



# SURFACE VEHICLE INFORMATION REPORT

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Definitions and Data Sources for the Driver Vehicle Interface (DVI)

## RATIONALE

The information in this document is intended to aid researchers and facilitate improved Driver Vehicle Interface (DVI) design and usability by establishing working definitions of key concepts and providing references to existing research in this area.

New automotive technologies such as crash avoidance systems, Connected Vehicles <sup>1</sup> (i.e., V2X), and vehicle automation offer many opportunities for improving mobility and driving safety. However, if in-vehicle systems, particularly the driver-vehicle interface (DVI), are not designed in a manner consistent with driver limitations and capabilities, these potential advantages may not be realized and these technologies can even lead to unintended negative outcomes.

Common definitions of key concepts are important for scientific advancement in these areas for several reasons. First, they enable effective communications among researchers and industry. Without common definitions, the relevance of others' work may not be recognized, or conflicting data may result due to the failure to detect that datasets are actually dealing with different in-vehicle systems. Second, it helps focus future research by ensuring researchers are working from a common reference. Third, it is difficult to compare and replicate studies if they do not use common definitions. Lastly, it helps establish credibility for the profession. Overall, having common definitions helps researchers avoid publishing research results that are unclear, inaccurate, misinterpreted, or inconsistent with related publications.

A comprehensive list of references to existing research is helpful to quickly discovering and accessing prior work; thus facilitating scientific advancement, and enabling effective communications among researchers. In this regard, the references to existing research in this document are deliberately limited to juried publications. However, other relevant data sources are available, and the reader is encouraged to pursue discovery and review of additional information such as related patents, scholarly opinion, newer publications, internet discussions, and news media articles.

NOTE: The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights.

<sup>1</sup> "Connected Vehicles" refers to "a multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices" (see also [http://www.its.dot.gov/connected\\_vehicle/connected\\_vehicles\\_FAQs.htm](http://www.its.dot.gov/connected_vehicle/connected_vehicles_FAQs.htm)).

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## INTRODUCTION

This information report provides a summary of the activities to-date of Task Force #1 - Research Foundations – of the SAE's Driver Vehicle Interface (DVI) committee. There are many promising technology-based solutions that address distracted driving by developing interfaces that mitigate, optimize, and minimize the attentional and physical demands of in-vehicle systems. However, an important key to their success is to integrate the technology properly - with both the driver and with the tasks that comprise driving (Angell, 2010). If this is done well, then technology can help the driver focus attention. If this is done poorly, then technology can further complicate, interfere with, and distract the driver.

The challenge of integrating the driver, the technology they use, and the task of driving is a difficult one – especially given that technologies may be carried into the vehicle (e.g., mobile phone, personal navigation device, etc.), transmitted into the vehicle (e.g., roadside unit, cloud-based server, etc.), or downloaded into an embedded vehicle module after the time of manufacture. A systems-level perspective and technology standards to ensure interoperability between subsystems should be used; for example, to preserve the manufacturer's ability to lock-out functions and features that would violate applicable driver distraction guidelines. It also requires a fundamental understanding of the part the driver plays in safe driving – with a priority on supporting the driver's ability to focus attention on the primary task of driving.

As technology progresses, there are some areas that are important for helping to prevent and mitigate distraction and high workload (see also Angell, 2010, 2012), for example:

1. Assuring that technologies are designed, developed, and integrated within the driver interface to minimize distraction and workload. This has to do with the need to assure that the basic technologies of the driver interface achieve this goal. It involves:
  - The application of good, basic DVI design practices
  - Harnessing techniques for: de-cluttering, lock-outs when demand is excessive, and perhaps safety-coaching and embedded training; maybe even very low-level dialog managers (e.g., delaying a phone call when the turn signal is on)
2. Developing and integrating new advanced technologies which can actively prevent and reduce distraction, as well as support the driver in managing attention and workload. This reflects the need to develop and apply technologies that actively support the driver in preventing distraction – or in preventing or mitigating safety conflicts or crashes should they arise. Such technologies/capabilities could include:
  - Active attention monitoring
  - Cueing the driver to return their attention to the road
  - Triggering of active safety and/or driver assistance systems (e.g., collision-imminent braking, lane-departure warning or prevention, etc.)

To support approaches such as these, this Information Report has been developed to provide information in each of these areas to aid the design and development of the driver-vehicle interface of in-vehicle technologies, systems, and applications. It does this by providing working definitions of key concepts and references to research in these areas.

