes
1.0	20 Aug 2009	Paul Piamonte	Originated

1.3 Abbreviations

BOS	Back-Office Systems
CAN	Controller Area Network
CDL	Commercial Drivers License
CVII	Commercial Vehicle to Infrastructure Integration
CVO	Commercial Vehicle Operations
DOT	Department of Transportation
ECU	Electronic Control Unit
GUI	Graphical User Interface
HMI	Human-Machine Interface
HVI	Human-Vehicle Interaction
ITS	Intelligent Transportation Society
KTC	Kapsch TrafficCom Inc.
MCNU	Multiband Configurable Networking Unit
N/A	Not Applicable
NYS	New York State
NYSDOT	New York State Department of Transportation
OBE	On-Board Equipment
RSE	Roadside Equipment
SAE	Society of Automotive Engineers
TTU	Volvo Telematics Terminal Unit
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
VII	Vehicle to Infrastructure Integration
VTEC	Volvo Technology
WRI	Wireless Roadside Inspection

2 CVII Program Scope

CVII (Commercial Vehicle Infrastructure Integration) is a term coined by New York State DOT (NYSDOT) to refer to the development, adaptation and application of VII using 5.9GHz dedicated short range communications (DSRC) to commercial vehicles (trucks). CVII is a technology program that enables a variety of safety, mobility and security applications.

CVII is anticipated to provide the following advantages, encompassing all of the VII functions and applications, but with specific application to commercial vehicles:

- Safety advantages
- Transportation system efficiency advantages
- Driver convenience advantages
- Regulatory advantages
- Traffic operations advantages

2.1 Report Objectives

This document aims to deliver a state-of-the-art review on information and warning strategies ranging from in-vehicle information (where majority of the recent work has been done) to those concerning vehicle-vehicle and vehicle-infrastructure applications. Focus will be given on related and existing usability and safety interface design guidelines and recommendations, as well as latest researches performed in the US, Europe and Japan. Aside from an updated knowledge on information presentation and warning strategies relevant to V2I work, another output of the review will be a practical V2I driver interface specifications and requirements guidelines, to minimize driver distraction, information overload and annoyance. System architecture as well hardware and software requirements are beyond the scope of this task and hence not covered in this document.

3 Human-Vehicle Interface

A safe and efficient Human-Vehicle Interface (HVI) is a major ingredient towards the realization of intelligent road vehicles with higher safety and value-added services. The HVI will be the bridge between the vehicle's driver and Telematics Gateway. The HVI allows for information to be collected from the driver (e.g. driver authentication) and for the presentation of information to the driver (e.g. dynamic travel information, electronic roadside signage, truck parking availability, etc.). Thus, all of these interactions must occur in a safe, efficient and productive manner in order to realize the envisioned benefits of CVII in enabling a variety of safety, mobility and security applications.

3.1 Advances in human-vehicle interface research and development

The current advances in research and development on HVI relevant to CVII can be traced to the growth of Advanced Driver Assistance Systems (ADAS) and In-vehicle Information Systems (IVIS) being introduced in modern vehicles. ADAS include speed alert, lane support/blind spot detection, automated safe following, pedestrian detection, vision enhancement and driver impairment monitoring. In contrast to ADAS, IVIS provide services not directly relevant for the primary driving task and thus imposing secondary tasks on the driver. Moreover, the in-vehicle use of portable computing devices e.g. hand-held mobile phones and portable digital assistants (PDAs), often referred to as Nomad devices, is increasing rapidly.

Furthermore aside from the ADAS and IVIS functions, third-party applications are now proliferating such as telematics' Vehicle-Vehicle (V2V), and Vehicle-Infrastructure (V2I) applications. CVII related applications typify these V2V and V2I applications. They can be broadly seen as ADAS- and/or IVIS-related, with their functions and information mainly provided or coming from the infrastructure, i.e. outside the vehicle. The introduction of V2V and V2I applications in vehicles are seen to cause the vehicle horizon to be extended in time and space.

