INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

AIDE
IST-1-507674-IP

Interaction Plan, M13-30

Deliverable No. (use the number indicated on technical annex)	**D4.0.1**		
SubProject No.	**SP4**	SubProject Title	**Horizontal Activities**
Workpackage No.	**WP4.0**	Workpackage Title	**Technical Coordination**
Activity No.		Activity Title	
Authors (per company, if more than one company provide it together)	**Johan Engström, Volvo**		
Status (D: draft, in progress, S: Submitted to EC, F: Final accepted by EC)	**F**		
File Name:	**AIDE D4.0.1 V4.doc**		
Project start date and duration	**01 March 2004, 48 Months**		

History table

Version No.	Date (dd/mm/yy)	Details
3		*First submitted version*
4	2006-08-09	Revised according to review comments

Executive summary

The present report describes achieved and planned interactions, both between the AIDE sub-projects as well as between AIDE and other related projects. The report focuses mainly on interactions during the M13-30 period and is expected to be updated for the next period (M25-42). In addition, the current version of the AIDE Glossary and an introduction to Conceptual Framework adopted in the project are included as Annexes.

Table of Contents

1. INTRODUCTION 5

2. AIDE GENERAL OBJECTIVES AND WORK PLAN 6

2.1. AIDE GENERAL OBJECTIVES 6
2.2. GENERAL WORK PLAN 7

3. AIDE SUB-PROJECT INTERACTIONS 10

3.1. MEANS FOR REALISING SP INTERACTIONS 10
3.2. SP1-SP2 INTERACTIONS 10
3.2.1. Follow up on SP1-SP2 interactions planned for M1-18 11
3.2.2. Planned SP1-SP2 interactions for M13-18 12
3.3. SP2-SP3 INTERACTIONS 13
3.3.1. Follow-up on SP2-SP3 interactions planned for M1-18 13
3.3.2. Planned SP2-SP3 interactions for M13-30 14
3.4. SP1-SP3 INTERACTIONS 16
3.4.1. Follow-up on SP1-SP3 interactions planned for M1-18 16
3.4.2. Planned SP21-SP3 interactions for M13-30 17
3.5. INTERACTIONS BETWEEN SP4 AND SP1-3 19

4. INTERACTIONS WITH EXTERNAL ACTIVITIES 21

4.1. THE INTEGRATED SAFETY PROGRAM 21
4.1.1. The ISP task force 22
4.1.2. Interactions with PReVENT 23
4.1.3. Interactions with EASIS 26
4.1.4. Interactions with GST 27
4.2. HUMANIST 28

ANNEX A: THE AIDE GLOSSARY 32

A1 INTRODUCTION 32
A.2 THE AIDE GLOSSARY – V.1.0 33

ANNEX B: INTRODUCTION TO THE AIDE CONCEPTUAL FRAMEWORK 45

B1 INTRODUCTION 45
B2 OVERVIEW OF COCOM/ECOM 45
B2.1 Control 45
B2.2 The Contextual Control Model (COCOM) 46
B2.3 The Extented Control Model (ECOM) 47
B3 POTENTIAL APPLICATIONS OF THE FRAMEWORK IN AIDE 48
B3.1 Characterisation of in-vehicle functions 48
B3.2 Characterisation of behavioural effects of ADAS and IVIS 50
B4 CONCLUSIONS 51
B5 REFERENCES 51

Figures

Figure 1 The AIDE concept 7
Figure 2 Integration of research, methodological and technological development in AIDE 8
Figure 3 Pert chart illustrating the general interactions between the SPs.....9
Figure 4 Different types of applications of the DVE model developed in SP1.....17
Figure 5 Overview of the main interactions between the AIDE SPs during M13-30 20
Figure 6 Overview of the Integrated Safety Program.....21
Figure 7 Illustration of the long-term objective of the ISP interactions 22
Figure 8. Overview of planned interactions with the PReVENT IP.....23
Figure 9. Main planned interactions between EASIS and AIDE 26
Figure 10. Overview of interactions with GST 27
Figure 11 The Contextual Control Model (COCOM) 47
Figure 12 The Extended Control Model (ECOM).....48
Figure 13 Example mapping of in-vehicle functions on the ECOM layers 50

Tables

Table 1 HUMANIST deliverables feeding into AIDE 28
Table 2 AIDE deliverables feeding into HUMANIST 30

1. Introduction

It is of key importance that the different AIDE sub-activities are integrated towards the overall common goal of the IP. Moreover, the project needs to maintain close interactions with related ongoing projects in the eSafety area. These interactions are described on a general level in the "Annex 1 - Description of Work" (henceforth referred to as the Technical Annex). The objective of the present report is to provide more detailed plans of the interactions, based on recent discussion within AIDE as well as with external projects. During the first year of the project, the interaction plan existed as an internal document. However, due to a request from the Annual Review of the first year, it is now being upgraded to a deliverable. The present report focuses mainly on interactions during M13-30, but also follows up the interactions planned during the previous period. The intention is that the interaction plan will be further updated with the Implementation Plan for the next period (M25-42).

With respect to the AIDE-internal interactions, a key purpose of the present interaction plan is to ensure that all activities in the project are aimed towards the same general goal. A further objective is to optimise the efficiency of work by avoiding duplication and exploiting synergies between activities. Another goal is to reach consensus on key concepts in the automotive HMI field. The AIDE project is strongly interdisciplinary by nature, and contains partners with widely different backgrounds and competencies, and the automotive HMI field in general is plagued by a lack of common terminology. Thus, a key achievement of the project would be to reach, if not universal consensus, so at least an enhanced common understanding of key terms and concepts related to automotive HMI and human factors.

With respect to the external interactions, a key objective is to ensure compatibility with technologies developed in other projects, in particular the safety applications developed in PReVENT and the electronics- and telematics architectures developed in EASIS and GST. Such compatibility is clearly critical for the future industrialisation of the integrated safety technologies developed. Moreover, interactions with the HUMANIST Network of Excellence are needed in order to harmonise the research activities in the two projects. Finally, interactions are also aimed towards the exploitation of synergies with respect to dissemination.

The document is structured as follows: The next section briefly reviews the overall objectives of the IP and the general work plan described in the Technical Annex. Chapter 3 then describes the AIDE-internal SP interactions in further detail. Finally, Chapter 5 gives an overview of the key external interactions. In Annex A, the current version of the AIDE Glossary is presented and Annex B provides a brief overview of the Conceptual Framework adopted in the project.

2. AIDE general objectives and work plan

With the purpose to provide the necessary background to the more detailed interaction plan, this chapter presents the general AIDE objectives and work plan, as described in the Technical Annex.

2.1. AIDE general objectives

As described in the AIDE Technical Annex, the general objective of the AIDE IP is to "generate the knowledge and develop the methodologies and human machine interface technologies required for safe and efficient integration of multiple driver assistance and information functions into the driving environment."

Specifically, the goal of the IP is **to design, develop and validate a generic Adaptive Integrated Driver-vehicle InterfacE (AIDE) that...**

- ...maximises the efficiency of individual and combined advanced driver assistance systems by means of innovative, integrated and adaptive, human-machine interface concepts that prevent negative behavioural effects (e.g. under-load, over-reliance and safety margin compensation) and maximises positive effects (e.g. enhanced situational awareness), thereby enhancing the safety benefits of these systems. **AIDE should demonstrate significantly enhanced safety benefits compared to existing solutions.**

- ..reduces the level of workload and distraction related to the interaction with individual and combined in-vehicle information and nomad devices, thereby reducing the number of road accidents. **AIDE should demonstrate a significant reduction in the imposed workload and distraction compared to existing solutions.**

- ...enables the potential benefits of new in-vehicle technologies and nomad devices in terms of mobility and comfort, without compromising safety. **AIDE should demonstrate that the benefits of new in-vehicle technologies could be enjoyed without increased accidents risk.**

The central concept of the Adaptive Integrated Driver-vehicle Interface is illustrated in Figure 1 (see the AIDE Technical Annex for further details)

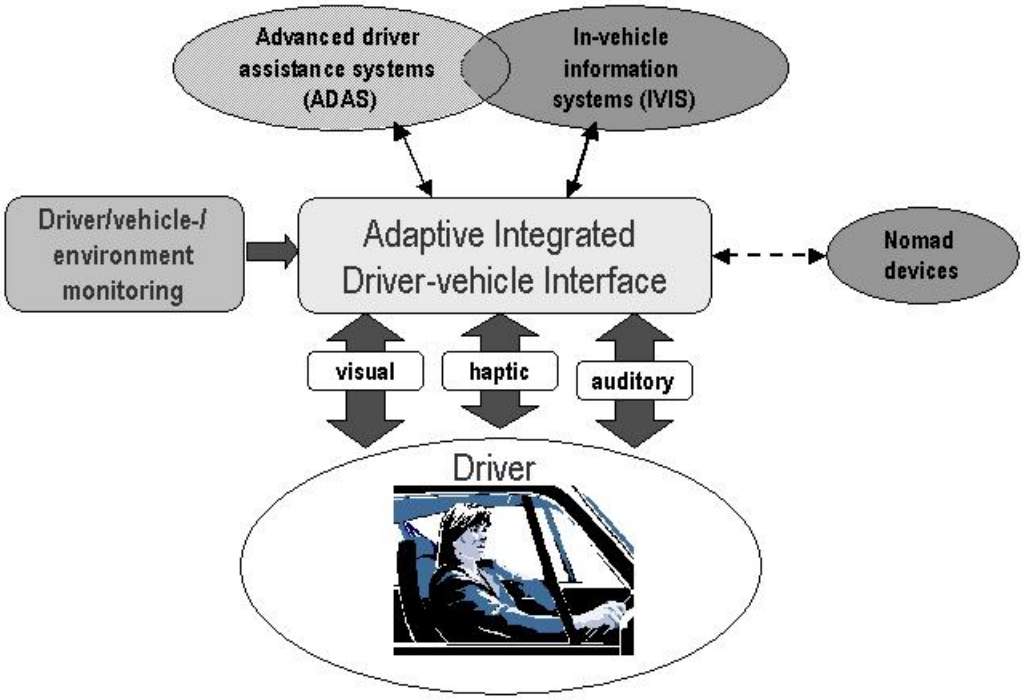

Figure 1 The AIDE concept

2.2. General work plan

This section briefly reviews the general IP work plan, as described in the Technical Annex. The realisation of the AIDE concept requires strongly integrated RTD (Research and Technological Development) in a number of different areas. In particular:

1. Behavioural research for understanding key aspects of the interaction between the driver and individual/integrated IVIS and ADAS,

2. Development of an evaluation methodology for AIDE-type systems.

3. Development and integration of the AIDE technologies.

The concrete technical output of the project is a set of three vehicles demonstrating the AIDE concept – one city car, one luxury car and one heavy truck. These will be designed based on human factors research conducted in the project. Moreover, the demonstrators will be validated by means of the AIDE evaluation methodology developed in the project. Figure 2 describes the general process towards the validated demonstrators, as described in the Technical Annex. As illustrated in the Figure 2, both the technological and the methodological development will be based on human factors research. The latter comprises both empirical studies, modelling and computer simulation of the driver-vehicle-environment (DVE) joint system. The technological development will produce the three demonstrator vehicles and the methodological development

will produce a common evaluation methodology for AIDE-type systems. While the three demonstrators constitute the main output of the project, the other activities will produce deliverables that can be exploited on their own right after the project (a DVE model/simulation and a specified evaluation methodology).

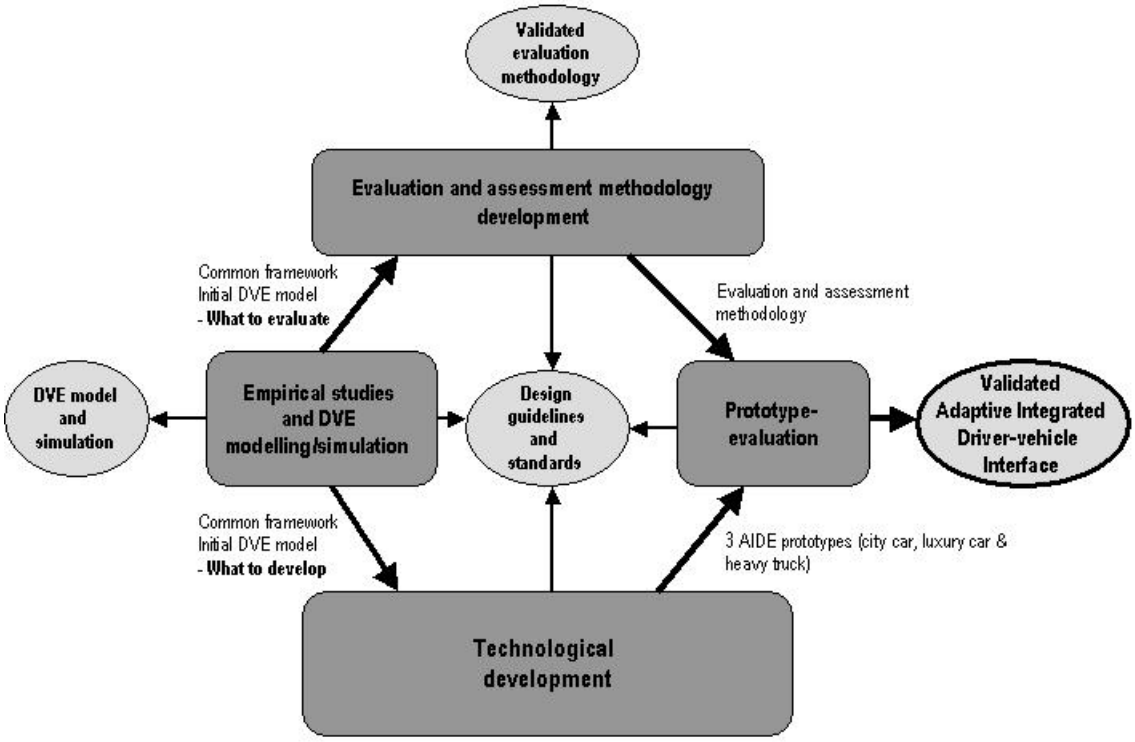

Figure 2 Integration of research, methodological and technological development in AIDE

In the AIDE IP, the three areas sub listed above are pursed in three sub-projects (SP 1-3 respectively). These are the main RTD sub-projects, while SP4 focuses on horizontal issues such as project management, dissemination and exploitation, guidelines and standards and review and assessment of project results. The Pert chart from the Technical Annex, illustrating the interactions between the sub-projects, is illustrated in Figure 3. The remainder of this report will focus on describing these interactions in further detail.