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## 1. SCOPE

This document provides a summary of the activities to-date of Task Force #1 - Research Foundations – of the SAE's Driver Vehicle Interface (DVI) committee. More specifically, it establishes working definitions of key DVI concepts, as well as an extensive list of data sources relevant to DVI design and the larger topic of driver distraction.

## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

|           |                                                                                                                                        |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------|
| SAE J1138 | Design Criteria - Driver Hand Controls Location for Passenger Cars, Multipurpose Passenger Vehicles, and Trucks (10 000 GVW and Under) |
| SAE J2364 | Navigation and Route Guidance Function Accessibility While Driving                                                                     |
| SAE J2395 | ITS In-Vehicle Message Priority                                                                                                        |
| SAE J2396 | Definitions and Experimental Measures Related to the Specification of Driver Visual Behavior Using Video Based Techniques              |
| SAE J2400 | Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements                          |
| SAE J2802 | Blind Spot Monitoring System (BSMS): Operating Characteristics and User Interface                                                      |
| SAE J2830 | Process for Comprehension Testing of In-Vehicle Icons                                                                                  |

#### 2.1.2 Other Publications

Angell, L.S. (2010). *Using Technology to Prevent & Reduce Distraction*. Invited presentation to the USDOT National Distracted Driving Summit, September 21, 2010. Washington, DC.

Angell, L. S. (2012). *Driver Attention & Scanning: A Focus Area for Enhancing Safety in the Connected Vehicle Era*. Center for Automotive Research, Invited Talk, Breakfast Briefing Series. September 28<sup>th</sup>, 2012. Livonia, Michigan.

Foley, J. P., Young, R., Angell, L., & Dorneyer, J. E. (2013). Towards operationalizing driver distraction. *Proceedings of the Seventh International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design*, 57-63.

Regan, M.A., Hallett, C., & Gordon, C. P. (2011). Driver distraction and driver inattention: Definition, relationship and taxonomy. *Accident Analysis & Prevention*, 43(5), 1771-1781.

### 2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

#### 2.2.1 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>

|                    |                                                                                                             |
|--------------------|-------------------------------------------------------------------------------------------------------------|
| ANSI/HFES 100-2007 | Human Factors Engineering of Computer Workstations. Santa Monica, CA: Human Factors and Ergonomics Society. |
|--------------------|-------------------------------------------------------------------------------------------------------------|

## 2.2.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>

- |            |                                                                                                                                                                                                                               |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 15008  | Road Vehicles - Ergonomic Aspects of Transport Information and Control Systems - Specifications and Test Procedures for In-Vehicle Visual Presentation. Geneva: International Organization for Standardization (ISO).         |
| ISO 15623  | Transport Information and Control Systems - Forward Vehicle Collision Warning Systems - Performance Requirements and Test Procedures. Geneva: International Organization for Standardization (ISO).                           |
| ISO 16673  | Road Vehicles - Ergonomic Aspects of Transport Information and Control Systems - Occlusion Method to Assess Visual Demand Due to the use of In-Vehicle Systems. Geneva: International Organization for Standardization (ISO). |
| ISO 17361  | Intelligent Transport Systems - Lane Departure Warning Systems - Performance Requirements and Test Procedures. Geneva: International Organization for Standardization (ISO).                                                  |
| ISO 17387  | Intelligent Transport Systems - Lane Change Decision Aid Systems (LCDAS) - Performance Requirements and Test Procedures. Geneva: International Organization for Standardization (ISO).                                        |
| ISO 2575   | Road Vehicles - Symbols for Controls, Indicators and Tell-Tales. Geneva: International Organization for Standardization (ISO).                                                                                                |
| ISO 3461-1 | General Principles for the Creation of Graphical Symbols, Part I: Graphical Symbols for use on Equipment. Geneva: International Organization for Standardization (ISO).                                                       |
| ISO 7731   | Danger Signals for Public and Work Areas - Auditory Danger Signals. Geneva: International Organization for Standardization (ISO).                                                                                             |

## 2.2.3 FMVSS Publications

Copies of this document are available online at <http://ficsw.nhtsa.gov/cars/rules/standards/FMVSS-Regs/index.htm>.

Federal Motor Vehicle Safety Standard (FMVSS) No. 208, *Occupant crash protection [Docket No. 74-14; Notice 103]*, RIN 2127-AG14, to be codified at 49 C.F.R. pt. 571. 208. Retrieved from <http://www.nhtsa.dot.gov/cars/rules/rulings/Labels5.mlv.html>.

