6th Framework Programme - Priority 2 “Information Society Technologies”
“HUMAN centred design for Information Society Technologies”
Proposal n°507 420
Contract n°507420

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Common methodology for definition of scenarios environment and selection of most relevant scenarios for data collection

Deliverable C.4

Reference: CINR-060127-T1-DA4

CONFIDENTIALITY LEVEL: CONFIDENTIAL

Rev.	Issuing date	Pages	Written by	Visa	Verified by	Visa	Approved by	Visa
A1	06/01/27	x p	Hélène Tattegrain Veste (INRETS), Alan Stevens , Tony Wynn (TRL)	✓	José Carvalhais			
Modifications: Creation of the document								
A2	06/03/01	33	Hélène Tattegrain Veste (INRETS), Alan Stevens (TRL) Maura Houtenbos (SWOV), Christine Turetschek(FACTUM)	✓	Executive Committee	✓	Coordinator: Jean-Pierre Médevielle	

Modifications: Insertion modifications from TRL, SWOV, FACTUM								
A3	06/10/15	33	Hélène Tattegrain Veste, Arnaud Bonnard(INRETS)	V	José Carvalhais, UTL Rafael Jurado, UPM			
Modifications: Corrections required by reviewers								
A4	07/08/24	36	Hélène Tattegrain Veste (INRETS)	V	José Carvalhais, UTL Rafael Jurado, UPM	V		
Modifications: Corrections required by internal reviewers								

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List of Abbreviations

ACC	Advanced Cruise Control
ADAS	Advanced Driver Assisting System(s)
AIDE	Adaptive Integrated Driver vehicle interfacE
ADVISORS	Action for advanced Driver assistance and Vehicle control systems Implementation, Standardisation, Optimum use of the Road network and Safety
DVE	Driver Vehicle Environment
HUMANIST	HUMAN centred design for Information Society Technologies
ITS	Intelligent Transportation System
IVIS	In-Vehicle Information System
NoE	Network of Excellence

Executive Summary

The specificity of Humanist Network of Excellence is to promote a Human Centred Design of ITS, in which the assistance is designed according to the needs and the capabilities of the human being and not driven by the technological offer. Thus, an important work is done to improve the driver's behaviour models developed inside the network. Indeed, specific developments have to be made to use driver's behaviour models for User Centred Design. These developments are centred on the impact of driving assistance systems on the driving activity. The task force C.2 "Specification of driving contexts in relation to assistance systems functions" is in charge of elaborating a common methodology for defining scenarios environment and selecting the most relevant scenarios for data collection. The use of these scenarios will bring all the data that is needed to calibrate these models for our specific use.

To define the data collection usable by driver's models, a new type of scenario has been created and a methodology has been defined in the Humanist network. The scenario architecture was created using several concepts coming from Aide and Advisor projects but also using some other concepts specific to Humanist to take into account drivers' variability. Thus, the methodology is based on this scenario architecture and is separated into 3 tasks. The first task concerns the inventory of the potential use of the data. This inventory will be guided by the type of driver's models which will use the final data. The second task concerns the design of the specific scenario architecture which will become the HUMANIST common framework to describe scenarios. Finally, the third task will be done later and will consist in defining the data collection.

Then, different tools needed to collect information about driver's models have been defined. These tools are based on questionnaires that will allow us to summarize information inside Humanist NoE and to select the most relevant and realistic scenarios needed to define the future data collection.

Introduction

The specificity of Humanist Network of Excellence is to promote a Human Centred Design of ITS, in which the assistance is designed according to the needs and the capabilities of the driver and not driven by the technological offer. Thus, an important work is done to improve the driver's behaviour models developed inside the network. Firstly, an international workshop (TFC.1) took place at ISPRA in May 2005 to share knowledge on this specific topic between the different teams of the network and secondly, the task force C.2 "Specification of driving contexts in relation to assistance systems functions" is in charge of elaborating a common methodology for defining scenarios environment and selecting the most relevant scenarios for data collection. Indeed, to use driver's models for User Centred Design, specific developments have to be made. These developments are centred on the impact of driving assistance system on the driving activity. The use of scenarios will bring us the data that is needed to calibrate these models for this specific use.

1 Humanist methodology

The goal of this deliverable is to define what type of scenarios will be used in Humanist project. These scenarios will be used to carry out experiments in order to collect data.