The attraction and proliferation of these systems especially among commercial vehicles can be attributed to their great potential for increasing mobility and comfort. For example fleet management systems enhance the efficiency of work in the freight industry and road-and traffic information systems potentially facilitate the quality of life for the commuter. However, information systems in vehicles may also compete with the primary driving task for the driver's attention and hence induce dangerous levels of distraction and workload. CVII applications

are basically telematics-driven and thus provide information to the driver that can be ADAS or IVIS related but pertaining more to the broader horizon outside the vehicle – those from other vehicles and the highway infrastructure. For example, existing traffic management systems (TMS) and freight distribution management systems (FDMS) tend to operate independently of one another. Freight distributors seem to make little use of traffic data available from TMS or other sources. With telematics technology offering the possibility of integrating these two, the driver will now have to contend with much more information aside from the current ADAS and IVIS.

Thus, the design of the HVI is of key importance for minimizing the workload and distraction that they impose on the driver. Methods and criteria are needed to validate these systems with respect to their potential negative safety effects.

This document will go through the latest information on human-vehicle interfaces in terms of research and development as well as standards and guidelines in the fields of system design and message prioritization, evaluation and assessment, and development process that are relevant to the CVII project in terms of its HVI work.

3.1.1 State-of-the-art on human-vehicle interfaces research

With the onset of multiple ADAS, IVIS and telematics applications such as V2V and V2I into the vehicle, the amount of information that the driver deals with has become enormous. Hence, integrating and adapting HVI are currently hot topics in the automotive industry, and both the government and the private sector are investing heavily in these areas in Europe, US and Japan. The most important developments to date are listed in Table 3.1.

Table 3.1. Overview of major finished and ongoing initiatives in the area of driver-vehicle interfaces with description of their HMIs.

Initiative	Area/ Status	Description	Description of HMI	References
IN-ARTE	EU/ finished	The main work was to integrate route navigation and collision avoidance. It also integrated other secondary functionalities, such as sharp curves speed and lane departure warnings, excessive speed warnings, etc.	Tested different combinations of displaying message - icons, written text, and voice messages available. Interesting result was the high understanding, intuitiveness and acceptance of icons symbolizing actual road signs for speed limits	Frese and Becker (1999)
CEMVOCAS	EU/ finished	Design and development of an integrated HMI for vocal interaction between the driver and the vehicle.	The audio channel was adaptable to 3 levels of "situational demand" computed based on available in vehicle mechanical parameters (e.g. steering wheel and pedals).	Bellet et al. (2002).
COMUNICAR	EU/ finished	The aim was to design and develop an in-vehicle multimedia HMI that would be able to manage the messages coming from several functions concerning ADAS, telematics links, comfort and convenience aids	- Similar HMI devices (haptic input device, two configurable displays) and the HMI solutions (in terms of implemented functions, graphic layout, look and feel and on board integration) specific for two vehicle models (Volvo, Alfa Romeo cars) - Used the same simple 3 level "situational demand" estimation as CEMVOCAS, but managed visual information as well.	Amditis et al. (2002)
TRAVELGUIDE	EU/ finished	This project aimed to evaluate the impact of information provided by telematics systems and to obtain information concerning their usability and acceptability to the driver/user	Included HMI for Internet, SMS, RDS, VMS (Variable Message Signs), and Radio	Andreone et al. (2002)
MOTOROLA's Driver Advocate	US/ finished	Development of HMI solutions for the integration of multiple ADAS and IVIS	Focus on driver information management functions that "filter and prioritize incoming	Wheatley (2002), Remboski et