## 3. WORKING DEFINITIONS

### 3.1 DEFINITION OF DRIVER DISTRACTION

#### 3.1.1 Driver Distraction

The diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving (Regan, et al., 2011, p. 1776).

#### 3.1.2 Competing Activity

An activity or activities which place/s demands upon cognitive, auditory, vocal/verbal, visual, motoric, and other resources separately or in any combination-demands that are the same as or similar to the resources demanded by safe driving (hence giving rise to resource-competition), and which occur concurrently while driving (Foley et al., 2013, p. 61).

#### 3.1.3 Subsidiary Definitions Relevant to "Competing Activity" (all from Foley et al., 2013, p. 62)

##### 3.1.3.1 Visual Distraction

Any glance that competes with activities necessary for safe driving.

### 3.1.3.2 Manual Distraction

Any physical manipulation that competes with activities necessary for safe driving.

### 3.1.3.3 Auditory Distraction

Any period of aural stimulation that competes with activities necessary for safe driving.

### 3.1.3.4 Vocal Distraction

Any vocal utterance (or covert sub-vocal utterance) that competes with activities necessary for safe driving.

### 3.1.3.5 Cognitive Distraction

Any epoch of cognitive loading that competes with activities necessary for safe driving.

## 3.2 DEFINITIONS FOR RESOURCES

Resources are defined as (all from Foley et al., 2013, p. 61):

### 3.2.1 Cognitive

The alerting, executive, and orienting attentional networks singly or in combination, as well as the memory and representational systems (e.g., working and long-term) from which information may be retrieved and in which it may be held and operated upon.

### 3.2.2 Auditory

The sensory organs and associated neurological structures, pathways, and processes by which hearing and perceiving sound occurs.

### 3.2.3 Vocal/Verbal

The structures, pathways, and processes associated with speaking, verbalizing, or making utterances covertly or overtly.

### 3.2.4 Visual

The visual sensory organs and associated neurological structures, pathways, and processes.

### 3.2.5 Motoric

The motor/biomechanical system and associated structures of movement within the body.

### 3.2.6 Other

While not typically included in the discussion of resources in the context of driving, activation of "other" resources (for example, the structures, pathways, and processes associated with somatosensory/vestibular functions, smell, or taste) may also impact attention and result in distraction.

## 3.3 DEFINITION OF DRIVER WORKLOAD

### 3.3.1 Global definition of Driver Workload

The amount of physical and mental activity that is required to perform a particular task or set of tasks while driving.

#### 3.3.1.1 Overall Driver Workload

The amount of physical and mental activity that is required to perform a particular task or set of tasks while driving.

### 3.3.1.2 Average Driver Workload

The amount of physical and mental activity that is required to perform a particular task or set of tasks while driving over the time it takes to complete them.

### 3.3.1.3 Instantaneous Driver Workload

The amount of physical and mental activity over a specified unit of time that is required to perform a particular task or set of tasks while driving.

## 3.4 DEFINITION OF DISTRACTION MITIGATION SYSTEMS RELEVANT TO DVI DESIGN

Driver distraction and mitigation systems are likely to consist of several, somewhat independent, subsystems. Therefore, working definitions of the overall system, as well as each of the major subsystems, are needed to facilitate discussions on the topic. Below are some terms and associated definitions related to driver distraction and workload mitigation systems.

### 3.4.1 Definition for the Complete System Used to Mitigate Driver Distraction and Workload

#### 3.4.1.1 Driver distraction and workload mitigation system

A system, sometimes made up of several distributed subsystems with their own inputs and outputs, which helps a driver maintain situational awareness (or enhancing attentiveness) by drawing the driver's attention towards important roadway events and controlling the timing and format of communications with other objects (e.g., device and cloud-based applications, vehicle systems, etc.) based on the current roadway situation, driver abilities, and vehicle status.

### 3.4.2 Definitions for each of the Subsystems Used to Mitigate Driver Distraction and Workload

#### 3.4.2.1 Situational Awareness (SA) management subsystem

A subsystem of a "driver distraction and workload mitigation system" that controls when and how communications is presented to the driver based on information received from other subsystems that are responsible for monitoring the current roadway situation, driver abilities, and vehicle status.