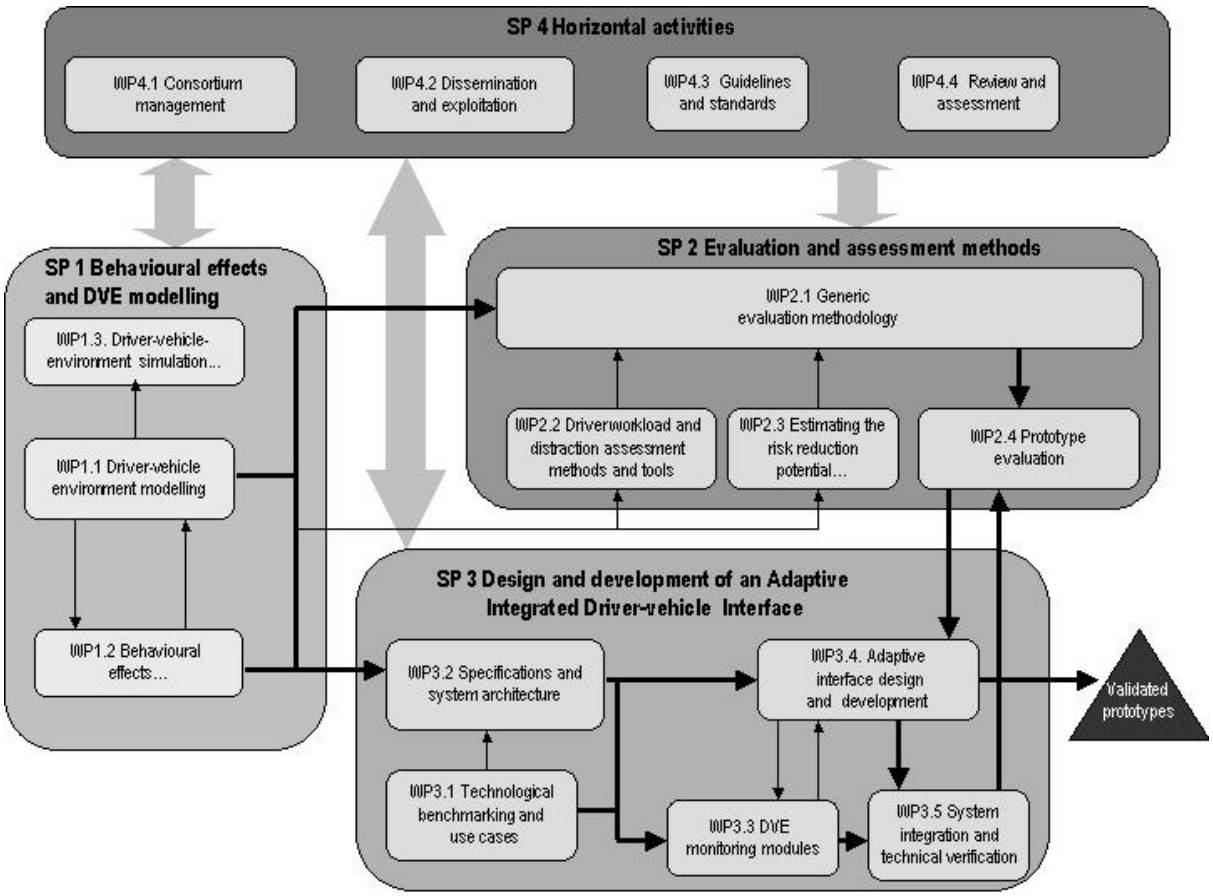

Figure 3 Pert chart illustrating the general interactions between the SPs

3. AIDE sub-project interactions

This chapter starts with a description of the means that have been implemented in order to promote the internal SP interactions. Then, the interactions between each of the main RTD SPs are described in detail. This includes a follow up on the interactions planned for M1-18, as well as descriptions of the interactions planned for the period covered by the new implementation plan, i.e. M13-30.

3.1. Means for realising SP interactions

The interactions within the AIDE IP will be facilitated by a number of means:

- *IP-level technical coordination:* The main objective of this work is to keep track of the scientific and technical progress in the project and identify potential synergies, conflicts and potential interaction points. In concrete terms, this includes, for example, reading all project deliverables, participating to key SP meetings and following up the present interaction plan.
- *Active participation of SP leaders to meetings of other SPs:* While the role of the IP-level technical coordination is a supervisory one (i.e. identifying the general needs and opportunities for interactions), the concrete interactions must be implemented directly between the SPs under the responsibility of the SP leaders. Thus, the active participation of SP leaders in the working meetings of other SPs is a key means for establishing efficient SP interactions.
- *Concrete working level interaction points:* Concrete specification of the content and timing of the key interaction points.
- *The AIDE glossary:* A common problem in multidisciplinary work is the different usage of terms and taxonomies. In order to facilitate a common understanding of key terms used in AIDE, an AIDE Glossary has been defined. The glossary currently exists in draft form as an Excel document. It is expected to be continuously updated during the course of the project, based on discussion in the SPs and agreement in the Core Group. The first official version will soon be put on the AIDE web, as part of the Innovation Observatory. The current version is appended in Annex A.
- *The Conceptual Framework*: As a further step beyond the Glossary, it has been decided to promote, at IP level, a common conceptual framework for describing key issues and phenomena related to AIDE. The proposed framework is based on the COCOM/ECOM model, identified in the SP1 review of existing models (D1.1.1a) as the main candidate for a Generic Driver-Vehicle-Environment Model. A brief introduction to the framework is included in Annex B.

3.2. SP1-SP2 interactions

SP1 and SP2 both address behavioural effects of ADAS and IVIS. However, while the goal of SP1 is to identify and explain these effects (and to create models able to predict them), the aim of SP2 is to develop valid and cost-efficient methods and tools to quantify behavioural effects for validation purposes. The main interaction points between SP1 and 2 are: (1) common taxonomies, exchange of empirical results, the relation between driver behaviour and risk, and synergies in data collection.

3.2.1. Follow up on SP1-SP2 interactions planned for M1-18

Common taxonomy (D2.1.2)
A review and taxonomy of ADAS/IVIS has been produced in SP2 (D2.1.2). This taxonomy has been input to SP1 and agreed on a general level.

Review on behavioural effects (D1.2.1)
A comprehensive literature review on behavioural effects of ADAS/IVIS (D1.2.1) was produced in SP1. This was used as a main input to the Deliverable 2.2.1 in SP2, which focused on methods and tools for quantifying such effects.

Methods and tools for driver behaviour data collection
It was suggested that the SP2 deliverables D2.1.1.and D2.2.1 could be used in the selection of methods and tools for the SP1 experiments. However, in practice it turned out that, since the tools and methods focused on in SP2 where mainly targeted towards cost-efficient evaluation studies, they were not always the most appropriate for the large-scale scientific studies conducted in SP1.

Synergies in data collection
The experimental plans were checked by both sides in order to identify whether there are synergies to be exploited with respect to data collection. However, due to the rather different objectives of the studies in SP1 and SP2, it was concluded that no major synergies could be exploited at this point.

Relation between behaviour modelling and risk estimation
The issue of accident risk in general, and its relation to driver behaviour in particular, is one of the main common topics of SP1and SP2. The issue was first jointly addressed at a workshop held in connection to the SP2 meeting in Soesterberg 22-23/11, 2004. The division of labour between the SPs was discussed agreed on: SP1 will produce data on behavioural effects of ADAS/IVIS, both through empirical experiments and as outputs from DVE simulation, while SP2 (WP2.3) will develop functions that maps from these behavioural effects to risk estimates. However, it was agreed that the details of the interface between the SP1 behaviour models and the SP2 risk models need to be further discussed. An open issue is the DVE models are mainly concerned with individual behaviour while the SP2 functions will model risk on a collective level.

A second workshop on risk issues was arranged in Munich on April 29 (by BMW and Linköping University), involving key participants from SP1 and SP2. At the workshop, a number of key terms were discussed and draft definitions agreed. These will be added to the AIDE Glossary in the next update. A key conclusion was that we need to find a way to bridge the gap between performance on the individual level and aggregate/collective accident risk. This is partly the work of WP2.3, but further close interaction with SP1 is needed. Moreover, different potential sources of behavioural accident data were identified, e.g. results from recent naturalistic field studies conducted in Japan and the US (e.g. the 100-car study), and other related initiatives such as INVENT, SAVE-IT and ITCTC. An action list was defined which will be followed up as part of the new interaction plan (see below). This discussion should also be linked to the real-time risk estimation worked on in SP3.

3.2.2. Planned SP1-SP2 interactions for M13-18

1. Conceptual framework
Description The conceptual framework developed in SP1 should be adopted on a general level in SP2, that is, as a "common language" to describe e.g. ADAS/IVIS functions, behavioural effects and methods for quantifying them. The framework is based on the COCOM/ECOM model described in Hollnagel and Woods (2005). See Annex B, for a brief introduction to the framework and its intended application in the project.
Means for realisation Summary included as Appendix to the (present) Interaction Plan. Initial presentation of the framework at SP meetings by the Technical Coordinator Subsequent follow up at SP meetings
Timing M15-16 for initial presentation to the SPs M17-30 for follow-up

2. Exchange of empirical results
Description As described in the M13-30 workplan for the IP, both SP1 and SP2 have a number of important deliveries on results from empirical studies around M20. For SP1, this involves the results from the WP1.2 studies on behavioural effects during the learning phase, while SP2 will deliver specifications for distraction and workload methods and tools (WP2.2), some of which are based on empirical work or re-analysis of data from existing projects. It is of key importance that these results, and their implications, are discussed between the SP1 and 2 and also fed into the AIDE system design and development in SP3.
Means for realisation A joint SP1-2-3 workshop has been planned for October 12-13 at Volvo Office Brussels, where key results from the different SPs will be presented and discussed.
Timing M20

3. Behaviour-risk modelling
Description As described above, the relation between driver behaviour and risk is one of the main interaction topics for SP1 and SP2, and the subject of a two SP1-SP2 workshops. However, there are still a number of open issues regarding this topic and the results and actions from the Munich workshop need to be followed up during M13-30, mainly based on further development in WP1.1 (DVE modeling) and WP2.3 (behaviour-risk functions).
Means for realisation Joint SP1-2-3 workshop, October 12-13, Volvo Office Brussels Follow up by representation of SP1 in SP2 meetings and vice versa
Timing M20 – workshop M21-20 – follow up

4. DVE parameterisation
Description It is important that the parameters used to describe the Driver-Vehicle-Environment (DVE) in the two SPs are coherent.
Means for realisation Joint SP1-2-3 workshop, October 12-13, Volvo Office Brussels Follow up by representation of SP1 in SP2 meetings and vice versa
Timing M20 – workshop M21-20 – follow up

5. Use of SP1 DVE model/simultion as part of the SP2 evaluation toolkit
Description One of the key applications of the DVE model/simulation developed in SP1 is as a tool for predicting to behavioural effects associated with different ADAS/IVIS design solutions early in the development process. It should be considered to what extent it could be incorporated as part of the final AIDE evaluation methodology and toolkit to be delivered by SP2.
Means for realisation Presentation and discussion of D1.1.4 (Results of preliminary model application to existing ADAS and IVIS) in SP2 (WP2.1)
Timing M26-30

6. Input of empirical results from SP1 long-term experiments to SP2
Description The results from the empirical studies on long-term effects will be available by M30 and documented in D1.2.4. While the SP2 Evaluation Methodology should be almost finalised by then, it is important that these results are accounted for in the experimental design of the final AIDE demonstrator validation in WP2.4.
Means for realisation To be defined - possibly a new workshop around M30.
Timing ~M30

3.3. SP2-SP3 interactions

The main interaction points between SP2 and SP3 concern the application of the SP2 evaluation methods and tools in (1), the (formative) early design and evaluation of AIDE prototypes performed in WP3.4 and (2) in the final (summative) evaluation of the SP3 prototypes, to be conducted in WP2.4. Other important common topics are taxonomy and risk estimation.

3.3.1. Follow-up on SP2-SP3 interactions planned for M1-18

Common taxonomy (D2.1.2)
As mentioned in the description of SP1-SP2 interactions, it is important that the IVIS/ADAS taxonomies described in D2.1.2 are universally adopted in the IP. In SP3, this document was used

both for the technological benchmarking, as well as input for the categorisation of IVIS/ADAS in D3.1.2 (Scenarios and use cases) and D3.2.1 (Requirements for AIDE HMI and safety functions).

AIDE scenarios and use cases
This interaction point topic was discussed at length at the Soesterberg SP2 meeting 22-23/11, 2004, where the draft SP3 scenarios and use cases were presented. A task force, led by BMW, was formed within SP2 with the mission to interpret the SP3 scenarios and use cases, documented in D3.1.2. Further interactions are needed during M13-30 to provide SP2 with more detailed descriptions of the targeted AIDE functionality, in particular the requirements and specifications documented in D3.2.1.

SP2 requirements on demonstrator vehicles
SP2 provided a preliminary description of the basic requirements of the SP2 evaluation methodology on the demonstrator vehicles (e.g. the accuracy required from the onboard sensors to compute the relevant evaluation metrics). This description was incorporated as a chapter in D3.2.1.

Techniques for driver behaviour and state assessment
A common denominator of SP2 and SP3 is that both SPs develop techniques for driver behaviour and state assessment. However, the crucial difference concerns the application of these techniques. While, SP2 focuses on offline measures to be applied in IVIS/ADAS evaluation, SP3 focuses on online measures to be used to enable real-time HMI adaptivity. These two applications imply different requirements and the development of offline and online techniques are expected to be quite independent. However, some synergies were exploited during M1-18, e.g. for visual demand measurement where the same sensor (the Seeing Machines FaceLab system) is used by the Cockpit Activity Assessment - CAA – module (T3.3.5) and the Visual Demand Measurement - VDM – Tool (T2.2.5).

Risk estimation
In SP2 (WP2.3), functions will be developed for (offline) mapping between behaviour and risk on the collective level. In SP3, the objective of the TERA Traffic and Environment Risk Assessment) module is to provide a real-time estimate of risk. Some initial discussions on this topic took place during the first year. However, further interaction is needed during M13-30 when the results from WP2.3 are ready (around M20). As mentioned above, this also has strong links to SP1.

3.3.2. Planned SP2-SP3 interactions for M13-30

1. Input from SP3 to SP2 on the AIDE system functionality (i.e. what to be evaluated)
Description As mentioned above, the evaluation methods developed in SP2 will be used in SP3 for mainly two purposes: (1) For the (formative) evaluation of the virtual prototypes during M19-22 (see the next interaction topic) and (2) in the (summative) evaluation of the AIDE demonstrators. It is thus critical that the SP2 evaluation methodology is targeted towards the AIDE functionality developed in SP3. Thus, this functionality needs to be clearly communicated by SP3. This information is contained in a series of SP3 deliverables. During M1-12, the AIDE scenarios and use cases were developed and documented in D3.1.2. During M13-30, more detailed descriptions of the AIDE system will be documented in the following deliverables:

D3.2.1 Requirements for AIDE HMI and safety functions (M15)
D3.2.2 System Architecture, data flow protocol definition and design and AIDE specifications (M20)
D3.4.1 Interaction Management logic definition (M21)

Moreover, the first set of virtual prototypes, embodying a subset of the AIDE functionality will be developed and evaluated during autumn 2005 (M19-22).

Besides the study of these documents and virtual prototypes by SP2, face-to-face meetings with key SP2 and SP3 partners will be arranged during M19-22 to discuss the AIDE functionality, and the requirements it puts on the SP2 evaluation method. This will be a key topic at the SP1-2-3 workshop in October 2005.