Each scenario has to be classified in terms of driver characteristics, kind of systems used and main characteristics of the driving situations. Then, a data collection protocol will be defined and several scenarios will be selected to test the models. However, this data collection has to be defined according to the models needs. For example, the driver's behaviour is not sufficient to elaborate mental representations of driving situations. Thus, the analysis of verbalisations, if possible with the auto-confrontation approach, will be required to collect the necessary information.

The methodology can be divided in 3 tasks. The first task concerns the inventory of the potential use of the data. The type of driver's models that will use the final data will guide this inventory. The second task concerns the design of the scenario architecture defined inside the Humanist project to agree on a common representation of scenarios. The third task concerns the accurate definition of the data collection, and will be done later.

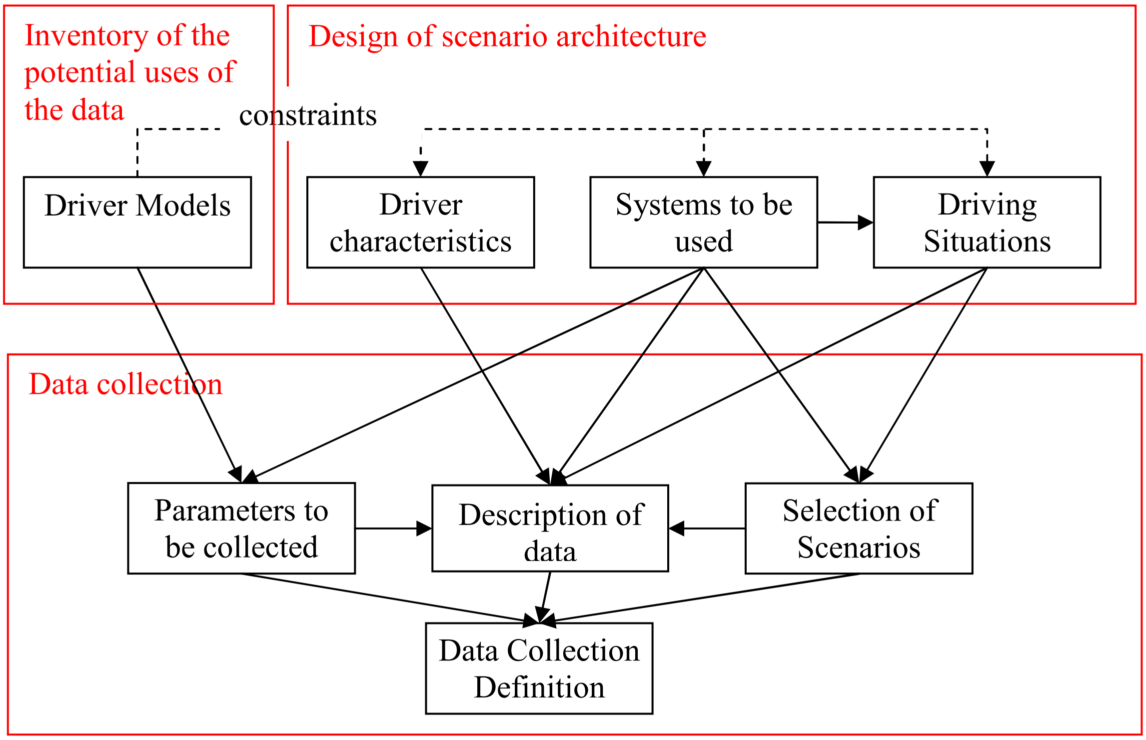

Figure 1: First organisation of tasks to define the data collection.

The two first tasks will be discussed in this deliverable. The last one concerns the work to be done later.

At first, we have to identify which driver's behaviour models could participate in the model evaluation based on the Taskforce C data collection. To do so, we analyzed the different models presented during the Workshop organized by TF C on «Modelling Driver Behaviour in Automotive Environment» in May 2005 at ISPRA and we proposed a classification of these models according to their modelling objectives. Then, the second step was to use this inventory to determine the most relevant models to participate in the data collection of TF C.

In parallel, we designed a specific architecture for HUMANIST scenarios. This architecture is inspired by the concept of scenario developed in other European projects but also takes into account the specific use of scenario by HUMANIST to evaluate and compare driver's behaviour models. This specific architecture allows an accurate description of the experimental tests conditions on road situation during which we will collect data to test driver's models. Indeed, the aim of each scenario is to describe accurately driver/system interactions performed by a given driver in a particular driving situation.