Initiative	Area/ Status	Description	Description of HMI	References
		functions.	information and present the right information at the right time and in the right way to support the primary task of driving". Implemented in simulator prototype.	al. (2000)
Delphi Integrated Safety Systems	US/ finished	Development of a generic solution for integrating ADAS and other safety systems.	- HMI components (interface devices) mainly controlled by a workload manager based on real-time driver state monitoring. Implemented in a demonstrator vehicle.	Delphi (2003)
SAVE-IT (SAfety VEhicle using adaptive Interface Technology)	US/ finished	Developing, demonstrating and evaluating "the potential safety benefits of technologies and methods that manage the information from various in-vehicle systems (e.g. cell-phones, navigation systems, Internet applications and warning systems) based on real-time monitoring of the roadway environment and the driver capabilities to attend to the demands of the driving task."	HMI components included in the tests: - Visual displays in text and icons (LCD, HUD), and warning lamps - Speech output c - Sound signal output - Blinking warning lamps (amber and red)	NHTSA/ VOLPE (2002)
DaimlerChrysler/ MIT SmartCar	US/ finished	Develop an "automobile integrated system for assessing and reacting to driver cognitive load"	Different displays including alarms, warnings and communications were selectively suppressed or dynamically reconfigured to maximize driver attention on the road scene and avoid cognitive overload. Implemented in a test car.	Pompei et al. (2002)
Toyota	Japan/ finished	Development of techniques for managing voice information based on drivers' mental workload.	Mostly on use of voice or speech interface	Uchiyama et al. (2002)
AIDE (Adaptive and Integrated Driver-Vehicle Interface)	EU/ finished	Development of adaptive integrated HMI for ADAS and IVIS in road vehicles. The general objectives of the project are a) to model and simulate behavioral affects of	- Used all channels of modality or interfaces available (i.e. visual, auditory, voice/speech, and haptic/kinesthetic) alone and in combinations	AIDE (2008)

Initiative	Area/ Status	Description	Description of HMI	References
		ADAS and IVIS, b) to develop a generic methodology for the evaluation of HMI with respect to safety, and c) to develop and evaluate prototypes with an adaptive integrated HMI implemented.	- Main info and warning strategy based on what it called *meta-functions ("functions that control other (more basic) functions)*, composed of HMI I/O management, action prioritization, DVE scheduling, and warning adaptation to DVE	
IVBSS	US/ ongoing	UMTRI and partners aim to develop and test a new, integrated crash warning system in a fleet of 16 passenger cars and 10 heavy-duty trucks.	Several collision warning systems will be integrated into one vehicle in a way that alerts drivers to potential collision threats with an effective driver vehicle interface (DVI), while minimizing the number of excessive warnings presented to the driver. The warnings are when drivers are about to leave the roadway, when in danger of colliding with another vehicle while attempting a lane change, or are at risk of colliding with the vehicle in front of them.	IVBSS (2009)
CVIS (Cooperative Vehicle-Infrastructure Systems)	EU/ ongoing	The project aims to design, develop and test technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure. Based on real-time road and traffic information, many novel applications can be produced leading to increased road safety and efficiency, and reduced environmental impact.	- Mainly use of existing in-vehicle visual display (LCD) - Icons, text messages, maps - Acoustic or auditory display (warning sounds) also used depending on type and criticality of message	CVIS (2009)
SAFESPOT (Cooperative Systems for Road Safety)	EU/ ongoing	It aims to design cooperative systems for road safety based on vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication. Main concept being developed is	- For each application, the messages were classified into three warning levels (comfort, safety, critical) according to the urgency and intensity of required	SAFESPOT (2009)

Initiative	Area/ Status	Description	Description of HMI	References
		called the "SAFETY MARGIN ASSISTANT" that will detect in advance potentially dangerous situations and extend, in space and time, drivers' awareness of the surrounding environment.	intervention - Safety and critical messages are multimodal involving at least an appropriate acoustic signal ("auditory icon") complemented by visual/ kinesthetic / haptic stimuli. - If preferred and possible, comfort messages can be designed without acoustic warning stimuli	
HAVE-IT (Cooperation for Automation)	EU/ ongoing	This project aims to help realize the long-term vision of highly automated driving for intelligent transport. The project will develop, validate and demonstrate important intermediate steps towards highly automated driving. Of interest is work on HVI for semi-automated functions, i.e. how to keep the driver "in the loop" even under autonomous driving conditions	Under development	HAVE-IT (2009)
SMARTFREIGHT	EU/ ongoing	The main aim is to specify, implement and evaluate Information and Communication Technology (ICT) solutions that integrate urban traffic management systems with the management of freight and logistics in urban areas. The actual transport operations carried out by the freight distribution vehicles will be controlled and supported by means of wireless communication infrastructure and on-board and on-cargo equipment	Under development	SMART FREIGHT (2009)