Means for realisation
Study of SP3 documents by SP2
Representation of SPX in SPY meetings
SP1-2-3 workshop October 12-13, Volvo Office Brussels

Timing
M19-22

2. SP3 use of methods and tools developed in WP2.2 for virtual prototype evaluation

Description
By M22, WP2.2 will deliver specifications for a set of workload and distraction evaluation methods and tools (where draft specification will be available by M19). Some of these methods and tools could potentially be used in the SP3 formative evaluation of the AIDE virtual prototypes. The available state-of-the art reviews on evaluation methods and tools (D2.1.1 and D2.2.1) could also be very useful for the selection of evaluation methods in SP3. Thus, the draft WP2.2 results on workload and distraction measurement methods and tools need to be input to SP3 around M20.

Means for realisation
Study of existing SP2 deliverables (D2.1.1, D2.2.1 and draft WP2.2. deliverables) by SP3
Representation of SPX in SPY meetings
SP1-2-3 workshop October 12-13, Volvo Office Brussels

Timing
M19-20

3. Risk estimation

Description
As mentioned above, the relation between the SP2 behaviour-risk functions (WP2.3) and the SP3 real-time risk estimation (WP3.3) needs further consideration. This should be strongly related to the DVE modelling in SP1

Means for realisation
SP1-2-3 workshop, October 12-13, Volvo Office Brussels

Timing
M20

3.4. SP1-SP3 interactions

As described above (and in more detail in the Technical Annex), the general goal of AIDE SP1 is to enhance the understanding of behavioural effects associated with the interaction with IVIS and ADAS. This will be achieved by means of empirical research, the results of which are embodied in models and computer simulations of the integrated driver-vehicle-environment (DVE) system. Thus, the key interactions between SP1 and SP3 concern (1) the use of the empirical results as input to the SP3 design and (2) the different potential applications of the DVE model and simulation in SP3 design and development.

3.4.1. Follow-up on SP1-SP3 interactions planned for M1-18

General application of the DVE model
A key interaction topic between SP1 and 3 is the question how the SP1 model/simulation is intended to be used, in SP3 as well as in exploitation after the project. A first workshop devoted largely to this issue held in connection to the SP3 meeting in Santorini, July 2004. A general conclusion was that three general applications of the DVE model could be distinguished:

1. ***DVE model as a descriptive framework:*** The basic, and most important, input expected from SP1 (to SP3 as well as SP2) is a DVE model that can be used for describing in a formal way the problem domain addressed in AIDE. More specifically, the model should be able to represent the design problems encountered in SP3, e.g. which adaptive HMI functions that should be implemented to solve a particular problem. This includes a parameterisation of the DVE space that could be used to describe adaptivity to the DVE conditions. In SP1, this model has been termed the Generic (G-) DVE model. The AIDE Conceptual Framework, further described in Annex B, is the starting point for the G-DVE model.
2. ***DVE simulation for use in AIDE design:*** Based on the G-DVE model, a further step is to implement a more detailed model of the DVE system, with the purpose to answer more complex design questions, e.g. which types of behavioural adaptation that could be expected for different IVIS/ADAS solutions in different driving conditions. This model, known as the E- (electronic) DVE model, will be implemented as a computer simulation (in WP1.3). In the most basic implementation, the simulation runs offline for use as a tool in automotive HMI design. Initial guidelines for the application of such a model were given in D1.1.2. This simulation will not be finalised in time for application in the design work in AIDE SP3 and is thus mainly intended for exploitation after the project. This simulation could potentially be included as a component of the AIDE Evaluation Methodology, to be developed in SP2.
3. ***Real time DVE simulation for use in DVE modules:*** The E-DVE model could also potentially be implemented as part of the real-time AIDE system to be developed in SP3. The main current idea is to incorporate the DVE model into the Driver Characteristics module.

The basic relations between these potential applications of the DVE model are illustrated in Figure 4.

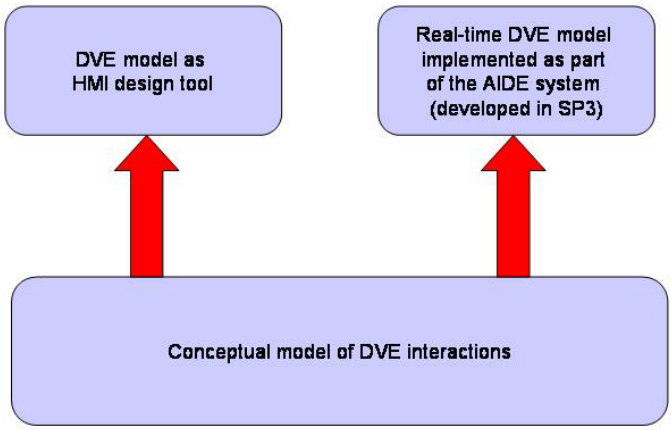

Figure 4 Different types of applications of the DVE model developed in SP1

DVE parameterisation
A more specific interaction point between SP1 and SP3 concerns the parameterisation of the DVE space. A key question here is to what extent the DVE parameterisation in the SP1 should correspond to the DVE parameterisations adopted in SP3 and SP2. An obvious minimum requirement is that the different parameter sets should not be contradictory, but it is also clear that it is not feasible to have identical parameter sets in the different SPs (due to the different objectives). During the first year, both SP1 and SP3 have worked in parallel on identifying a set of DVE parameters that meet their respective requirements and some effort has been spent to establish a mapping the two parameter sets (documented e.g. in D1.1.1b), However, the issue has not been completely resolved and further interaction is needed on this topic.

Risk estimation
As mentioned above, risk estimation is a topic of general interest in all three SPs. SP3 will develop a module for real-time risk estimation (the TERA, WP3.3). At the Santorini meeting SP1, it was agreed to initiate interactions on how the model development in SP1 could inform the SP3 TERA development on the identification of key traffic risk factors. However, during the first year, these interactions have been quite limited and this needs to be further addressed in the new interaction plan, also taking into account the results from SP2 (WP2.3).

3.4.2. Planned SP21-SP3 interactions for M13-30

1. Conceptual framework
Description Like for SP2, the conceptual framework developed in SP1 should be adopted on a general level in SP3 as well. See Annex B, for a brief overview of the framework and its intended application in the project.
Means for realisation Summary included as Appendix to the (present) Interaction Plan. Initial presentation of the framework at SP meetings by the Technical Coordinator

Subsequent follow up at SP meetings
Timing M15-16 for initial presentation to the SPs M17-30 for follow-up

2. Input from SP3 on the AIDE system functionality (i.e. what to be modelled)
Description Like for SP2, it is important that the detailed functionality of the AIDE system developed in SP3 is clearly communicated to SP1, so that the AIDE functions can be accounted for in the modelling work. During M1-12, the scenarios and use cases were developed and documented in D3.1.2. During M13-30, more detailed descriptions of the AIDE system will be documented in the following deliverables: D3.2.1 Requirements for AIDE HMI and safety functions (M15) D3.2.2 System Architecture, data flow protocol definition and design and AIDE specifications (M20) D3.4.1 Interaction Management logic definition (M21) Moreover, the first set of virtual prototypes, embodying a subset of the AIDE functionality will be developed and evaluated during autumn 2005 (M19-22). The SP1-2-3 workshop in October 2005 is a key opportunity to realise these interactions.
Means for realisation Study of SP3 documents by SP1 Representation of SPX in SPY meetings SP1-2-3 workshop October 12-13, Volvo Office Brussels
Timing M19-22

3. Input of results from learning phase experiments to SP3
Description The results from the WP1.2 studies on behavioural effects during the learning phase, should be fed into the AIDE system design and development in SP3.
Means for realisation The joint SP1-2-3 workshop, October 12-13, Volvo Office Brussels
Timing M20

4. Behaviour-risk modeling and DVE parameterisation
Description As mentioned above, the issue of risk estimation and DVE parameterisation were identified as key interaction topics between SP1 and SP3 already in the previous period, and the discussions initiated need to be followed up, also with respect to the work in SP2 and the results and actions from the Munich workshop.
Means for realisation Joint SP1-2-3 workshop, October 12-13, Volvo Office Brussels
Timing

M20

5. Input of empirical results from long-term experiments to SP3
Description The results from the empirical studies on long-term effects will be available by M30 and documented in D1.2.4. Although this is too late for these results to have a major influence the actual design and development in SP3, it is important these results are discussed in depth, especially with respect to the further development of design guidelines in WP4.3 as well as exploitation after the project.
Means for realisation To be defined - possibly a workshop around M30.
Timing ~M30

3.5. Interactions between SP4 and SP1-3

SP4 contains activities that are common to the other three SPs, in particular IP management, dissemination and exploitation, guidelines and standards and review and assessment. Thus, interactions involving SP4 generally concern all the other SPs. Moreover, these interactions are generally continuing by nature and described in detail in the Technical Annex. For this reason, they are only briefly described here:

IP management
Naturally, management issues requires input from all SPs.

Exploitation
Input is needed from all SPs on exploitation issues, following the plan described in the Technical Annex. The task leader (BMW) will request input from the other SPs regarding the exploitation plans when needed.

Dissemination
Input is needed on a regular basis from all SPs on dissemination activities and material. This is handled by the dissemination manager (ICCS).

Innovation Observatory
The Innovation Observatory, to be set up by M18, will rely on input from SP1-3. One first key input is the Technological Benchmarking conducted in SP3 (WP3.1).

Guidelines and standards
During the first year, a review of existing Guidelines and Standards (D4.3.1) was produced. This has been input to the other SPs. In the last year of the project, new/updated guidelines and proposal for standards will be developed in WP4.3, based on input from all SPs. This will be further described in the next version of the interaction plan (M25-42).

Review and assessment
The methodology adopted requires regular input from all SPs.

An overview of the main M13-30 interactions between SP1-3 and their approximate timing is given in Figure 5.

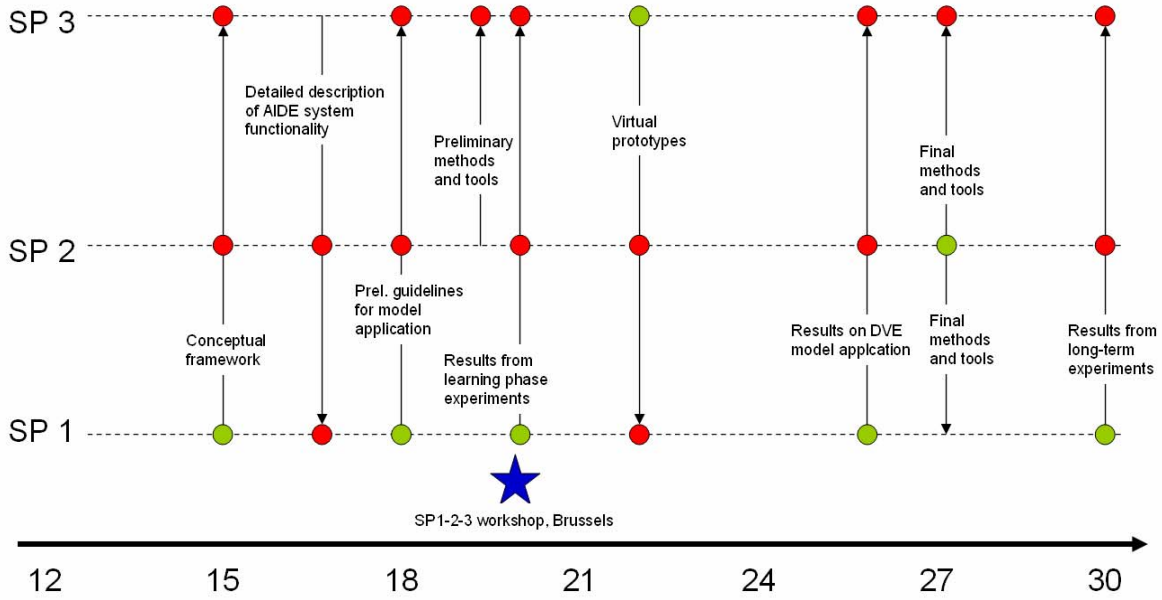

Figure 5 Overview of the main interactions between the AIDE SPs during M13-30

4. Interactions with external activities

In addition to the AIDE-internal interactions described in the previous chapter, it is of key importance that close interactions are maintained with other relevant initiatives in the eSafety area. For AIDE, the most relevant external initiatives are the HUMANIST network of excellence and the projects in the Integrated Safety Program, in particular EASIS, PReVENT and GST, and to some extent APROSYS.

Relatively detailed plans for interaction with these projects are defined in the Technical Annex. The purpose of the present text is to follow up and complement this information with more detailed descriptions of achieved and planned interactions, based on recent discussions between the projects.

4.1. The Integrated Safety Program

The Integrated (IP) and Specific Targeted Research (STREP) Projects under the leadership and strong involvement of the EUCAR (the European association for collaborative automotive research) members have been organised into three Programs; "Fuels and Powertrain", "Manufacturing and Materials" and "Integrated Safety". The AIDE IP belongs to the Integrated Safety Program (ISP), which consists of four IPs (AIDE, PReVENT, GST and APROSYS) and one STREP (EASIS) as indicated in Figure 6 below.

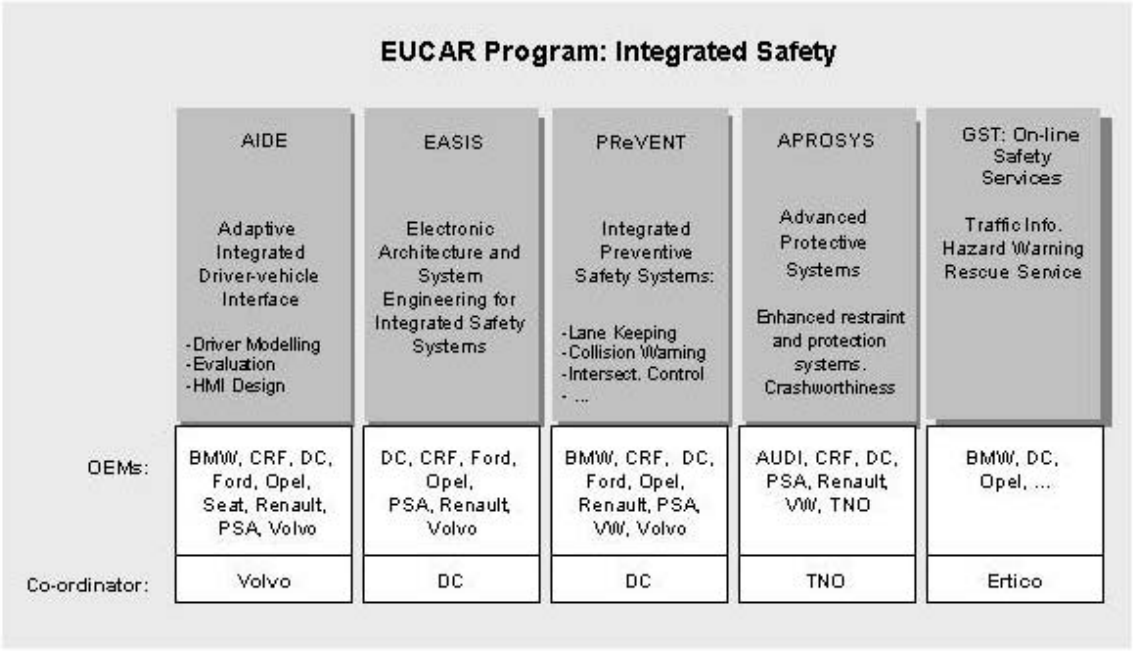

Figure 6 Overview of the Integrated Safety Program.