The last task will be done in the near future using the tools described in section 4. The objective of this part is to describe in detail the data collection phase, by specifying the models and the retained scenarios, and by specifying the data to record during the experiment.

2 Inventory of the potential uses of the data

2.1 Classification presentation

To define a model, several types of classification can be used. In fact, the goal of the driver's behaviour model used is different according to the research objectives. This first step is important to define the type of data collection. Some questions will be explored like: Are data needed? Which detail level could be needed? Which kind of collection could be done? After the description of several classifications, an example will present theirs uses.

Firstly, the type of modelling defines the global use of the model. Types of modelling can be:

- Conceptual: the model is used to organize the knowledge of the researchers. It is a conceptual framework helpful to define research hypotheses, or new researches…
- Correlation: the model is used to verify some hypotheses, to validate the effects of some variables, to explain some observed phenomena…
- Simulation: the model is implemented. It is useful to test the hypotheses made during its conception, with real driving data.

The conceptual models do not use recorded data like driver's actions. There are only theoretical views of driver's functioning. There are useful to share a common view of driver's functioning between the researchers and to discuss the different hypotheses. If experimentation is needed to validate one part of a model like the decision making process, then this part is correlation or simulation model. Correlation models correspond to models which define only correlation between input and output data. On the other hand, simulation models want to simulate several internal processes which allow them to predict the output data using the input data. The correlation and simulation models need recorded data to be elaborated or tested but not the conceptual ones.

Secondly, the modelisation level of the models is a very important criterion. It defines the focus of the model. Model modelisation level can be:

- Driving basic control: the model focuses on a specific driving action like the steering wheel strategy….
- Behavioural strategy: the model focuses on more complex behaviour.
- Adaptation strategy: the model focuses on some driver's behavioural change in relation with motivation, emotion, risk perception…
- Cognitive processes modelling: the model infers some internal states of driver's to explain behaviour.

This criterion will allow us to define which detail level is needed to run the model. For example, driving basic control models could need only driving action parameters. In addition, the three other models could need some questionnaires to investigate other parameters like motivation, risk perception or other parameters like physiological data.

Thirdly, the technical theories used to define the type of results given by the model. The technical theories can be:

- Control Theory models: these models give quantitative output of a driver's actions.
- Statistical models: these models give an estimation of correlation or an estimation of the driving situation.
- Knowledge based models: these models give symbolic information on the driver's internal states.

This criterion is useful to define the kind of data collection. Control theory and statistical models needs only recorded data. But knowledge based models could need other information, given by a verbalisation phase for example, to investigate some other aspects like driving situation perception by the driver's himself.

To illustrate the criteria use, an example, like models to explore a driving situation such as collision avoidance situation, can be processed.

- A model which wants only to predict trajectory will be a simulation (predict trajectory), driving basic control (use of simple data given by vehicle) and control theory model (mathematical algorithms).
- A model which wants to predict the percentage between a braking and an evasive action taking into account the type of road, the visual strategy, will be a correlation (predict a correlation), behavioural strategy (use of objective data on driver) and statistical model (statistical analyzes).
- If it use in addition the drivers characteristics like gender, age, driver's stress, it will be a correlation, adaptation strategy (use of subjective data on driver given by questionnaire) and statistical model.
- A model which wants to predict the driver's trajectory by modelling the cognitive processes like hazard perception, mental representation elaboration, decision making, and operational implementation of decision will be a simulation (predict the trajectory), cognitive processes modelling (modelize internal states) and knowledge based model (complex algorithms).

2.2 Classification of driver behaviour modelling researches

The following table shows the classification of some classical models and of models identified in the WP C.1 (Macchi L. and all, 2005) according to the modelisation level of the model, the type of modelling and the technical theories used.