Table 3.1 above summarizes the numerous major initiatives that aimed to develop integrated driver-vehicle interfaces in Europe, the US as well as in Japan.

Majority of the earlier projects focused on ADAS and IVIS integration, specifically on information and warning presentation, and how this can be done without cognitive overloading of the driver. The latter ones have more direct implications to the CVII HVI work. Nonetheless, the general information and warning strategy employed in these projects used the 3-level warnings, of which their levels of criticality and prioritization to be displayed when and how (i.e. visual, acoustic, haptic, or their combinations) depended on the type of information management (ex. from simple rule-based system to dedicated information management systems receiving and processing all data from relevant sensors).

The latter projects such as the US SAVE-IT and EU's AIDE projects dealt with information management for applications emanating from the usual ADAS and IVIS and even those "outside" the vehicle such as nomadic devices (i.e. mobile phones and PDAs), internet, and freight/goods handling (for trucks in the AIDE project).

The SAVE-IT system was a set of interconnected subsystems that monitor the driver, the driving environment, and the in-vehicle systems in order to gauge driver distraction, driving demand, task load, and safety during critical driving events. It uses a single-camera to monitor driver state and to determine whether the driver is attending to the roadway. Driver alerts for warning systems were auditory tones, visual icons, and haptic cues. Distraction mitigation alerts were in the form of changes to the display color of buttons and function lock-out associated with the IVIS display.

The AIDE HMI information and warning strategy was basically the same across its 3 demonstrator vehicles (city car, luxury car, and commercial truck). The strategy employed the common 3-level display, i.e. informational, cautionary, and critical. An information manager called Information Communication Assistant (ICA) handles all messages targeted for presentation to the driver, then prioritizes them and decides which communication channel or modality (visual, acoustic, haptic, or combinations) to use, based on the workload level of the driver.

The SAFESPOT HMI was designed to allow different (both in-vehicle and external) applications to be able to present warning messages to the user (mainly the driver). All the requests of using the HMI by these different applications were scheduled by an Application Manager. For the built-in applications, the priority is based on the function of the internal state (comfort, safety, critical) of each

application. The priority levels between applications had to be done, in order to allow the Application Manager to drive the HMI toward the most critical application requiring immediate action. The application selected by the Application Manager is allowed to send its message to the HMI. The HMI manager would then decide to send the signal to what was called HMI actuator (i.e. visual display, speaker, haptics) also taking into consideration the type of vehicle that had to be supported, since each type of vehicle used its own (different) HMI actuators.