The ISP will implement both high-level monitoring and alignment of the projects, as well as concrete working-level links. With respect to the former, the ISP will be monitored and mentored by representatives of the key stakeholders. The automotive manufacturers have selected their representatives among the members of the Council of EUCAR (the assembly of the research directors). The purpose of such mentorship is, among others, to assist in the harmonisation of research and industrial strategy, give guidance on relevant research directions and promote the deployment of the results.

The long term objective of the interactions implemented between the ISP projects is to establish a general consensus and compatibility of technologies already during the research phase illustrated in Figure 7. To this end, a task force, consisting of representatives from the projects' coordination and core groups plus experts on the relevant topics (mainly architecture), has been formed in order to further harmonise the projects on a more technical level. Below, the activities of the ISP task force and the detailed interactions between AIDE and the other ISP projects are further described.

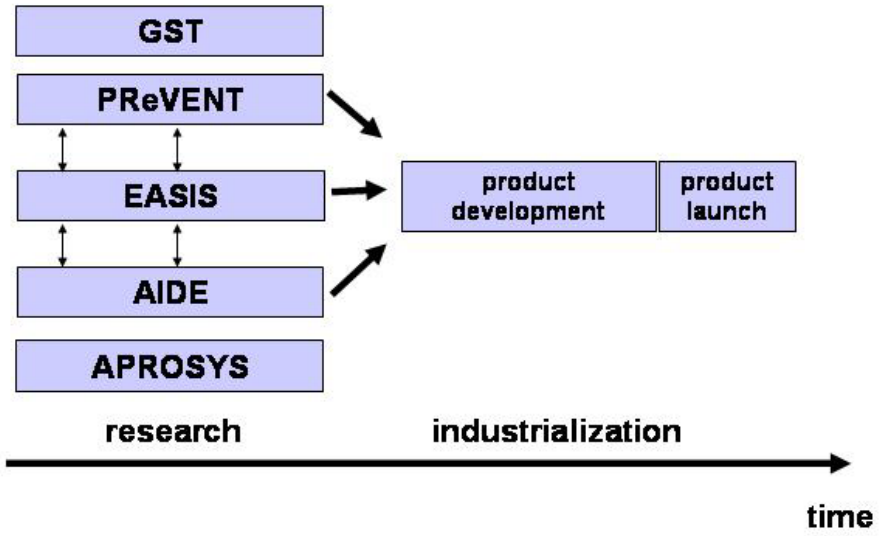

Figure 7 Illustration of the long-term objective of the ISP interactions

4.1.1. The ISP task force

The ISP task force was formed during 2005, with the general goal to create a common understanding on the role of each project and relations between them within the integrated safety framework. During 2005, the task force has met regularly at common events such as the general ISP meeting (January), AIDE User Forum (March), the PReVENT General Assembly (May), the IST Europe Congress (June), and the EASIS Open Workshop (July). A common work space has been established in Projectplace, an internet based project management platform.

The task force currently focuses mainly on the definition of a common use case and agreement on a high-level architecture. *The common use case* will be described in the form of a narrative, in the same vein as the "AIDE story" in the beginning of the Technical Annex. The purpose of the story

is to illustrate how the technologies developed by the ISP projects can be integrated in future vehicles to solve real problems. To date, a draft story has been produced, which is currently being revised in the task force. *The high-level architecture* will provide a functional component view of a future integrated safety system, identifying its main components and their mutual relations. The main purpose of this is to ensure general compatibility between the technologies developed in the different projects. These two items are expected to be finalised by the beginning of 2006. In addition, discussions have been initiated on the possibilities to harmonise some dissemination activities.

4.1.2. Interactions with PReVENT

The PReVENT IP develops preventive safety applications that, in future products, should be able to interact with the driver through the integrated, adaptive, HMI developed by AIDE. Thus, in order to facilitate the integration of PReVENT applications and AIDE HMI solution in the industrial phase, it is necessary to ensure that the technologies developed in the two projects are compatible (i.e. interface easily to each other). Other areas of common interest include the development of a code of practice for ADAS development, including evaluation procedures. Moreover, it is expected that synergies in the technological development in the projects could be exploited. In order to achieve this, a number of working level interactions has been set up between the projects. These interactions are facilitated by the great overlap in partnership between the projects, especially with respect to the industrial partners. The general plan for interactions with PReVENT, as stated in the AIDE Technical Annex, is presented in Figure 8.

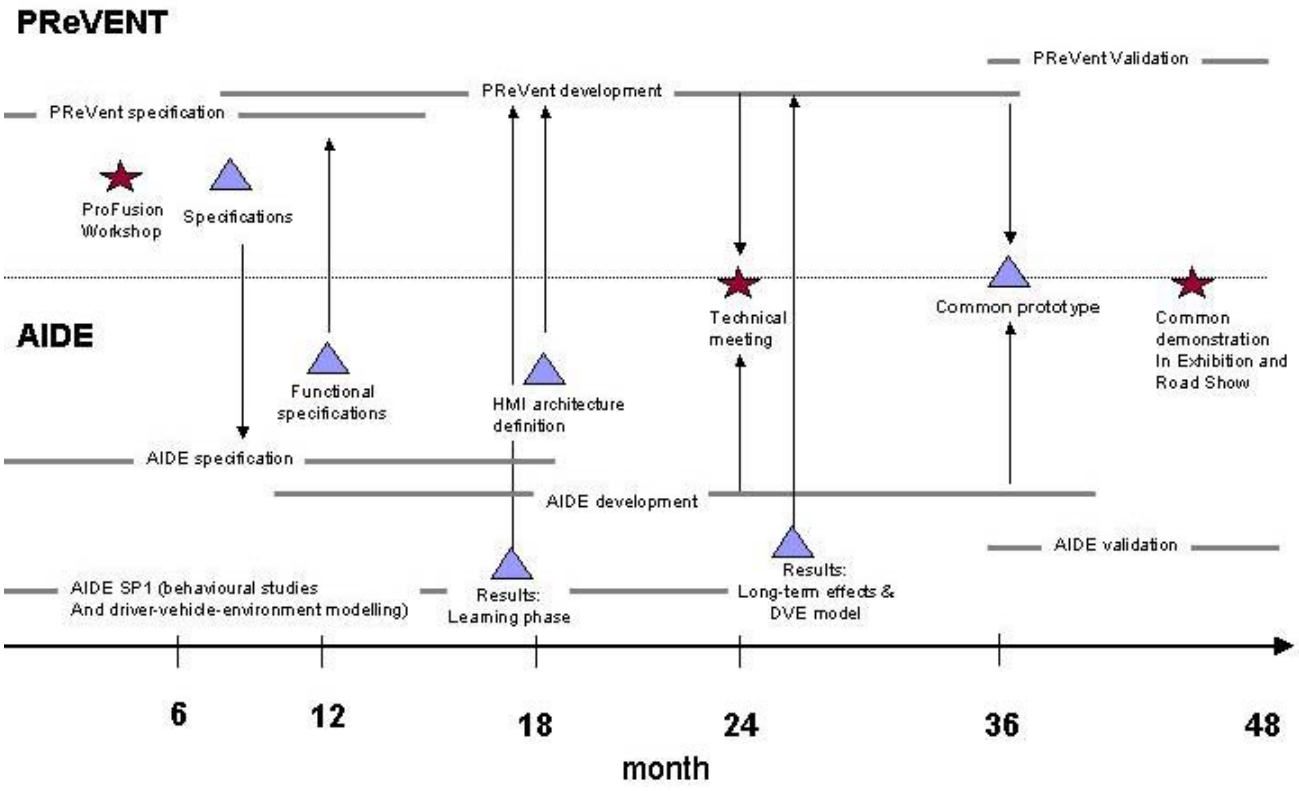

Figure 8. Overview of planned interactions with the PReVENT IP

Detailed discussions on following up the interactions between the projects have been initiated at a series of workshops, in particular:

- Technical meeting in connection to the ISP board meeting (Brussels, January 2005)
- The AIDE User Forum (Cologne, March 2005), where the PReVENT coordination was represented
- The PReVENT General Assembly (Stuttgart, May, 2005), where a major focus was on interactions with other project. The AIDE coordination was represented and an overview presentation of the IP was given to the PReVENT consortium. Moreover, specific interactions were discussed during a break-out session.
- EASIS workshop before which the IS task force met in order to discuss the high level architecture. AIDE and IP PReVENT presented their functional architecture.
- PReVENT HMI- and RESPONSE 3 workshops (Athens, June 2005), where all AIDE SPs were represented
- The EASIS Open Workshop (Gothenburg, July 2005)

During these meetings, the following detailed interaction topics between AIDE and PReVENT have been identified:

Compatibility between PReVENT applications and the AIDE integrated HMI
During the first year of the project, AIDE has developed a general solution for the centralised management of an integrated HMI and a logical HMI architecture to support it. This solution puts certain requirements on the applications that want to use the integrated HMI to interact with the driver. Specifically, it requires that an "AIDE interface adapter" is added on top of the application software. This interface adapter handles the interaction with the Interaction and Communication Manager (ICA), which functions as the centralised intelligence in the AIDE integrated HMI (determining, for example, which application that gets access to which HMI device). This was a main topic at the PReVENT HMI workshop that was held in Athens in June 2005. At this workshop, it was agreed that:

- The AIDE HMI architecture will be integrated to the general architecture of PReVENT
- All PReVENT SPs will integrate the AIDE architecture to their SW architecture without obligation to implement it in the real demonstrators
- AIDE should further specify and communicate the application-ICA communication protocol to PREVENT

Moreover, it is expected that at least some PReVENT SPs actually implement the AIDE Interface Adapter in their applications, thus enabling the demonstration of integrated PReVENT-AIDE solutions. This applies especially for the demonstrator vehicles that are shared between the projects (see below). In the next step, AIDE will communicate more detailed descriptions of its proposed HMI architecture solution, in particular the requirements on the interface adapter. As indicated in Figure 8, a dedicated technical meeting will be arranged by M24 with the main purpose of checking compatibility between the PReVENT and AIDE technologies. These discussions will also be strongly linked to the development of the general high-level integrated safety architecture mentioned above.

Sensor data fusion
In PReVENT, the ProFusion 1 and 2 sub-projects are dedicated to the development of algorithms and a general architecture for sensor data fusion. In AIDE, the Driver-Vehicle-Environment (DVE) monitoring modules could be regarded as special-purpose sensor data fusion modules (i.e. as part of the "perception layer" in the ProFusion architecture). Thus, it is of great importance that these activities are harmonised, especially with respect to system architecture. This interaction topic was identified in the Technical Annex, and needs to be followed up.

Code-of-practice – RESPONSE3
The RESPONSE 3 sub-project within PReVENT develops a code-of-practice for ADAS development, which will include descriptions on procedures for user requirements, system definition and validation procedures. Thus, this work is strongly relevant, both for the HMI development in AIDE SP3 as well as for the evaluation methodology development in SP2. Discussions with RESPONSE 3 were initiated at the AIDE User Forum and continued at the RESPONSE3 workshop in Athens. It was agreed that the draft RESPONSE3 checklist will be used and validated in the AIDE HMI development in WP3.4. In SP2, it will be investigated to what extent the RESPONSE3 tools could be incorporated into the AIDE evaluation methodology.

HMI design guidelines and evaluation methods and tools
In addition to the items above, PReVENT has requested input from AIDE in terms of HMI design guidelines and evaluation methods and tools. With respect to the former, AIDE will not produce any new guidelines until the final year of the project (D4.3.2). However, a thorough review of existing HMI guidelines and standards has been produced during the first year (D4.3.1), which is available for use in PReVENT. With respect to evaluation methods and tools, two public deliverables are available (D2.1.1 and D2.2.1) with reviews of the state-of-the-art in the area. These have been sent to the PReVENT coordination team, who will distribute them within the project. Further interaction on this topic is expected around M22, when the evaluation methods and tools from AIDE WP2.2 will be delivered. Finally, the first results from the SP1 studies on behavioural effects of ADAS, which should be of great relevance for PReVENT, will be available by M21.

Common demonstrators
As stated in the Technical Annex, a common prototype vehicle (heavy truck developed at VTEC) will be developed for the subproject SAFELANE within PReVENT and the subproject SP3 (Adapted Integrated Driver Vehicle Interface) within AIDE. The vehicle will implement a lane keeping support system, as well as innovative vehicle-driver interface solutions, according to the AIDE concepts. Therefore, AIDE will develop an integrated interface compatible with the selected PReVENT application and the evaluation process in SAFELANE will include these specific HMI aspects. This common prototype will be ready by M36.

Common demonstrator at IP PReVENT exhibition
AIDE plans to participate actively to the IP PReVENT Exhibition and Road Show in the fourth year, to demonstrate the project results. This will include the common PReVENT/AIDE prototype vehicles and the other experimental vehicles specific for each IP. The details of this event are still to be determined however. Further information will be incorporated into the next interaction plan.

4.1.3. Interactions with EASIS

The general objective of the EASIS STREP is to develop a modular, scalable electronics architecture for active, passive and integrated safety systems. An enabling electronics architecture is one of the most important pre-requisites for an AIDE-type integrated HMI to enter the market. It is thus crucial that the architectural requirements of AIDE are input to EASIS and discussed in detail. While AIDE also conducts significant work on HMI architecture (WP3.2), this work only deals with the functional level of abstraction which is largely independent of the implementation. A key interaction topic between AIDE and EASIS is thus to map the proposed AIDE functional HMI architecture onto the EASIS software and hardware architectures, and identify potential technical barriers for product deployment.

The main interactions between the projects, as planned in the Technical Annex, are illustrated in Figure 9.