#### 3.4.2.2 Roadway situation subsystem

A subsystem of a "driver distraction and workload mitigation system" that monitors the roadway situation via on-board sensors and communications with external objects (e.g., other vehicles, roadside infrastructure, cloud-based servers, etc.) to detect roadway hazards, predict escalating crash situations, and assess driver distraction and workload caused by the current roadway situation.

#### 3.4.2.3 Driver abilities subsystem

A subsystem of a "driver distraction and workload mitigation system" that assesses the abilities of a driver to handle driving and non-driving tasks based on stored driver profile data (e.g., deaf driver, historical driving behavior, etc.) and monitoring the current driver state (e.g., driver-facing camera, vehicle control data, etc.).

#### 3.4.2.4 Vehicle status subsystem

A subsystem of a "driver distraction and workload mitigation system" that monitors the status of vehicle controls and systems to assess driver distraction and workload caused by current interactions with the vehicle (e.g., adjusting climate control, etc.) and predict escalating crash situations (e.g., current speed, etc.).

#### 4. SUMMARY OF DATA SOURCES RELEVANT TO DVI DESIGN AND CONCEPTUALIZING DRIVER DISTRACTION

##### 4.1 Key Data Sources

Appendix A provides a list of search terms that can be used to identify literature relevant to specific issues or topics, and to generate candidate data sources/publications for use in DVI design.

Appendix B provides a list of publications that may be helpful for conceptualizing and developing DVIs for advanced automotive technologies and systems.

Appendix C provides a list of publications helpful for conceptualizing and defining driver distraction.

As noted above, the information provided in these appendices can help researchers and system developers discover and access prior work, thus facilitating scientific advancement in this area. In this regard, the references to existing research in this document are deliberately limited to published data sources. However, other relevant data sources are available, and the reader is encouraged to pursue discovery and review of additional information such as related patents, scholarly opinion, newer publications, internet discussions, and news media articles.

#### 5. NOTES

##### 5.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE SAFETY AND HUMAN FACTORS STANDARDS STEERING COMMITTEE

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## APPENDIX A – PRELIMINARY SEARCH TERMS FOR DVI DESIGN

- Accuracy
- Arbitration of Crash Warning Messages
- Automation to Reduce Workload and Distraction
- Characteristics of Controls (control movement compatibility)
- Coding for Physical and Virtual Controls, and Labeling
- Compatibility
- Complexity
- Consistency
- Conspicuity
- Customization
- Driver Distraction
- Designing Messages for Driver Comprehension
- Display Glare
- Display Type
- Distinctiveness
- Driver Training
- False and Nuisance Warnings
- General DVI-Driver Interactions
- General Guidelines for Automated Systems
- General Support to the Driver
- Guidance for Active Control
- Guidance for Partial Automation
- Guidance for Promoting/Maintaining Driver Vigilance and Situation Awareness
- Integration of Nomadic and Aftermarket Devices
- Legibility of Icons and Text
- Location or Placement of a Visual Display
- Message Repetition
- Non-critical Information
- Obstruction
- Physical and Functional Aspects of Integration
- Prioritization of Messages to the Driver
- Procedures for Assessing Cognitive Load
- Procedures for Assessing Visual Load
- Providing Feedback to the Driver

- Selection of Sensory Modality (compatibility, use of hands-free interactions, use of redundant modalities)
- Signal Characteristics (distinctiveness, loudness, urgency, localization, use of speech)
- System Error Handling/Recovery
- System Status
- Use of Color
- Using Naturalistic Driving Data to Assess Crash Risk
- Using Secondary Tasks to Assess Driver Load
- Timeliness
- Virtual Controls
- Voice Recognition Inputs
- Workload