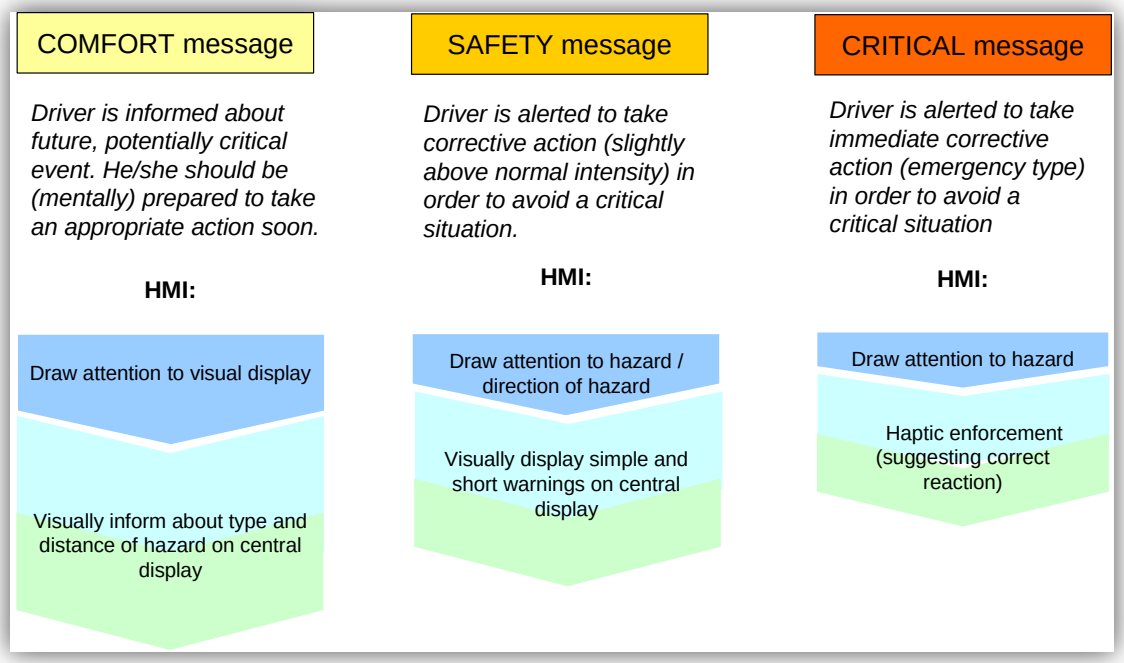

Figure 1: SAFESPOT HMI design guidelines based on SMA concept

For each application, the messages were classified into three warning levels (comfort, safety, critical) according to the urgency and intensity of required intervention (Figure 1). If preferred, comfort messages could be designed without acoustic stimuli, if they are deemed too distracting or irritating.

In the comfort stage, the signal should draw attention to the central screen of the vehicle which shows information about the type and the distance of the hazard. In the safety stage a suitable signal should attract the driver's attention and also indicate the direction of the hazard. Short and intuitive visual information should inform the driver to perform the correct actions. The character of the warning

should be more urgent than the one for the comfort stage since the time horizon is shorter. In the critical stage a clear signal must direct the driver's attention towards the hazard. Since the time horizon is very narrow in this situation slight system intervention could suggest the correct action in an intuitive and quick manner.

One distinct property of the SAFESPOT HMI was the possibility for the driver to select some visualization options. For example, the driver could decide to disable all the comfort signals because if he/she did not want to be distracted for non-critical warnings.

3.1.2 Major initiatives in road vehicle HMI evaluation methods and design guidelines

Extensive efforts have been performed during the past decade on road vehicle HMI evaluation methods and design guidelines. The ISO, SAE and non-ISO standards and guidelines relevant to the CVII project are listed on Tables 3.2 and 3.3.

Table 3.2. ISO and SAE standards relevant to CVII

Standard	Subject
ISO 2575	Symbols for representing certain vehicle functions on controls and displays
ISO13407	User-centered design for interactive systems
ISO15005	Dialogue management principles and compliance procedures for traffic information and control systems
ISO 15006	Auditory information presentation
ISO15007; SAE2396	Visual demand measurement
ISO15008	Ergonomic aspects of in-vehicle presentation of information given by traffic information and control systems.
ISO16951; SAE2395	Message prioritization
ISO17287	Procedure for assessing suitability for use of traffic information and control systems while driving

Table 3.3. Major Non-ISO Telematics guidelines and recommended practices standards (from Green, 2007 in Sears and Jacko, 2007).