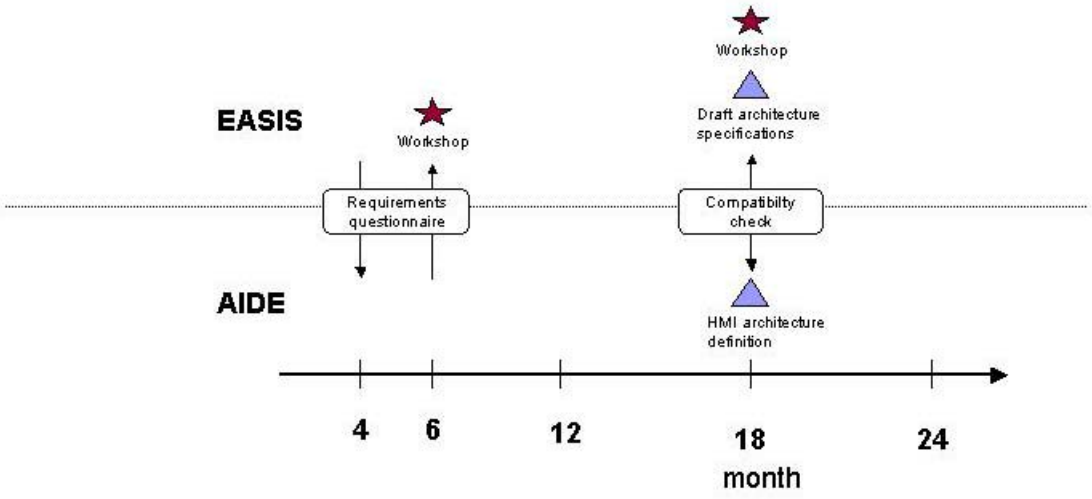

Figure 9. Main planned interactions between EASIS and AIDE

First requirements were gathered by the EASIS team by means of a questionnaire responded to by AIDE by M4. However, since the AIDE architecture was not yet defined at this point, only very general information could be provided.

At the current stage of development, however, the AIDE HMI architecture is sufficiently developed to be discussed in detail with EASIS. These discussions were initiated at the EASIS Open Workshop, arranged in Göteborg in July 2005. At the workshop, the AIDE project was presented, with special focus on the proposed HMI architecture solution. Moreover, the relation between the proposed AIDE HMI architecture and the EASIS SW/HW architecture was discussed in a break-out session (which also included discussions on PReVENT and GST). A key issue discussed was how the AIDE logical architecture could be mapped onto to the EASIS SW/HW architecture. Another issue, where AIDE and PReVENT has a strong common interest, was the architecture requirements imposed by the need for applications and sensor fusion units, to share access to a common sensor array. Further interaction with EASIS on a regular basis will be needed in order to identify potential barriers to the efficient deployment of the proposed AIDE solution.

4.1.4. Interactions with GST

The general objective of the GST IP is to develop an open and standardised framework architecture for end-to-end telematics services. A key interaction topic with AIDE is thus how telematics services could interface to the AIDE integrated HMI in a flexible way. Interactions between the projects have been set up in order to ensure compatibility between the GST telematics architecture and the AIDE HMI architecture. During the first year, general requirements and architecture specifications have been exchanged by the projects, and technical discussions have been initiated (mainly in the ISP task force). The general time plan for interaction with GST, defined in the Technical Annex, is presented in Figure 10.

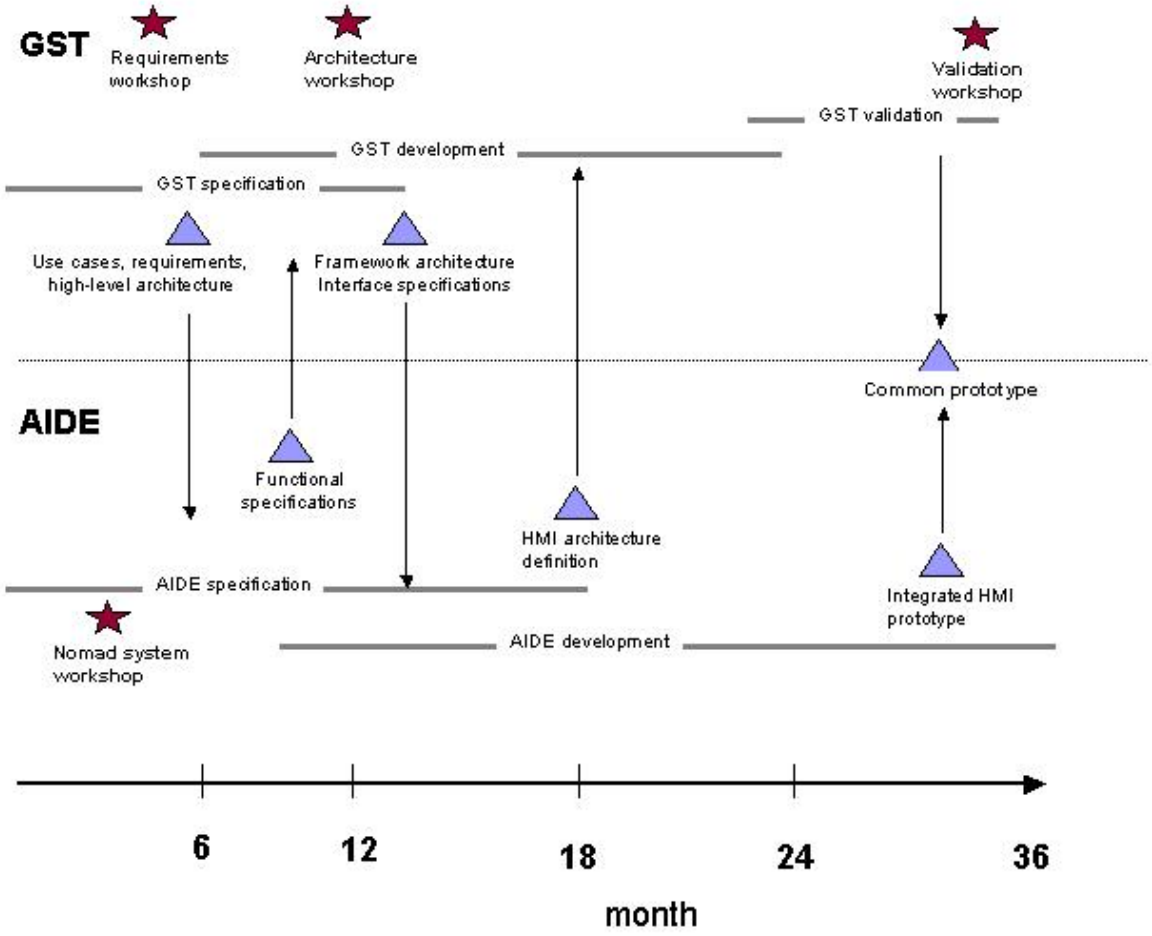

Figure 10. Overview of interactions with GST

A further important interaction topic for AIDE and GST is the integration of nomadic devices. Nomadic devices is a central topic in AIDE, and work involves both the establishment of the Nomadic Device Forum (gathering key stakeholders, e.g. the automotive, telematics industries and road authorities around the same table) and demonstration of potential solutions for nomadic device integration. For GST, nomadic devices are important as client systems for telematics services, and GST will also work on technical solutions for nomadic device integration. Thus, it is of key importance that these activities are harmonised. Detailed discussions between the key partners involved (mainly Motorola and ERTICO) will be initiated ASAP. Moreover, more

general strategies for nomadic device integration will be discussed in the Nomadic Device Forum Steering Group, where the GST management is represented.

4.2. HUMANIST

HUMANIST is a Network of Excellence (NoE) focusing on HMI issues in the context of intelligent transportation systems, with the main goal to create a European Virtual Centre by connecting the leading research institutions in the area. The research outputs from the NoE are targeted towards national and European authorities, standardisation bodies and European Integrated Projects, where AIDE is naturally one of the key targets. It is thus of key importance to create strong links between the research efforts in the two projects. This is facilitated by the strong overlap in partnerships between the projects, where most of the research institutes in AIDE are also participating in HUMANIST. Moreover, the AIDE coordinator (VTEC) is represented in the HUMANIST Scientific Advisory Board. The main achieved and planned interactions between the projects are presented below:

Exchange of public deliverables
The deliverables produced by the respective projects are monitored from each side. A mapping of the potential use of the deliverables in the respective projects were included in the AIDE Technical Annex, and reproduced in Table 1 and Table 2 below.

Table 1 HUMANIST deliverables feeding into AIDE

HUMANIST activity	Deliverables	Timing	Relevance to AIDE
Task Force A	**A.2:** Definition of user groups and review of their specific needs on ITS	M6	Input to the SP3 (esp. WP3.1 and 3.2) where the basic functionality of the AIDE system will be defined and specified based on user needs and analysis of critical scenarios.
	A.3: Analysis of context of use and definition of critical scenarios	M11	
	A.5: Identification of the modifications in driver needs due to implementation of new ITS	M20	
Task Force C	**C.3:** Synthesis of models and approaches for cognitive representation of Joint cognitive models of DVE	M11	This will provide the basis for the modelling and simulation development in AIDE SP1 (WP1.1 & 1.3). JRC is the leader of both HUMANIST TF C and AIDE SP1.
	C.5: Review of knowledge on human centred design applied to IVIS and ADAS	M23	This will be an important input to SP3, especially the user centred HMI development in WP3.4.
	C.6: Report on interest and use of Joint cognitive models	M35	This will be important for the dissemination exploitation of the DVE models and simulations in SP1.
Task Force D	**D.2**: Review of driver distraction effects due to the interaction with IVIS	M11	This will be an important input for the development of workload and distraction measurement methods and tool in SP2, WP2.2.
	D.5: Review of driver distraction effects due to the interaction with IVIS (update)	M35	
Task Force E	**E.2**: A matrix of the advantages and disadvantages of ITS assessment methods and the application and effectiveness of ITS assessment methods	M10	Direct input to the reviews of methods and tools in AIDE SP2.
	E.4: Report on the tools and methods for integrating methods into an assessment methodology	M25	Direct relevance for WP2.1 where tools and methods will be integrated to an HMI assessment methodology adapted tom industrial use.

	E.8: A set of predefined integrated methodologies for the assessment of ITS in terms of driver appropriation processes over time	M56	This will be an opportunity for a general collation of the results from the two initiatives with respect to HMI assessment methodologies.

Table 2 AIDE deliverables feeding into HUMANIST

AIDE SP	Deliverables	Timing	Relevance to HUMANIST
SP1 Behavioural Effects and DVE Modelling	D1.1.1b Requirements for HMI design and driver modelling	M8	The AIDE work on DVE modelling/simulation and its application in industrial HMI design will provide continuous feedback to HUMANIST Task Force C to for further basic research in this area.
	D1.1.5 Final DVE model structure	M30	
	D1.3.5 DVE validation tests: data analysis and results	M48	
	D1.2.3 Learning and Appropriation phase test and results	M18	These results will be an important input to the HUMANIST work towards DE.8: the assessment of ITS in terms of driver appropriation processes over time
	D1.2.4 Long-term phase test and results	M30	
SP2 Evaluation and Assessment Methodology	D 2.1.1 Review of existing tools and methods (for generic assessment methodology)	M6	These reviews will provide input to the activities in Task Force E on assessment methodologies, especially DE.2 (a matrix of the advantages and disadvantages of ITS assessment methods and the application and effectiveness of ITS assessment methods).
	D 2.2.1 Review of existing techniques (for offline workload assessment).	M8	
	D2.2.3 Development of advanced secondary task methodology	M22	These tools and methods for workload/distraction assessment will provide input to the activities in Task Force E, especially DE.3 (report on the tools and methods for integrating methods into an assessment methodology)
	D2.2.4 Development of potential of workload look-up tables	M22	
	D2.2.5 Performance indicators as workload measurement tool	M22	
	D2.2.6 Subjective assessmnet methods for workload	M22	
SP3 Design and Development...	D3.1.1 Workshop on nomad devices minutes	12	The AIDE work on nomad devices will be an important input to several activities in HUMANIST, in particular in Task Forces A and D.
	3.4.4Guidelines for safe Integration of NOMAD devices within the vehicle environmen	36	
	3.5.1 Prototype vehicles	40	The AIDE prototype vehicles will provide real examples of the AIDE concept and are thus of key importance keys for identifying further basic research needs in this area.
SP 4 Horizontal activities	D4.2.1 Report on results of First User Forum	12	The results of these workshops are strongly relevant for the HUMANIST Task Forces A and C.
	D4.2.2Report on results of Second User Forum	36	
	D4.3.1 Report on the review of the available guidelines and standards	6	This is relevant to corresponding activities in HUMANIST, especially on the further development of the European Statement of Principles. In general, the activities in the two initiatives on guidelines and standards will be strongly coordinated.
	D4.3.2 Report on design guidelines and standards recommendations	46	This is relevant to corresponding activities in HUMANIST, especially on the further development of the European Statement of Principles. In general, the activities in the two initiatives on guidelines and standards will be strongly coordinated.

Common events
To date, several common events have been arranged:

- *Joint session on evaluation methods at ITS Europe in Budapest (June, 2004):* At this session, experts from both projects presented the state-of-the-art in the field of evaluation methodologies.
- *Driver Modelling Workshop, at JRC, Ispra (May, 2005):* This highly successful workshop, gathering the leading European expertise in the area of driver behaviour modelling, was arranged within the framework of HUMANIST but with strong support and participation from the AIDE project. The workshop also featured a poster session where HUMANIST PhD students were given the opportunity to present their work to a wider audience (including the AIDE partners present).

A common HUMANIST-AIDE session is planned at the next ITS world conference in San Francisco (November, 2005), with the main focus on evaluation methods. The idea is to follow up the previous, more generic, session in Budapest, with presentations of concrete results from the projects. The preliminary agenda is the following:

1. Introduction to AIDE and HUMANIST (AIDE/HUMANIST)
2. Basic issues in IVIS and ADAS evaluation: Towards a generic ITS test regime (HUMANIST)
3. Behavioural effects of IVIS and ADAS (HUMANIST)
4. Workload/distraction assessment methods and tools (AIDE)
5. Application to user-centered HMI design (AIDE)

Annex A: The AIDE Glossary

A1 Introduction

The main objective of the AIDE Glossary is to provide a common reference for key terms used in the project. The glossary is based on the glossary defined in the EAST-EAA project on electronics architecture (EAST, 2003)[1,2]. Thus, all terms related to architecture are directly adopted directly from EAST, while a number of HMI and human-factors-related terms have been added. As far as possible, the definitions in the Glossary are obtained from well-established references, preferably ISO standards or well-known literature sources. However, many definitions have also been defined within the project. If needed, alternative definitions are be included.

The Glossary has the following structure:

1. **Term:** The term to be defined
2. **Definition:** Definition of the term
3. **Reference:** Reference to the source of the definition
4. **Alternative definition:** If needed, an alternative definition could be included
5. **Reference to the alternative definition**
6. **Notes:** Further explanation, e.g. on the interpretation of the definition
7. **Category:** A categorisation of the terms into the following categories: (1) General, (2) HMI design, (3) HMI evaluation, (4) Behavioural effects and (5) SW development/architecture.
8. **Status:** Whether the entry has been approved by the core group

The Glossary is a living document, which will be updated throughout the project. The current version is implemented in Excel, but it will soon be put on the AIDE web as part of the Innovation Observatory. It is maintained by VTEC.