Models	**Type of modelling**	**Modelisation level**	**Technical theories**
Weir	Simulation	Driving basic control	Control Theory model
Jürgensohn	Simulation	Driving basic control	Control Theory model
Doniec & Espie	Simulation	Driving basic control	Control Theory model
Maroto	Simulation	Driving basic control	Control Theory model
Parker	Correlation	Behavioural strategy	Statistical model
Wynn	Correlation	Behavioural strategy	Statistical model
Dapzol	Simulation	Behavioural strategy	Statistical model
Carsten	Conceptual	Adaptation strategy	Knowledge based model
Janssen	Correlation	Adaptation strategy	Statistical model
Van Der Horst	Correlation	Adaptation strategy	Statistical model
Bauman & Krems	Conceptual	Cognitive processes modelisation	Knowledge based model
Hollnagel	Conceptual	Cognitive processes modelisation	Knowledge based model
Summala	Conceptual	Cognitive processes modelisation	Knowledge based model
Houtenbos	Correlation	Cognitive processes modelisation	Knowledge based models
Bellet (COSMODRIVE)	Simulation	Cognitive processes modelisation	Knowledge based model
Cacciabue (DVE)	Simulation	Cognitive processes modelisation	Knowledge based model

Table 1 : Classification of Driver's models according to Humanist criteria

2.3 Conclusion

The final objective of this task is to collect data which could be used in a driver's behaviour model. All type of modelisation levels for the models (driving basic control, behavioural strategy, adaptation strategy, cognitive processes modelling) as well as all type of technical theories used (Control Theory model, Statistical models, Knowledge based models) are concern but only simulation and correlation models will be concern to use the data.

3 Design of scenario structure

3.1 Scenarios definition in other European projects

3.1.1 ADVISORS

The overall objective of the Advisors project (Wiethoff M., 2003**)** was to develop a comprehensive framework to analyse, assess and predict the implications of a range of ADAS (Advanced Driver Assistance System), as well as to develop implementation strategies for ADAS expected to have a large positive impact.

The ADVISORS approach to ADAS implementation can be represented as a 4-step process:

1. Identification of ADAS for attention
2. Choice of future scenarios
3. Design of implementation strategies
4. Strategy validation (through workshops with Stakeholders)

Thus, in ADVISORS step 2 a scenario describes all the significant elements of the future situation. This question is related to knowledge of ADAS performance and impacts of ADAS implementation in the transport system.
Step 3 concerns deciding how the future scenario should be brought about. This question is related to the knowledge about the preferences and choices of the Stakeholders involved in or affected by ADAS implementation and can be described through an implementation strategy.

The scenario defined for an ADAS is very closely linked with assessment of the impact of the ADAS. In fact, the scenario suggests and influences the assessment parameters that are appropriate in the situation. The scenario is a key methodology, as prevailing conditions outside (and inside) the vehicle influence strongly the outcome of the assessment and the conclusions that can be drawn. Scenario specification and assessment methodologies therefore need to be considered together (Brook-Carter N., 2002).

The scenario parameters identified as necessary for ADAS assessment are:

- the driver
- the vehicle
- the road infrastructure
- the traffic conditions
- the environmental conditions

The ADAS can be seen either as a component that stands for itself or as being part of the vehicle component. One way of illustrating the scenario concept is shown in figure 2. It is important to note that the significance of the different scenario components may vary in different assessments. Also, the components are related to each other and interact in different ways in different cases.

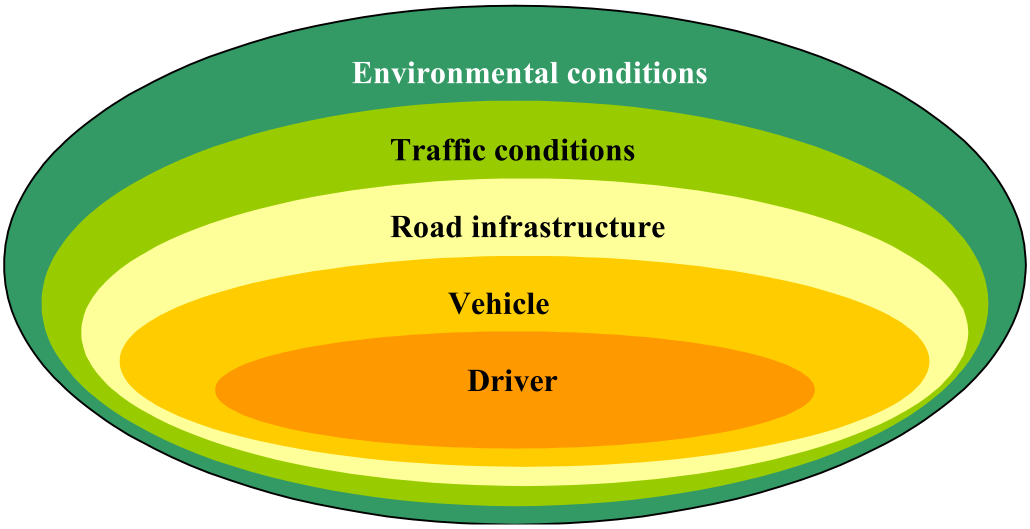

Figure 2: Main components to be considered and specified for a scenario

Vehicle
The vehicle type used in ADAS assessment may also impact the results of the assessment and should therefore be carefully defined. The vehicle type used should be that for which the ADAS is designed. If the ADAS is meant for more than one type of vehicle then it is advisable to test the system in all vehicle types.
Vehicle types might include:

- mini
- super mini
- small family
- medium
- executive
- sports
- four by four
- people carrier
- van
- HGV
- Powered two-wheeler

- **ADAS System type**
  From manual control to full automation five different grades of automation can be distinguished. The lowest level of automation is, of course, (1) no automation. Increasing the levels of automation lead via (2) decision support, (3) consensual Artificial Intelligence (AI), (4) monitored AI to (5) full automation.

- **ADAS System penetration**
  The percentage of vehicles equipped is an important factor in determining the impact.

- **Driver**
  The participants involved in a study will, obviously, be determined by the nature of the study. For example, a study on elderly drivers use of ITS will require a specific population

whereas a more general study might require participants representative of the normal driving population.

In any study, it is recommended that the following characteristics, at least, be recorded in the following categories:

- professional/private driver
- age category: (18-24; 25-60; over 60)
- experience, or total mileage driven (< 10.000; 10.000-100.000; > 100.000; > 1000.000)
- gender
- special characteristics, needs etc. (e.g. experience with specific system, sleep apnoea, extreme personality characteristics, etc)

The average driver: 25-50 years, driving experience 10.000 – 100.000 km, both male and female.

Traffic Conditions

The surrounding traffic conditions involved during an ADAS assessment need to be defined and will be affected by the testing environment. For example, on a test track there can be specifically defined additional traffic but in real traffic its conditions will be out of the experimenter's control.

Traffic conditions can be defined as:

- Light
- Medium
- Heavy
- Stop/start (congested)

Traffic conditions will both affect the speed of the traffic and the stop/start nature of the traffic.

Road infrastructure

The road type and infrastructure used within the assessment of ADAS will also affect assessment results and therefore needs to be defined. The system should be assessed on all roads for which it is designed.

Road types will include:

- Rural
- Urban
- Motorway

Traffic infrastructure will also include details of for example the traffic junctions and traffic lights to be included within the assessment.

Environmental characteristics

The overall environmental contexts in which the ADAS will operate and their interaction with the system need to be defined, as external characteristics can influence results of measurements or surveys during system assessment.

Environmental conditions which need to be defined include:

- Weather conditions (rain, fog, snow)
- Lighting conditions (day, night, lit/unlit)
- Road surface conditions (wet, damp)

Example of advisors scenarios (described in final report of advisors project)

Scenario title: Stop&Go (urban ACC)

<u>(ADAS) function</u>: Vehicles are equipped with STOP&GO (urban ACC).
Stop & Go - A vehicle system which controls vehicle speed even in the low speed range (congested roads) and enables the vehicle to automatically adjust speed and stops according to the vehicle in front.
However, the function does not include the so called emergency braking function, which could prevent a crash by forceful braking. It will not detect the possibility of a collision (for example obstacles on road) and either warn a driver or even automatically control the vehicle's movements if the collision is otherwise unavoidable.

<u>Level of operation</u>: Drivers have the option to switch on/off Stop&Go and select a time-headway to the vehicle in front. The Stop&Go functions even when the vehicle slows to a stop and re-starts.

<u>Penetration</u>: One penetration level will be explored – 25% of the vehicles having (and using) Stop&Go.

<u>Important parameters:</u>
- Road type: urban OR peri-urban roads (rings etc.)/motorways.
- Traffic density: Two traffic density situations will be explored – one congested situation (80% or 100% of the lane capacity) and one free-flow situation (60% or 40% of the lane capacity). The traffic flow values might be about 1200 and 2000 vehicles per hour per lane).
- Penetration level: only one penetration level will be explored – 25% of the vehicles having (and using) STOP&GO.
- Traffic characteristic: High level of pedestrian activity; wide variation in vehicle speed

<u>Intended benefits:</u>
- Safety: Reduction in accidents.
- Network: Improvements in traffic flow.
- Environmental: Reduction in noise, fuel consumption and exhaust output.