Common Document Name	Reference	Size (pages)	Comments
Alliance guidelines	Alliance of Automobile Manufacturers (AAM) (2003 June 17); version 3	67	Restatement of EU principles, plus considerable details and rationale, to be used by almost all manufacturers in U.S.; key sections are principles 2.1 and 2.2, which still need development; still being updated by AAM
Battelle guidelines	Campbell, Carney, and Kantowitz, (1997)	261	Voluminous document with references to interface design, heavy on trucks. User interface has been said to have a Windows OS flavor, includes physical ergonomics information (e.g., legibility, control sizes) which are not included in the UMTRI guidelines.
EU guidelines	Commission of the European Communities (1999)	2	Mostly "motherhood" statements. Some revisions are expected.
HARDIE guidelines	Ross, Midtland, Fuchs, Pauzie, Engert, Duncan, Vaughan, Vernet, Peters, Burnett, and May (1996)	480	Early set of European guidelines, less data than UMTRI or Battelle.
JAMA guidelines	Japan Automobile Manufacturers Association (2004)	15	First set of detailed design guidelines for driver interfaces. These guidelines are voluntary in Japan but followed by all OEMs there and sometimes by aftermarket suppliers. Some aspects are particular to Japan. Device location restrictions are important.
SAE J2364 ("15-second rule")	Society of Automotive Engineers (2004, August)	13	Specifies the maximum allowable task time and test procedures for navigation system tasks performed while driving for systems with visual displays and manual controls; also describes an interrupted vision (visual occlusion) method as well; See also SAE J2678.
SAE J2365 (SAE calculations)	Society of Automotive Engineers (2002, May)	23	Method to compute total task time for tasks not involving voice used early in design to estimate compliance.
TRL checklist	Quimby (1999)	18	Simple check list
UMTRI guidelines	Green, Levison, Paelke, and Serafin (1993)	111	First set of comprehensive design guidelines for the U.S. (includes principles, general guidelines, and specific design criteria with an emphasis on navigation interfaces.

3.2 General driver interface specifications and requirements for CVII's HVI

Listed below are the general specifications and requirements for CVII's HVI extracted from the review of state-of-the-art vehicle HMI research, as well as relevant standards and guidelines:

3.2.1 Visual interface (Graphical User Interface, GUI)

3.2.1.1 The main visual display should be placed in the central part of the dashboard, or in direct line of sight of driver when driving

3.2.1.2 There shall be three levels of notifications

- Critical/Safety-related
- Convenience
- Informational/commercial

3.2.1.3 Consistent GUI - Notifications of the same priority shall use a consistent layout with common graphical elements and color palette (e.g. icons, title bar text, message placement, notification border color, background color, etc.)

3.2.1.4 Visual display information should be visible and dynamically updated within the comfort, safety and critical stages. It must be guaranteed that visual information is displayed long enough to be read by the driver.

3.2.1.5 Use of both symbols such as icons and brief text messages to describe status and action recommended.

3.2.1.6 The presentation of speed limits and other road information should be given in form of icons, or symbols akin to actual road signs.

3.2.1.7 Any redundant information/warnings should be presented in the form of icons.

3.2.1.8 Flashing of warning lights and/or icons must be reserved for really critical, safety-related warnings.

3.2.2 Acoustic (sound) interface

3.2.2.1 Distinctly different acoustic warning for the different levels of information/warning (i.e. Critical and convenience)

3.2.2.2 Sound level shall be higher than ambient sound but not higher than 80dB. Alternative is use of automatic mute function of in-vehicle sound (ex. from radio, CD-player, phone, etc.)

3.2.2.3 Use of bi-directional sounds (laterality aspect) is recommended especially when conveying source or location of interest is important (ex. crash object)

3.2.2.4 If preferred and possible, comfort messages can be designed without acoustic warning stimuli, provided that the visual stimulus alone can attract the driver's attention in time.

3.2.2.5 Haptics (ex. vibrations) can be used in lieu of sound

3.2.3 Bi-modal or multi-modal interface (visual and acoustic/haptic displays)

3.2.3.1 Reserved for mission critical, safety-related warnings involving at least an appropriate acoustic signal ("auditory icon") complemented by visual/ kinesthetic / haptic stimuli.