The general procedure for updating the Glossary is as follows:

1. A partner identifies a need for update (e.g. adding a term or changing a definition)
2. The partner proposes the change to the relevant SP
3. The proposal is discussed within the relevant SP. If agreement is reach, the proposal is passed on to the Core Group.
4. The Core Group makes a final decision on whether to include the new definitions
5. VTEC updates the Glossary

In order to ensure that the Glossary is being used as intended, the Core Group decided that all AIDE deliverables should include a sub-set of the Glossary, featuring the terms that are relevant to the particular deliverable. A common scenario is that the author of a deliverable discovers that a key term is missing. In this case, a draft definition could be included for the deliverable, with a clear indication that it is not yet an official entry in the AIDE Glossary. The additional terms and

[1] The EASIS Glossary (D0.0.1 in the EASIS project) is also based on EAST which should ensure consistency between the terminologies used in the projects.
[2] EAST-EEA project, "Embedded Electronic Architecture", ITEA project 00009, *Glossary*, 30 October 2003.

their definitions should then be handled according to the procedure above in order to be finally included in the Glossary.

The current version of the AIDE Glossary is included in the following section. This version is yet fairly incomplete, and needs to be updated. The main next steps are:

1. Agree in the Core Group on the current version
2. Add new terms discussed in recent meetings
3. Put the first official version of the Glossary on the AIDE web site (as part of the Innovation Observatory)

A.2 The AIDE Glossary – v.1.0

Term	Definition	References	Alternative definition	References alt. definition	Notes
Action	An event initiated by the driver or an **application**	Original AIDE definition			Some examples of actions are: route guidance message from the navigation application, a warning from the ACC or an SMS from the phone. An action could also be a continuous output presented to the driver (e.g. the speedometer or streaning sound output from the radio). The driver actions of interest here are those directed towards systems
ADAS	Systems that interact with the driver with the main purpose of supporting the **driving task** on the tracking and regulating levels.	Original AIDE definition			Based on the ECOM model, adopted as the Conceptual Framework of AIDE (Hollnagel, E. & Woods, D. D., 2005), the driving task can be described in terms of, potentially simultaneous, layered control processes: (1) tracking, (2) regulating, (3) monitoring and (4) targeting. Hollnagel, E. & Woods, D. D. (2005). Joint cognitive systems: Foundations of cognitive systems engineering. Boca Raton, FL: Taylor & Francis/CRC Press.
AIDE design scenario	A driving situation, specified by at least one **action** and one or more **DVE state** parameters, acted upon by **the AIDE system**.	Original AIDE definition			AIDE design scenarios represent a problem scenario (conflict situation). A description of possible general solution is included. The scenario + solution represents a use case for AIDE meta-functions.
AIDE meta-function	The response of the AIDE system to an **AIDE design scenario**.	Original AIDE definition			Examples of potential AIDE meta functions are HMI I/O management, prioritisation, scheduling and warning adaptation
AIDE system	The Adaptive Integrated Driver-vehicle Interface targeted by the AIDE IP, implementing the AIDE meta-functions	Original AIDE definition			The AIDE system consists of a basic set of HMI management components, in particular the ICA and the DVE monitor. Thus, the AIDE system does not include a specific set of applications or HMI I/O devices. Rather, the AIDE system should support different applications, I/O devices and configurations in a modular way.

Application	A program (such as a word processor or a spreadsheet) that performs one of the important tasks for which a computer is used	EAST-EAA (Webster)			An application is a software component that fulfils a functional specification. Exchanges between application components are persistent or non-persistent information.
Application Programming Interface (API)	A software interface that enables **applications** to communicate with each other. An API is the set of programming language constructs or statements that can be coded in an application program to obtain the specific functions and services provided by an underlying operating system or service program.	EAST-EAA (http://www-3.ibm.com/ibm/terminology/.)			API represents a way to get application independence from the lower SW layer (namely operating system, drivers and other system service).
Architecture	The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution.	EAST-EAA (IEEE Recommended Practice for Architectural Description of Software-Intensive Systems; IEEE Standard P1471, IEEE Architecture Working Group (AWG))			In EAST WP3, architectures denote system descriptions on different abstraction levels. For example, the same system has a sketchy architecture on a high level (the Functional Analysis A.) and a detailed architecture on a lower level (The Logical A.). The term "view" could be used, but does not catch the fact that the architectures are subject to design work on the respective level of abstraction.
Behavioural adaptation	The whole set of behaviour changes that are designed to ensure a balance in relations between the (human) organism and his surroundings, and at the same time the mechanisms and processes that underlie this phenomenon	Grand Dictionnaire de la Psychologie	Those behaviours which may occur following the introduction of changes to the road-vehicle-user system and which were not intended by the initiators of the change." (p. 23).	OECD. 1990. Behavioural Adaptations to Changes in the Road Transport System. Report Prepared by an OECD Expert Group, Road Transport Research Programme.	The first, more general, definition refers to adaptation processes that come into play each time a situation embodies one or several new, unknown or simply unfamiliar elements. These processes are said to be assimilating when they integrate the new data into previously established patterns of behaviour, and accommodating when the new data transform an existing pattern or schema in such a way as to make it compatible with the situation. The alternative (OECD) definition refers to the use of the term in road safety research, where it is mainly used to signal unexpected or unanticipated behavioural changes that appear in response to the introduction of a change in the traffic system and which may (more or less) jeopardise its expected safety benefits.
CAN Frame	Information on the bus sent in fixed format frames of different but limited length.	EAST-EAA (ISO 11898, section 4.1.)			A CAN Frame can have a wide range of lengths. A CAN Frame in Standard Format with zero data bytes has 47 bits. A CAN Frame in Extended Format with 8 data bytes can have up to 154 bits because of bit stuffing. Of course, the length is still defined – within a large range. The Data Link Layer adds more to the raw data than just some identification bits. In the case of CAN, it adds the Start-Of-Frame bit, the Arbitration Field, the Control Field, calculates the CRC and adds the CRC Field, the Acknowledge Field and the End-Of-Frame Field (see CAN Specification for details).

Certification	Activity performed, in order to certify the System (or Software) conformance with respect to a predefined quality assurance.	EAST-EAA			
Class	A description of a set of objects that share the same attributes, operations, methods, relationships, and semantics. A class may use a set of interfaces to specify collections of operations it provides to its environment.	EAST-EAA (OMG)			
Complacency	A feeling of being at ease, satisfied or comfortable	Original AIDE definition			In the aviation Human Factor domain the term is used to characterize pilot's over reliance on automation.
Configuration	The arrangement of hardware and/or software elements in a system.	EAST-EAA (Functional safety: safety instrumented systems for the process industry section; Part 1: Framework, definitions, system, hardware and software requirements; IEC2002.)	Adaptation of an application to different physical targets or functional strategies	EAST-EAA (Functional safety: safety instrumented systems for the process industry section; Part 1: Framework, definitions, system, hardware and software requirements; IEC2002.)	
Data	Information output by a sensing device or organ that includes both useful and irrelevant or redundant information and must be processed to be meaningful.	EAST-EAA (Webster)	Data is the software implmentation of an information. It can be exchanged between software components. A data is persistent. It is persistent in memory.	EAST-EAA (Webster)	
Dependability	Dependability is defined as the trustworthiness of a computer system such that reliance can justifiably be placed on the service it delivers .	EAST-EAA (J.C. Laprie; Dependability: Basic Concepts and Terminology; Dependable Computing and FaultTolerant Systems Vol. 5; Springer-Verlag Wien New York, 1992.)			The service delivered by a system is its behaviour as it is perceived by its user(s); as user is another system (human or physical) which interacts with the former. Depending on the application(s) intended for the system, different emphasis may be put on different facets of dependability, i.e. dependability may be viewed according to different, but complementary, properties, which enable the attributes of dependability to be defined: (1) With respect to the readiness for usage, dependable means available; (2) with respect to the continuity of service, dependable means reliable; (3) with respect to the prevention of unauthorised access and/or handling of information, dependable means secure.
Device	Functional unit of hardware or software, or both, capable of accomplishing a specified purpose.	EAST-EAA (Functional safety: safety instrumented systems for the process industry section; Part 1: Framework, definitions, system, hardware and software requirements; IEC2002.)			Devices can implement a part of a function (more than one device could be necessary to fulfil a function – e.g. rear-view mirror inside and outside to provide for rear-viewing) or one device can implement more than one function (side rear-view mirror is a device that can include temperature captor, direction signalisation, ...)..

Device-Driver	A program that controls a device. Every device, whether it be a printer, disk drive, or keyboard, must have a driver program. Many drivers, such as the keyboard driver, come with the operating system. For other devices, you may need to load a new driver when you connect the device to your computer.	EAST-EAA (http://lycos.webopedia.com/TERM/d/driver.html.)			A driver acts like a translator between the device and programs that use the device. Each device has its own set of specialized commands that only its driver knows. In contrast, most programs access devices by using generic commands. The driver, therefore, accepts generic commands from a program and then translates them into specialized commands for the device.
Direct behavioural effect	The impact of the support system on the performance of the specific driving sub-task to which it is dedicated				
Distraction	see **driver distraction**				
Domain	A problem space	EAST-EAA (IEEE Standard for Information Technology – Software Life Cycle Processes – Reuse Processes; IEEE Standard 1517-1999;1999.)	Used as a synonym for the groups of products defined in the EAST project: chassis, powertrain, telematic, body and HMI.	EAST-EAA (IEEE Standard for Information Technology – Software Life Cycle Processes – Reuse Processes; IEEE Standard 1517-1999;1999.)	Domain could be a set of features (set of problems) or a set of services (here service # solution). Domains are made of features. It could be that a domain contains more features but it could be that a domain is made by exactly one feature. Domains can be used to group electronic features for example in the WT1.2 feature model. Both domain and electronic feature are design concepts. Applications are software modules (refer to the term package in UML) that during run time implement electronic features. An electronic feature can be implemented by one or more applications. An application can during run time provide services (operations) to other applications and use services provided by a middleware or other applications.
Driver distraction	Attention given to a non-driving related activity	ISO TC22/SC13 WG8 CD 16673 (Occlusion Committee draft)			This definition is somewhat unclear due to the fact that “driving-related activity” and “driving performance” are not further defined. According to the AIDE Conceptual Framework, the driving task should not be seen as a single activity, but rather as a set of multiple simultaneous, and layered, control tasks. Distraction with respect to a given control process (e.g. tracking) could thus be viewed in terms of interference by another (driving- or non-driving related control process, typically resulting in degraded performance on the given control task. In practice, however, “driver distraction” is normally used to refer to interference with the tracking and/or regulating control tasks
Driving demand	The demands of the driving task	de Waard, D. (1996). The Measurement of Drivers' Mental Workload. ISBN 90-6807-308-7. Traffic Research Centre. University of Groningen.			Demand is determined by the goal that has to be attained by means of task performance, and is, once the goal has been set, external and independent of the individual driver (c.f. **mental workload**)

Driving performance	Performance on the **driving task**				According to the AIDE Conceptual Framework, the driving task should not be seen as a single activity, but rather as a set of multiple simultaneous, and layered, control tasks. Thus, driving performance could be defined with respect to any of these control tasks. For example, driving performance on the tracking level would be related to the ability to keep the vehicle within acceptable safety margins. Similarly, performance on the regulating level would be related to the ability to select these safety margins based on the general situation assessment at the monitoring level.
Driving style	The manner in which a person chooses to drive	West et al. (1993)			Basically, the driving style is described as a relatively stable characteristic of the driver, which typifies his/her personal way of driving, the way he/she chooses to drive (for instance, the level of speed or the safety margins more frequently adopted, the general level of attention devoted to the driving task and so on). The driving styles is most often defined in contrast to driving skills, which reflect the way in which a person is able to drive
Driving task	All aspects involved in mastering a vehicle to achieve a certain goal (e.g. reach a destination) , including tracking, regulating, monitoring and targeting.	Original AIDE defnition			Based on the ECOM model, adopted as the Conceptual Framework of AIDE (Hollnagel, E. & Woods, D. D., 2005), the driving task can be described in terms of, potentially simultaneous, layered control processes: (1) tracking, (2) regulating, (3) monitoring and (4) targeting. Hollnagel, E. & Woods, D. D. (2005). Joint cognitive systems: Foundations of cognitive systems engineering. Boca Raton, FL: Taylor & Francis/CRC Press.
DVE state	A set of **parameters** representing certain aspects of the driver, the vehicle and the environment	Original AIDE defnition			
Electronic Control Unit (ECU)	Small embedded computer system consisting out of at least one CPU and corresponding periphery which is placed in one housing.	EAST-EAA			
Element	A component of a system; may include equipment, a computer program, or a human.	EAST-EAA (IEEE Guide for Developing System Requirements Specifications; IEEE Standard P1233a, 1998.)			

Embedded System	A small computer system that is generally hidden inside equipment [machine, electrical appliance, or electronic gadget] to increase the value of the equipment for better or more efficient functionality.	EAST-EAA			This kind of system always involves both the software and hardware co-development. Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program. Embedded systems in French are the „on-board" systems, i.e. systems that run on mobile mechanics (airplanes, trains, ...), so they need not be small and hidden, but there are generally constraints of size and robustness. It is also a common acceptance that this term also designates systems which are small and hidden and robust..
Feature	User-visible aspects or characteristics of a system.	EAST-EAA (P. Clements; L. Northrop; Software Product Lines – Practices and Patterns; SEI series in software engineering; Addison-Wesley, 2002.)	(B) A feature is a functionality that is specifically perceptable by the customer/stakeholder. (C) A feature is a prominent or distinctive user-visible aspect, quality, or characteristic of the system.	EAST-EAA (P. Clements; L. Northrop; Software Product Lines – Practices and Patterns; SEI series in software engineering; Addison-Wesley, 2002.)	Whereas **requirement** expresses only a wish, feature goes a step further in the sense it is a requirement that I am sure to find in my system. In other words features set results from filtering the requirements set. Feature is a characteristic, quality, property, behaviour, capability, functionality, …, proper (related to) of a system that enables the users to better qualify (measure) that system. A feature is a perceptible quality or characteristic of a system. What is an electronic feature (as used in WP3)? An electronic feature could be defined as a desired functionality or quality, implemented by means of an electrical system. Electronic features bring added value to the user of a system (e.g. vehicle) and justify the electrical system. Climate control and navigation system are examples of electronic features.
Flexibility	The ability of a system to adapt to new, different or changing requirements.	EAST-EAA (J. W. Bracket; Software Requirements; SEI Curriculum Module SEICM-19-1.2, Carnegie Mellon University, 1990.)			
Function	A task, action, or activity that must be accomplished to achieve a desired outcome (EAST-EAA).	EAST-EAA (IEEE Guide for Developing System Requirements Specifications; IEEE Standard P1233a, 1998.); D3.2.1 draft	A specific service that can be offered by a **system**. The same Function can be offered from different systems	Federal Information Processing Standards Publications (EAST-EAA)	Examples of Functions include turn by turn navigation, voice call, lane departure warning