<u>Scenarios:</u>
Combining the different values of the key parameters results in the following appropriate implementation scenarios:

Scenario No:	Scenario name:	Road Type:	Traffic Flow:
1	Stop&Go1	Urban	High Flow
2	Stop&Go2	Urban	Low Flow
3	Stop&Go3	Peri-Urban	High Flow

Table 2: Example of Advisor scenario

3.1.2 AIDE design scenarios

In terms of safe driving, the scope of AIDE system is translated into the development of adaptive interface technologies to minimize driver distraction and to diminish the global risk increase due to an inadequate attention allocation from the driving task. Several monitoring modules (named in this project DVE Driver-Vehicle-Environment modules) will process the traffic/environmental demand, the level of driving demand, the level of driver distraction (Cognitive Distraction-Visual Distraction), the intent of the driver, and the driver's physical impairment to determine which functions should advise the driver in a particular circumstance. Non-driving task information and functions will be prioritized according to how crucial it is at a specific time, according to the level of driving task demand and according to the driver's profile. (Amditis A. and all, 2005)

In the AIDE project, a distinction is made between (*normal) use cases* and *AIDE design scenarios*. These terms are defined as follow:

- **(Normal) 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.

- **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.

Thus, the *use cases* describe interaction with individual functions while the *AIDE design scenarios* describe conflict situations that the AIDE system intends to address.

An example of a potential preliminary AIDE design scenarios is describe in the following table. It describes the scenario context (infrastructure and events), the actions (system information to be given at the driver), the conditions calculated by the diagnostic modules (DVE conditions) and the possible solution given by the AIDE system.

AIDE design scenario, Example 1
The driver enters a roundabout. In the roundabout, an incoming phone call is initiated at the same time with a route guidance message.
Actions
1. Indication of incoming phone call (e.g. by ring signal) 2. Output of route guidance message
DVE conditions
1. Roundabout
Possible AIDE solution
Delay both actions and present them in priority order after the roundabout

Table 3: Preliminary AIDE design scenario example

From the example above, it is immediately evident that it is impossible to describe all possible combinations of actions and DVE states. Thus, in order to obtain a parsimonious way to describe the conflict situations that AIDE should solve, we need a way to categorize the actions and DVE conditions.

The first step towards the action categorization scheme is to define a set of basic parameters that can be used to characterize the actions. A key issue here is that different experts parameterize the same action in a similar way. Thus, it is important that the actions are clearly defined and easy to understand.

The current parameters used for action description are defined as:

- **Initiator:** Information about the initiator of the action (driver, system)

- **Duration:** Duration of an action or information presentation

- **Safety Criticality:** Safety criticality of the output content for the safety of the driver or other traffic participants. The safety criticality is related to the consequence if the action is not executed.

- **Time Criticality:** The degree to which a (system-initiated) action requires an immediate response by the driver.

- **Real Time:** Indicates whether the action involves real time communication with another person (but not with the system).

Then, actions are classified in five categories:

- **W (warning)** Actions indicating high traffic/ environment risk.

- **D (dialog)** Actions which have been activated by the driver.

- **OP1 (output priority 1)** Time critical, mandatory real time or preferred actions.

- **OP2 (output priority 2)** Transient actions relevant to the driving task.

- **OP3 (output priority 3)**: Sustained information about or for the primary task, not requiring an action in the near future. Also, messages or information related to secondary tasks.

The goal here is to find a parameterization of the DVE state space, suitable for describing the DVE conditions that are relevant for the AIDE functionality. This will directly lead to requirements on the DVE monitoring modules. These should only output information that is relevant for the AIDE functionality.

- Driving demand: driver's "level of availability" to receive and process information, according to the requirements of the current driving task.
- Driver distraction: visual attention away from the road ahead, induced by an external event or a secondary task.
- Driver impairment: The physical ability of the driver to drive (fatigue, sleepiness, etc.).
- Driver intent: The driver's intention, e.g. for a lane change.

- Traffic and environmental risk: The total level of risk concerning the environmental and the traffic conditions (Environment type, traffic density, environmental conditions etc.).

Then, an AIDE scenario could be described by the following table. This scenario has the same structure as the preliminary scenario. On the other hand, its content is more generic by using message category.