3.2.3.2 Simultaneously triggered

3.2.4 Others

3.2.4.1 HVI should be partially configurable by the driver in particular for comfort messages (e.g. deactivation or selection of warning sound for comfort messages).

3.2.4.2 In cases when imminent risk or risk cause does not exist, the visual warnings should exclusively be activated.

3.2.4.3 HVI should be effective and accepted independently from the type and class of the vehicles.

REFERENCES

AIDE. 2002. *Adaptive Integrated Driver-vehicle InterfacE*. http://www.aide-eu.org/.

Amditis A., Polychronopoulos A., Belotti F., Montanari R. 2002. Strategy plan definition for the management of the information flow through an HMI unit inside a car. *e-Safety Conference Proceedings*, Lyon,

Andreone L. et. al. 2002. *TRAVELGUIDE Deliverable 5: Evaluation of pilots and testing*.

Bellet, T. et al. 2002. "Real-time" Analysis of the Driving Situation in Order to Manage On-board Information. *e-Safety Conference Proceedings*, Lyon.

CAMP. 2000. Proposed Driver Workload Metrics and Methods Project. In *NHTSA Driver Distraction Internet Forum: Summary and Proceedings*, July 5 – August 11, 2000.

Carsten, O.M.J. and Nilsson, L. 2001. Safety assessment of driver assistance systems. *European Journal of Transport and Infrastructure Research*, 1(3): 225–243.

CVIS. 2009. *Cooperative Vehicle-Infrastructure Systems.* http://www.cvisproject.org/en/cvis_project/.

Delphi. 2003. *Integrated Safety Systems*. http://www.delphi.com/pdf/vpr/products/iss.pdf

Frese T., Becker S. 1999. *IN-ARTE Deliverable 3.3: User Needs Analysis and Assessment of impacts to traffic safety, October 1999*.

HAVEit. 2009. *Cooperation for Automation.* http://www.haveit-eu.org/displayITM1.asp?ITMID=6&LANG=EN.

NHTSA/Volpe. 2002. *Broad Agency Agreement (BAA). Demonstration and evaluation of technologies for SAfety VEhicle(s) using adaptive Interface Technology (SAVE-IT).* DTRS57-02-R-20003.

Nilsson, L. et al. 2002. *Pilot Evaluations*. Deliverable D5.2, ADVISORS Project (GRD1-2000-10047), Fifth Framework, Competitive and Sustainable Growth Programme (1998-2002), Commision of the European Communities, DG TREN.

Pompei, F. J., Sharon, T., Buckley, S. J. and Kemp, J. 2002. *An Automobile Integrated System for Assessing and Reacting to Driver Cognitive Load*. SAE Paper 2002-21-0061.

Remboski et al. 2000. Driver Performance Improvement Through the Driver Advocate™: A Research Initiative Toward Automotive Safety. SAE paper 2000-01-CO75.

Richardson, J & Priez, A. 2002. Roadsense: A Common Approach to the Evaluation of Human Vehicle Interaction (HVI). *ITS World Proceedings*, Chicago.

SAFESPOT. 2009. *Cooperative Systems for Road Safety.* http://www.safespot-eu.org/.

SMARTFREIGHT. 2009. *Smart Freight Transport in Urban Areas.* http://www.smartfreight.info/.

Uchiyama, Y., Kojima, S., Hongo, T., Terashima, R. and Wakita, T. 2002. Voice Information System Adapted to Driver's Mental Workload. *Proceedings of the Human Factors and Ergonomics Society 46:th Annual Meeting.*

UMTRI. 2009. *Integrated Vehicle-Based Safety Systems.* http://www.umtri.umich.edu/divisionPage.php?pageID=249

Wheatley, D. 2002. The Human as a System Component in the Vehicle. *e-Safety Conference Proceedings*. Lyon.

Sears, A. and Jacko, J. A. (eds.) 2007. *Human Computer Interaction Handbook, Second Edition.*Human Factors and Ergonomics.