Functional Specification	Specification of the normal function of the system.	EAST-EAA (Safety terms for automation systems reliability and safety of complex systems; VDI/VDE 2000.)			A software specification is a set of requirements that can be of different types, as behaviour, interfaces, timing constraints, needed resources, safety, etc.
Functionality	A synthesis of functions to provide a major functional entity of a unit.	EAST-EAA			
Gateway	A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures.	EAST-EAA (http://www-3.ibm.com/ibm/terminology/).	A functional unit that connects two networks or sub-networks having different characteristics, such as different protocols or different policies concerning security or transmission priority.	EAST-EAA (http://www-3.ibm.com/ibm/terminology/).	The Multi network car architectures may need a gateway (e.g. From LIN to CAN). A gateway may also implement a filtering function.
Human Machine Interface (HMI)	A set of compoents that govern the interaction between the user and one or more vehicle systems	Original AIDE definition			
Indirect behavioural effects	The impact of a support system on the performance of other driving sub-tasks than those for which it is dedicated.	Original AIDE definition			
Integrated system	Two or more in-vehicle devices, which provide information to, or receive output from, the driver of a motor veehicle, whose output have been combined or harmonised	ISO TC22/SC13 WG8 PWI LCT 018			*Example 1:* An in-vehicle entertainment system and route guidance system which use the same visual and manual input portals and visual and auditory output portals. *Example 2:* An in-vehicle entertainment system whose auditory output mutes when a mobile phone call is made or received. This definition is still under discussion in ISO TC22/SC13 WG8
Interface	Abstraction of a service that only defines the operations supported by that service (publicly accessible variables, procedures, or methods), but not their implementation.	EAST-EAA (Szyperski, Clements.; Component Software – Beyond Object-Oriented Programming; Addison-Wesley, 1997;	An interface consists of the set of assumptions that users of the component may safely make about it – nothing more, but nothing less.	Parnas, D.; Information Distribution Aspects of Design Methodology"; In Proceedings of the 1971 IFIP Congress, Ljubljana, Slovenia, August 1971. pp339-344.)	This is far more complete than the simple functional signatures one finds in header files. Signatures simply name the programs and specify the numbers and types of their parameters, but they tell nothing about the semantics of the operations, the resources consumed, the exceptions raised, or the externally visible behavior.
Interface-Specification	A set of language and message formats used for the communication between software components.	EAST-EAA			

IVIS	Systems that interact with the driver with the main purpose to support tasks on the targeting and monitoring levels, or do not support driving at all.	Original AIDE definition			Based on the ECOM model, adopted as the Conceptual Framework of AIDE (Hollnagel, E. & Woods, D. D., 2005), the driving task can be described in terms of, potentially simultaneous, layared control processes: (1) tracking, (2) regulating, (3) monitoring and (4) targeting. Hollnagel, E. & Woods, D. D. (2005). Joint cognitive systems: Foundations of cognitive systems engineering. Boca Raton, FL: Taylor & Francis/CRC Press.
Learnability (of driver assistance system)	Á system is learnable, if accurate assimilation of information by the driver occurs, evidenced in the driver's understanding of system function, system handling and situational limits.	RESPONSE project			
Locus of Control	An individual's assumptions regarding responsibility for the outcome of events	Rotter & Hochreich, 1975			
Mental workload	The specification of the amount of information processing capacity that is used for task performance	de Waard, D. (1996). The Measurement of Drivers' Mental Workload. ISBN 90-6807-308-7. Traffic Research Centre. University of Groningen.			Mentall workload refers to effect that driving demand has on the operator in terms of stages that are used in information processing and their energetics (c.f. **driving demand**)
Message (in architecture)	A message is a group of data values that must be exchanged together. A typical reason for grouping data is the temporal consistency of different data values: a control algorithm may require for example that the temperature and the pressure are measured at the same time. Depending on the size of the message and the maximal size of frames, several messages may be transported by one frame or it may be necessary to split a message into several segments for being able to send it over a network.	EAST-EAA			
Modularity	Property of an architecture being composed of modules, i.e. of units that may be handled (implemented, exchanged...) without internal changes. This property requires well-defined interfaces of the modules. Furthermore, for easy handling, a proper tailoring of the modules is necessary.	EAST-EAA			
Parameter	An independent variable used to express the coordinates of a variable point and function of them.	EAST-EAA (Webster)			
Parameterisation	To express in terms of **parameters**.	EAST-EAA (Webster)			
Performance	see **driving performance**				

Primary task	The task with the highest priority in a multi-tasking situation.	Original AIDE definition			In the automotive domain, the primary task is normally the drivimg task
Realtime	System which has to finish the processing within a specific time interval (deadline) dedicated by its environment.	EAST-EAA			
Reference Architecture	A reference architecture is a reference model mapped onto software components (that will cooperatively implement the functionality defined in the reference model) and the data flows between the components. A reference model is a division of functionality together with data flow between the pieces.	EAST-EAA (L. Bass and P. Clements and R. Kazman; Software Architecture in Practice; Addison-Wesley, 1998; David Garlan and Mary Shaw "An Introduction to Software Architecture," Advances in Software Engineering and Knowledge Engineering, Volume I, edited by V.Ambriola and G.Tortora, World Scientific Publishing Company, New Jersey, 1993.	A reference architecture is a conceptual, or core architecture which generalizes the architecture of several systems. It describes feature interactions, architectural styles and design patterns, independently of the implementation.	EAST-EAA	A reference architecture is a conceptual, or core architecture which is published such that one can refer to it. That is, the description of the feature interaction, architectural style and design patterns, independently of the implementation.The reference architecture defines the common infrastructure of software components as well as data flows between these components. A reference architecture corresponds to a coherent design principle. It provides an organizational structure tailored to a family of applications, such as avionics, command and control, or vehicle management systems. The definition of the reference architecture facilitates deriving and extending new software architectures for classes of systems, through instantiation of the reference architecture.
Reference task	**Secondary task** activity which consitutes a primary task performance reference level when performed concurrently with the **primary task**	ISO TC22/SC13 WG8 PWI LCT 018			This definition is still under discussion in ISO TC22/SC13 WG8
Requirement	A condition or capability needed by a user to solve a problem or achieve an objective.	EAST-EAA (IEEE Guide for Developing System Requirements Specifications, IEEE Standard P1233a, 1998.)	(B) A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document. (C) A documented representation of a condition or capability as in definition (A) or (B). (D) The necessity that a system has a particular feature. (E) A requirement expresses condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification or other formally imposed properties.	EAST-EAA	To complete definition (E), we can notice that there are several kinds of documents that can express these properties. Moreover, the definition of a requirement can go from abstract statement of the services which the system is expected to provide (functional requirement) or of the constraints under which the system must operate (non-functional requirements) to a detailed mathematical specification. Requirements are general artifacts. They do not correspond to only one level of architecture but will be used at each level.

Scaleability	The degree to which assets can be adapted to support application engineering products for various defined measures.	EAST-EAA (IEEE Standard for Information Technology – Software Life Cycle Processes – Reuse Processes; IEEE Standard 1517-1999;)	Capability of an architecture to adapt varying quantitative requirements (number of applications, devices to be controlled, users, communication channels, transmission bandwidth, availability...). An architecture is optimally scalable if it imposes no constraints on quantitative requirements.	EAST-EAA	
Secondary task	A task with lower priority than the **primary task** in a multi-tasking situation.				In the present context, a typical secondary task is interacting with an in-evhicle system
Self-explanatory support system	A driver assistance system leaving a minimal amount of learning demand to the driver and eliminating learnability issues which can result in safety-critical traffic situations				
Sensation seeking	A trait defined by the seeking of varied, novel, complex, and intense sensations and experiences and the willingness to take physical, social, legal, and financial risks for the sake of such experiences	Zuckerman (1994)			Central to sensation seeking is the optimistic tendency to approach novel stimuli and explore the environment.
Service	A type of operation that has a published specification of interface and behaviour, involving a contract between the provider of the capability and the potential clients.	EAST-EAA			First a service could be seen as a functional feature. For example the middleware transmits the request of a client to the corresponding server. Another possibility could be that services are solutions (but don't mean implementation!) to fulfil features. [1..n] to [1..n] relation that is one service can be a solution for one or more features but also n services may be needed to fulfil a feature. Services could be solutions (not implementations!) to fulfil features. Services can be used to realize a feature; a service can be a feature. A service is the mean to satisfy a need.
Situational awareness	The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future	Endsley, M.R., Garland, D.J. (2000) Situation Awareness Analysis and Measurement, Lawrence Erlbaum Associates, Publishers, London (Quoted in D2.2.1)			Generally speaking, SA refers to the understanding of what is going on in the environment and what is going to happen in the nearest future.

Software Architecture	A software architecture is the structure or structures of a system, which comprise software components, the external visible properties of these components and the relationships among them.	EAST-EAA (L. Bass and P. Clements and R. Kazman; Software Architecture in Practice; Addison-Wesley, 1998)			
Software component	A unit of composition with contractually specified interfaces and explicit context dependencies only. A software component can be deployed independently and is subject to composition by third parties.	EAST-EAA (Szyperski, Clements.; Component Software – Beyond Object-Oriented Programming; Addison-Wesley, 1997; P. Clements; L. Northrop; Software Product Lines – Practices and Patterns; SEI series in software engineering; Addison-Wesley, 2002.)	A distributable source, binary or executable software module with identity, well-defined interfaces and well-defined dependencies (i.e. compiler, run time, etc.).. A software component is an identified piece of software that fulfils a software specification, with well-defined interfaces with other software components. Examples: Operation System, application component	EAST-EAA	
Specification	Precise (formal if possible) description of an object within the scope of the task.	EAST-EAA (Safety terms for automation systems reliability and safety of complex systems; VDI/VDE 2000.)			
Stakeholder	Any party that has a legitimate interest ("stake") in a corporate activity, either as individuals or representatives of a group. This includes people who influence a decision, or can influence it, as well as those affected by it	EAST-EAA(L. Bass and P. Clements and R. Kazman; Software Architecture in Practice; Addison-Wesley, 1998.)			
System	A collection of components organized to accomplish a specific **function** or set of functions.	EAST-EAA (IEEE Recommended Practice for Architectural Description of Software-Intensive Systems; IEEE Standard P1471, IEEE Architecture Working Group (AWG), 2000.)	Set of elements, which interact according to a design; an element of a system can be another system, called a subsystem, which may be controlling system or a controlled system and may include hardware, software and human interaction	Functional safety: safety instrumented systems for the process industry section; Part 1: Framework, definitions, system, hardware and software requirements; IEC2002.	The different components of the system are organized to accomplish a specific function or a set of functions.
System response delay (SRD)	Interval during which the driver has to wait for an interface to respind or update in order to continue the task	ISO TC22/SC13 WG8 CD 16673 (Occlusion Committee draft)			

Task	Process of achieving a specific and measurable goal using a prescribed method	ISO TC22/SC13 WG8 CD 16673 (Occlusion Committee draft)			Example: Obtaining guidance by entering a street address using the scrolling list method, continuing until route guidance is initiated (visual-manual task)
Use case	An intended or desired flow of events or tasks that occur within the vehicle and are directed to or coming from the driver in order to accomplish a certain system-driver interaction.	Original AIDE definition	A model of the usage by the user of a system in order to realise a single functional feature of the system.	EAST-EAA	
Visual demand	Degree of visual activity required to extract information from an object to perform a specific **task**	ISO TC22/SC13 WG8 CD 16673 (Occlusion Committee draft)			In general, visual demand depends on: (a) the quantity of information to be extracted and (b) the ease with which information can be resumed following any interruption

Annex B: Introduction to the AIDE Conceptual Framework

B1 Introduction

The objective of the conceptual framework is to establish a common theoretical frame of reference for describing key concepts and phenomena related to driver behaviour and performance. The development of such a framework was stated already in the Technical Annex, as a task of SP1. Based on the review of existing models in D1.1.1a, the COCOM/ECOM model (Hollnagel and Woods, 2005) was selected as the prime candidate the basis for the further development of the so-called Generic (G-) DVE model. However, a further motivation for promoting this development on the IP level was a requirement from the First Year Annual Review for the development of a ”Unified Theory of Behaviour” for the project. While it is clear that the development of a detailed theory of driver behaviour, agreed by all, is not realistic within the scope of the project, the establishment of a general conceptual framework for describing key AIDE-related issues, should be feasible and would of greatly facilitate the interaction between different activities.

The present text is intended as a brief overview of the COCOM/ECOM models, selected as the basis for the framework, its intended application in AIDE. For a more detailed description and further applications, see Hollnagel and Woods (2005), Hollnagel, Nåbo and Lau (2003), Engström and Hollnagel (2005) and Peters and Östlund (2005).

B2 Overview of COCOM/ECOM

The present section presents the basic ideas behind the COCOM and ECOM models. Since *control* is a key concept underlying these models, the section starts with a brief outline on of how this concept can be applied to describe driving behaviour.

B2.1 Control

Driving could be considered as an instance of the more general notion of *driver behaviour*. Behaviour, as opposed to mere movements, can be conceived of as goal-directed activity. Thus, *driving* can be thought of as a set of behaviours directed towards goals associated with vehicle operation. *Control* is a useful concept for describing the dynamics of goal-directed behaviour, in man as well as in machines. Controlling a process means achieving a consistent goal state (often called the reference- or target value), e.g. by means of countering effects of external disturbances. Control is thus closely related to orderliness or predictability, i.e. a controlled system is ordered, stable and predictable while a system that is out-of-control is disordered, unpredictable and unstable.

Control comes in different varieties: In *feedback control*, the controller performs corrective actions based on the deviation between a desired outcome (the goal) and the actual outcome. A prototypical example of a feedback control is the thermostat. Another type of control is *feedforward-*, or anticipatory, control. In this case, the control actions are based on predictions of

future states, and not purely reactive as in feedforward control. Driving behaviour involves both feedback, feedforward and mixed control loops.

Control theory has been widely applied to the modelling of operator vehicle handling, in automotive and other domains (e.g. Weir and McRuer, 1968; Weir and Chao, 2005; Donges, 1978). In these types of models, vehicle control is mainly modelled in terms of feedback control mechanisms where control inputs (steering wheel/pedal movement) are translated, via the vehicle dynamics, into vehicle position/heading values that are fed back to the human controller. However, control theory has also been applied to the modelling of higher level aspects of driving (e.g. Wilde, 1982; Vogel, 2002). See Jagacinski and Flach (2003) for a general text book on control theory applied to human performance modelling.

B2.2 The Contextual Control Model (COCOM)

A general account for human control of a process or plant, based on Neisser's (1976) concept of the perceptual cycle, is offered by the Contextual Control Model (COCOM, Hollnagel and Woods, 2005). An important starting point for COCOM is that the controller and controlled system is viewed as an integrated Joint Cognitive System (JCS). A key concept in the model is the *construct*, which refers to what the controller knows or assumes about the situation in which the action takes place. This understanding is the basis for selecting actions and interpreting information. The selected actions affect the process/application to be controlled. This generates feedback on the effects of the action which, together with external disturbances, modifies the construct and, hence, the future action selection. An important property of this model is thus that it captures both the feedback and feedforward aspects of control, i.e. action selection is a function of both direct feedback and the predictions of future events.