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## APPENDIX B

## INITIAL LIST OF DATA SOURCES HELPFUL FOR CONCEPTUALIZING AND DEVELOPING DVIS

| Reference                                                                                                                                                                                                                                                                                                                                                        | DVI Design Topic(s)                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| AAA Foundation for Traffic Safety. (2008). <i>Use of advanced in-vehicle technology by younger and older early adopters</i> . Washington, DC.                                                                                                                                                                                                                    | System Integration                                                                       |
| Abbink, D. A., Mulder, M., van der Helm, F. C. T., Mulder, M., & Boer, E. R. (2011). Measuring neuromuscular control dynamics during car following with continuous haptic feedback. <i>IEEE Transactions on Systems, Man, and Cybernetics—Part B</i> , 41(5), 1239-1249.                                                                                         | Haptic Interfaces                                                                        |
| Abbink, D., Mulder, M. & Boer, E. (2012). Haptic shared control: Smoothly shifting control authority? <i>Cognition, Technology, &amp; Work</i> , 14(1), 19-28.                                                                                                                                                                                                   | Automation                                                                               |
| Abe, G. & Richardson, J. (2004). The effect of alarm timing on driver behaviour: an investigation of differences in driver trust and response to alarms according to alarm timing. <i>Transportation Research Part F: Traffic Psychology and Behaviour</i> , 7(4-5), 307-22.                                                                                     | Haptic Interfaces                                                                        |
| Abe, G. & Richardson, J. (2005). The influence of alarm timing on braking response and driver trust in low speed driving. <i>Safety Science</i> , 43(9), 639-654.                                                                                                                                                                                                | Driver Needs, Safety Messages, Haptic Interfaces                                         |
| Abe, G. & Richardson, J. (2006). Alarm timing, trust and driver expectation for forward collision warning systems. <i>Applied Ergonomics</i> , 37(5), 577-586.                                                                                                                                                                                                   | Driver Needs, Message Characteristics, Safety Messages                                   |
| Abe, G. & Richardson, J. (2006). The influence of alarm timing on driver response to collision warning systems following system failure. <i>Behaviour &amp; Information Technology</i> , 25(5), 443-452.                                                                                                                                                         | Haptic Interfaces                                                                        |
| Ablaßmeier, M., Poitschke, T., Wallhoff, F., Bengler, K., & Rigoll, G. (2007). Eye gaze studies comparing head-up and head-down displays in vehicles. <i>2007 IEEE International Conference</i> , 2250-2252.                                                                                                                                                     | Visual Interfaces                                                                        |
| Adell, E., & Varhelyi, A. (2006). Development of HMI components for a driver assistance system for safe speed and safe distance. <i>Proceedings of the 13th ITS World Congress</i> .                                                                                                                                                                             | Visual Interfaces, Auditory Interfaces                                                   |
| Adell, E., Varhelyi, A., Fontana, M. D., & Bruel, L. (2008). Test of HMI alternatives for driver support to keep safe speed and safe distance-A simulator study. <i>Open Transportation Journal</i> , 2, 53-64.                                                                                                                                                  | Driver Needs, Visual Interfaces, Auditory Interfaces, Haptic Interfaces, Safety Messages |
| Adrian, W., & Bhanji, A. (1991). Fundamentals of disability glare: A formula to describe stray light in the eye as a function of glare angle and age. <i>Proceedings of the First International Symposium on Glare</i> (pp. 185-193). New York: Lighting Research Institute.                                                                                     | Visual Interfaces                                                                        |
| Advanced Systems Technology Branch. (1993). <i>Preliminary human factors design standards for airway facilities</i> (ACD-350). Atlantic City International Airport, NJ: Federal Aviation Administration Technical Center.                                                                                                                                        | Auditory Interfaces                                                                      |
| Ahlstrom, V., & Longo, K. (2003). <i>Human factors design standard</i> (HF-STD-001). Atlantic City International Airport, NJ: Federal Aviation Administration Williams J. Hughes Technical Center.                                                                                                                                                               | Message Characteristics, Visual Interfaces, Auditory Interfaces, Automation              |
| Alders, M., van Hemert, J. M., Pauwelussen, J., Heffelaar, T., Happee R., & Pauwelussen, J. (2012, August). Managing driver workload using continuous driver workload assessment. In A. J. Spink, F. Grieco, O.E. Krips, L.W.S. Loijens, L.P.J.J. Noldus, & P.H. Zimmerman, <i>Proceedings of Measuring Behavior 2012</i> (pp. 38-29). Utrecht, The Netherlands. | Integration                                                                              |
| Aldridge, L.C. & Lansdown, T.C. (1999). Driver preferences for speech based interaction with in-vehicle systems. <i>Proceedings of the Human Factors and Ergonomics Society Annual Meeting</i> , 977-981.                                                                                                                                                        | Driver Inputs                                                                            |

| Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DVI Design Topic(s)                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Allen, R. W. (1995). The driver's role in collision avoidance systems. <i>Workshop on Collision Avoidance Systems</i> , 33-57.                                                                                                                                                                                                                                                                                                                                                                                                      | Driver Needs                                                                                                                    |
| Allen, R.W. & Howe, C. (2013). <i>Volume 4 - Scheduling of messages to maximize driver performance</i> (Unpublished Task 4 interim report prepared for National Highway Traffic Safety Administration under contract DTNH22-121R-00629).                                                                                                                                                                                                                                                                                            | Integration                                                                                                                     |
| Allen, R.W. (1994, March). The driver's role in collision avoidance systems. <i>Workshop on Collision Avoidance Systems sponsored by the IVHS America Safety &amp; Human Factors Committee and the National Highway Traffic Safety Administration</i> (pp. 33-57), Reston, VA.                                                                                                                                                                                                                                                      | Driver Information                                                                                                              |
| Alliance of Automobile Manufacturers (AAM). (2006). <i>Statement of principles, criteria and verification procedures on driver interactions with advanced in-vehicle information and communication systems, including 2006 updated sections</i> [Report of the Driver Focus-Telematics Working Group]. Washington, DC: Author. Retrieved from <a href="http://www.autoalliance.org/index.cfm?objectId=D6819130-B985-11E1-9E4C000C296BA163">http://www.autoalliance.org/index.cfm?objectId=D6819130-B985-11E1-9E4C000C296BA163</a> . | General DVI Requirements, Driver Needs, Message Characteristics, Driver Inputs, Visual Interfaces, Assessing Driver Performance |
| Alm, H., & Nilsson, L. (2000). Incident warning systems and traffic safety: A comparison between the Portico and Melyssa test site systems. <i>Transportation Human Factors</i> , 2(1), 77-93.                                                                                                                                                                                                                                                                                                                                      | General DVI Requirements, Driver Needs, Message Characteristics                                                                 |
| Altmann, E. & Trafton, J. (2002). Memory for goals: An activation-based model. <i>Cognitive Science: A Multidisciplinary Journal</i> , 26(1), 39-83.                                                                                                                                                                                                                                                                                                                                                                                | Integration                                                                                                                     |
| Amditis, A., Bekiaris, E., Montanari, R., Baligand, B., Perisse, J., Belotti, F., et al. (2001). An innovative in-vehicle multimedia HMI based on an intelligent information manager approach: The comunicar design process. <i>Proceedings of the 8th World Congress on Intelligent Transport Systems</i> .                                                                                                                                                                                                                        | System Integration                                                                                                              |
| Amditis, A., Bertolazzi, E., Bimpas, M., Biral, F., Bosetti, P., Da Lio, M., et al. (2010). A holistic approach to the integration of safety applications: The INSAFES subproject within the European Framework Programme 6 Integrating Project PREVENT. <i>IEEE Transactions on Intelligent Transportation Systems</i> , 11(3), 554-566.                                                                                                                                                                                           | System Integration                                                                                                              |
| Amditis, A., Pagle, K., Tsogas, M., Bekiaris, E., Panou, M., Veste, H. T., et al. (2007). A real time platform for estimating the driver – vehicle – environment state in AIDE integrated project. <i>Proceedings of the 14th World Congress on Intelligent Transport Systems</i> .                                                                                                                                                                                                                                                 | System Integration                                                                                                              |
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| Sayer, J. R., Funkhouser, D.S., Bao, S., Bogard, S.E., LeBlanc, D.J., & Blankespoor, A.D., Winkler, C.B. (2010). <i>Integrated vehicle-based safety systems heavy-truck field operational test methodology and results report</i> (UMTRI-2010-27). Ann Arbor: University of Michigan Transportation Research Institute.        | Assessing Driver Performance                           |
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| Reference                                                                                                                                                                                                                                                                                                                | DVI Design Topic(s)                                                           |
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| Sayer, J.R., Bogard, S.E., Funkhouser, D., LeBlanc, D.J., Bao, S., & Blankespoor, A.D., Winkler, C.B. (2010). <i>Integrated vehicle-based safety systems heavy-truck field operational test key findings report</i> (Report No. DOT HS 811 362). Washington, DC: National Highway Traffic Safety Administration.         | Assessing Driver Performance, CWS<br>Driver Controls in HVs                   |
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| Schumann, J., Godthelp, H., Farber, B., & Wontorra, H. (1993). Breaking up open-loop steering control actions - The steering wheel as an active control device. In A.G. Gale et al. (Eds.), <i>Vision in Vehicles IV</i> . Amsterdam: Elsevier Science.                                                                  | Assessing Driver Performance                                                  |
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| Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DVI Design Topic(s)                                      |
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