Another key property of COCOM is that it offers an explicit account of time. As illustrated in Figure 11, the model contains three basic time parameters: (1) Time to perceive, (2) time to decide and (3) time to act. As in any control system, the relations between these different time parameters strongly determine the performance of the JCS. For instance, long delays between action and feedback, such as in the control of a large ship, make feedback control difficult and thus put greater requirements on feedforward control mechanisms. Moreover, the time needed to perform one cycle must be less than the total time available. If the available time becomes too small, it may be increased by slowing down the pace of the task, e.g. by reducing speed in the case of driving (as long as the task is self-paced).

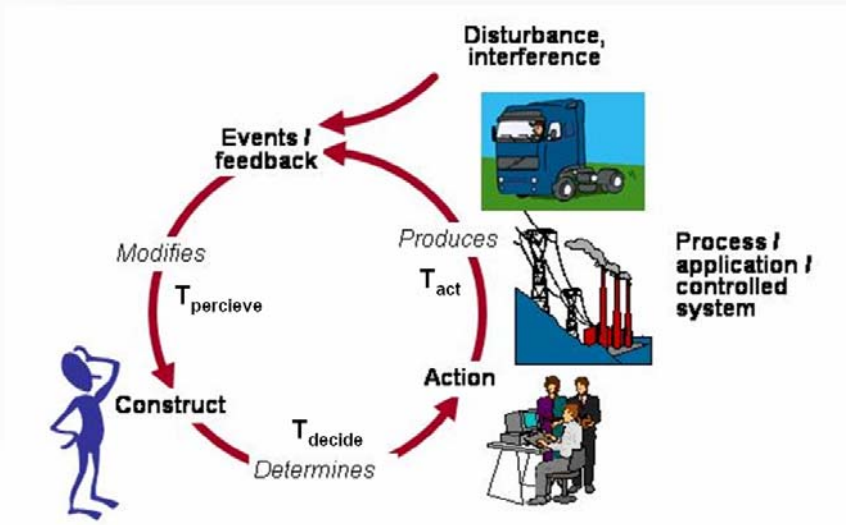

Figure 11 The Contextual Control Model (COCOM)

B2.3 The Extented Control Model (ECOM)

While COCOM only describe a single control process (i.e. pursuit of a single goal), the driving task can be viewed as the pursuit of several sub-goals on different time frames. A long-term goal could be to reach a destination in time. A medium-term scale goal would be to overtake a lead vehicle, while short-term goals include staying in the lane and avoiding obstacles. A goal may also subsume goals on shorter time frames. For example, in order to reach a destination in time, it may be necessary to overtake a number of vehicles. This, in turn, requires safe vehicle handling in order to avoid collisions. Thus, the driving task can be described as a set of simultaneous, interrelated and layered control processes. In addition, drivers generally pursue many goals that are totally unrelated to driving.

Hierarchical driver behaviour models are common in the literature, e.g. Michon's influential description of the driving task in terms of strategic, tactical and operational levels (Michon, 1985). While Michon's model is useful as general descriptive frameworks, it does not account for driving control as such. More specifically, they do not account for the dynamical aspects of driving, nor the relations *between* control processes on different levels. A model able to account for this is the Extended Control Model (ECOM, Hollnagel, Nåbo and Lau, 2003, Hollnagel and Woods, 2005). It should be noted that ECOM does not contradict Michons's model, but rather provides an extension to. The basic structure of ECOM is illustrated in Figure 12.

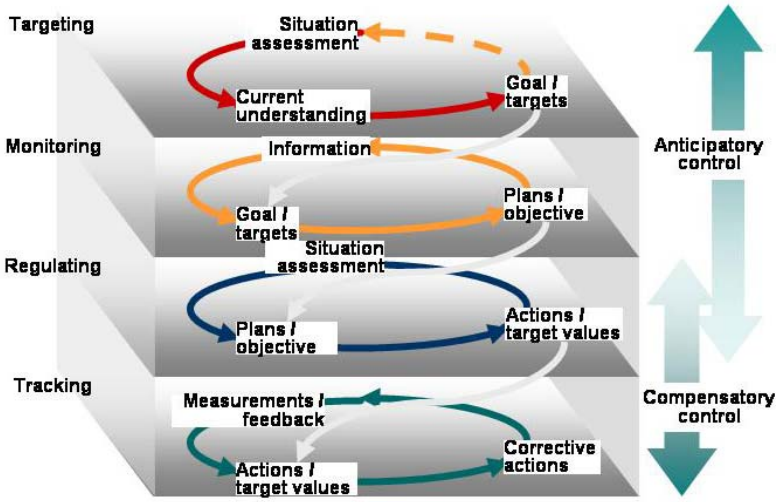

Figure 12 The Extended Control Model (ECOM)

A basic assumption behind the ECOM model is that goals corresponding to different layers can be pursued simultaneously, and that these goals and their associated control processes interact in a non-trivial way. In the current version, four control layers are postulated: tracking, regulating, monitoring and targeting. A key property of the model is that, during normal (controlled) task performance, the goals/targets for the control process on a given layer are determined by the control process one layer up.

In the driving domain, the *tracking* control refers to the momentary, automated, corrections to disturbances, e.g. wind gusts. *Regulating* refers to more conscious processes of keeping desired safety margins to other traffic elements. This determines the target values for the tracking loop. *Monitoring* refers to the control of the state of the joint vehicle-driver system relative to the driving environment. It involves monitoring the location and condition of the vehicle, as well as different properties of the traffic environment, e.g. speed limits. This generates the situation assessment that determines the objectives for the regulating layer. Finally, the *targeting* control level sets the general goals of the driving task, which determines the objectives for the monitoring layer.

The ECOM model provides an account for how goals at different layers interact and how high-layer goals propagate all the way down to moment-to-moment vehicle handling. In addition to driving-related activities, drivers may also engage in other types of behaviour directed towards non-driving-related goals, e.g. tuning the radio or talking to passengers.

B3 Potential applications of the framework in AIDE

B3.1 Characterisation of in-vehicle functions

In terms of the proposed framework, in-vehicle functions may be characterised with respect to the control task they are intended to support (where some functions support non driving-related goals). Based on this scheme, a tentative, user-centered, taxonomy of in-vehicle functions could

be outlined (this taxonomy should be viewed as complementary to the taxonomy defined in D2.1.2).

Tracking support
This category includes functions which support driving by (partly) automating tracking control, e.g. Antilock Brakes (ABS), Dynamic Stability and Traction Control (DSTC), Adaptive Cruise Control (ACC) and Lane Keeping Aid (LKA) involving active steering. For some functions, such as ACC, this means that human control is to a large extent re-allocated to the regulating control layer.

Regulating support
These are functions with the purpose of supporting regulatory control, i.e. setting the targets for the tracking control layer. This can be done e.g. by providing warnings when safety margins are about to be violated. Examples include forward collision warning (FCW), lane departure warning (LDW) and night vision systems.

Monitoring support
Functions belonging to this category support the monitoring of higher level aspects aspects related to the driver-vehicle-environment state. Examples include vehicle state monitoring functions (e.g. fuel and oil level indication), route guidance and traffic information. Importantly, activities on the monitoring level may interfere with tracking and regulatory control, as further discussed below.

Non-driving-related functions
In addition to the different types of driving support functions mentioned above, there are many in-vehicle functions that primarily support tasks other than driving. Examples include the radio, the media players, the phone and various functions supporting the work task of professional drivers, e.g. fleet management functions. However, it should be noted that such functions *may* be used to support driving, e.g. in a situation where the mobile phone is used to obtain directions. However, these functions are conceptually distinguished from driving support functions by the fact that they are not primarily intended to support driving.

Some examples of how individual functions could be mapped onto the ECOM layers are given in Figure 13.

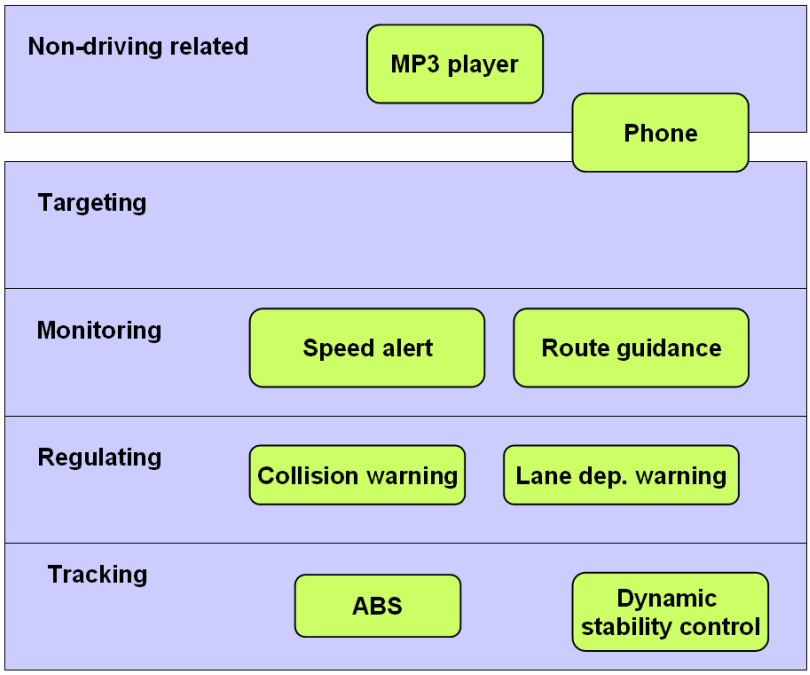

Figure 13 Example mapping of in-vehicle functions on the ECOM layers

AIDE metafunctions
The AIDE "metafunctions" are responsible for managing individual functions e.g. by means of information prioritisation or by putting non-critical information on hold in demanding driving situations. By contrast to the individual functions described above, meta-functions do not directly support specific driver tasks. Rather, in terms of the proposed framework, these functions could be described as indirectly supporting the driver by resolving conflicts between individual (driving- or non-driving related) goals. In particular, safe driving could be promoted by means of supporting the driver in prioritising the tracking and regulating control tasks in demanding driving situations (e.g. by putting non-critical messages on hold).

B3.2 Characterisation of behavioural effects of ADAS and IVIS

As mentioned in the introduction, interaction with in-vehicle functions may affect driving in many different ways. Below, some examples are given on how some common types of behavioural effects may be conceptualised based on the proposed framework.

Driving performance and driver distraction
Viewed in terms of the proposed framework, the driving task could be described as a set of multiple simultaneous, and layered, control tasks. Thus, driving performance could be defined with respect to any of these control tasks. For example, driving performance on the tracking level would be related to the ability to keep the vehicle within acceptable safety margins. Similarly, performance on the regulating level would be related to the ability to select these safety margins based on the general situation assessment at the monitoring level. A more detailed account of how driving performance can be conceptualised in terms of the present framework is currently being worked out in T2.2.5, to be reported in D2.2.5. See also Peters and Östlund (2005).

Distraction with respect to a given control process (e.g. tracking) could thus be viewed in terms of interference by another (driving- or non-driving related control process, typically resulting in degraded performance on the given control task. In practice, "driver distraction" is normally used to refer to interference with the tracking and/or regulating control tasks. However, the present framework enables a more precise conceptualisation of the concept and makes it possible to describe in more detail which tasks/control processes that are affected in a given distraction scenario.

Behavioural adaptation
Behavioural adaptation refers to behavioural changes in response to changes in the traffic environment or the vehicle. Such changes may be positive or negative with respect to safety and are often difficult to predict. They may reduce, or even cancel out, the expected benefits of a safety measure and have been demonstrated for many different types of driving support functions (see Smiley, 2000 and Saad et al., 2004, for examples).

The present framework may be very useful for describing more precisely the nature of these changes in terms of the control level where they occur. For example, it has been shown that antilock brake systems (ABS) lead drivers to adopt shorter headways and higher speeds (Fosser, Saetermo and Sagberg 1997). This could be described as an adaptation on the regulating control level, where the actual safety margins are reduced to compensate for the reduced subjective risk, perceived based on feedback from the tracking level. It has been hypothesised that such compensatory effects are more likely to occur if the change (in the traffic system or the vehicle) is mediated through direct sensory feedback (Evans, 1983). In terms of the present framework, this could be conceptualised as to what extent the change directly affects tracking control.

B4 Conclusions

This text was intended as a general introduction of the COCOM/ECOM models and their potential application as a general conceptual framework for AIDE. The central idea behind this framework is to conceptualise the driving task in terms of multiple layered control processes. This should be considered as an extension to the influential hierarchical model of Michon (1985). Some examples on how the framework can be applied in AIDE were outlined, including the characterisation of in-vehicle functions and common behavioural effects of in-vehicle functions such as driver distraction and behavioural adaptation. More detailed and comprehensive DVE models and simulations, based on the COCOM/ECOM (and potentially other models as well), is under development in SP1.

B5 References

Donges, E. (1978). A Two-Level Model of Driver Steering Behaviour. *Human Factors*, 20(6), 691-707

Evans, L. (1983). *Traffic safety and the driver*. New York: van Nostrand Reinold.

Engström, J. and Hollnagel, E. 2005. Towards a conceptual framework for modelling drivers' interaction with in-vehicle systems. In *Proceedings of Modelling Driver Behaviour in Automotive Environments*, Ispra, Italy.

Fosser, S., Saetermo, I. F. and Sagberg, F. (1997). An Investigaton of behavioural adaptation to airbags and antilock brakes among taxi drivers. *Accident Analyis and Prevention*. 29 (3).

Hollnagel, E. & Woods, D. D. (2005). *Joint cognitive systems: Foundations of cognitive systems engineering*. Boca Raton, FL: Taylor & Francis/CRC Press.

Hollnagel, E., Nåbo, A and Lau, I.V (2003). A systemic model for driver-in-control. In *Proceedings of the Second International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design*. Park City Utah, July 21-24.

Jagacinski, R.J.and Flach, J.M (2003). *Control theory for humans: Quantitative approaches to modeling performance*. Mahwah, NJ: Lawrence Erlbaum

Michon, J.A. (1985). A critical review of driver behaviour models: What do we know? what should we do? In L.A Evans and R.C. Schwing (Eds.) *Human Behaviour and Traffic Safety*. (pp. 487-525). New York: Plenum Press.

Neisser, U. (1976). *Cognition and Reality*. San Francisco: Freeman.

Peters, B. and Östlund, J. (2005) Joystick Controlled Driving for Drivers with Disabilities: A Driving Simulator Experiment. VTI Report 506A, Swedish National Road and Transport Research Institute.

Saad, F., Hjälmdahl, M., Canas, J., Alonso, M., Garayo, P., Macchi, F., Nathan, F., Ojeda, L., Papakostopoulos, M., Panou, M. and Bekiaris, E. (2004). Literature Review of Behavioural Effects. Deliverable 1.2.1, AIDE Integrated Project, Sub-project 1. IST-1-507674-IP

Vogel, K. 2002. *Modelling driver behaviour: A Control theory based approach*. PhD Thesis, Linköping University, Sweden, Diss. No. 751.

Weir, D. H. and McRuer, T.M. (1968). A theory of driver steering control of motor vehicles. *Highway Research Record*, 247, 7-39.

Wilde, G.J.S. 1982. The theory of risk homeostasis: Implications for traffic safety and health. *Risk Analysis*, 2, pp. 209-225.