AIDE design scenario
An application action or a combination of application actions is/are initiated/in progress in a single or complex DVE condition
Action/s = {…}
DVE Condition/s = {…}
Flow of events
Possible AIDE solutions
Example:

Table 4: AIDE design scenario structure

An example is given in the following table:

AIDE design scenario:
Action/s = {W + W}, where W= warning indicating high traffic risk.
DVE Condition/s: Driving demand =LOW, Driver impairment = NO, Driving intent =NO Traffic and environmental risk =HIGH, Driver distraction =YES
Flow of events 1. W1 is initiated 2. W2 is initiated while W1 is executing
Possible AIDE solution(s). 1. solution1 2. solution 2.
Example*:* The driver is distracted and, as a result, swerves out of the lane. The lane departure warning system gives a warning. However, shortly after, the vehicle ahead brakes suddenly, triggering the forward collision warning.

Table 5: AIDE design scenario example

3.2 Humanist Scenarios

3.2.1 Objectives

The objective of Advisor project is to develop a comprehensive framework to analyse, assess and predict the implication of a range of ADAS. However, the level of detail of this analysis is less accurate than the one needed by Humanist. In the Aide project, the scenarios will be used to design an adaptive interface for the driver. They are focused on the flow of events and the state of the driver's monitors. Thus, the scenarios are detailed according to these two points and provide an accurate description of the local situation in which it will be tested.

The Humanist scenario framework is somewhere between these two approaches. Some Advisor characteristics have to be included in our scenario to take the main factors into account. Some Aide characteristics also have to be included to obtain a detailed view of driving situations. Moreover, the scope of Humanist is focused on the driver and some other characteristics should be added on this particular aspect (see Annexe 4).

In the Humanist case, the scenario describes a driver/system interaction performed by a given driver in a particular driving situation. Thus, the scenario can be defined by its main objective and by the main characteristics of the driver's population, of the system and of the driving situation that will be analysed. The driving situation is defined by both the driving task performed by the driver and the driving environment in which this task is performed. The driving environment includes the infrastructure characteristics, the traffic, the weather and the lighting conditions and the presence of external events.

Finally, a scenario can refer to an investigation of e.g. "Safety of Function X of System Y as used by professional drivers on interurban routes". To investigate this general goal, several more detailed specific scenarios will be required. These scenarios will be grouped in a set defined by the global objective of the investigation.

3.2.2 Scenario architecture

Scenario number	
Global Objective of investigation	Summarize the objective of the investigation
Specific objective	Summarize the objective of this scenario
Driver's characteristics	
Studied population(s)	Summarize the main characteristics of the population or the main characteristics to be compared. These characteristics concern global aspects like gender, age, driving or telematic usage but not medical aspect like health problems.
Fixed characteristic	List of driver's characteristics which will have a fixed value
Studied characteristic	List of driver's characteristics which will have several values
System characteristics	
Type of system	Define the system (IVIS or ADAS) to be tested. This should include the make/model of the system, its state of development (prototype, commercial etc), the need or objective that it aims to fulfil and the element of the driving task addressed – i.e. whether the function being investigated is: in-built, informing, warning, assisting or automating – (see Table 9)
Man Machine interaction	Define the added task to be done in order to evaluate its impacts on the driving task like entry destination on navigation system, phoning, … Task Analysis should be undertaken
Interaction mode	Define the mode of output, like visual, audio, haptic...
Driving Situation characteristics	
Road context	Define the global driving context like urban, motorway, rural road, …
Infrastructure	Define the local infrastructure like intersection, roundabout, …
Local driving goal	Define the driving goal to be done on this infrastructure like turn, driver straight on, exit motorway, …
Traffic	Define the traffic condition wanted like heavy, light, …
Weather	Define the weather condition wanted like sunny, rainy, …
Lighting	Define the lighting condition wanted like night, day, …
External events	Define the External events which will be included in the scenario like pedestrian, bike, …

Table 6: Humanist scenario structure

Scenario number	Example Scenario 1
Global Objective of investigation	Analysis of different entry destination on motorway with experienced drivers
Specific objective	Analysis of vocal entry destination on motorway with experienced drivers in fluid traffic
Driver's characteristics	
Studied population(s)	Experienced drivers
Fixed parameters	Age Driving Experience
Studied parameters	Gender Telematic system usage
System characteristics	
System tested	Navigation
Man Machine interaction	Entry destination
Interaction mode	Output: Visual, Input: Vocal
Driving situation characteristics	
Road context	Motorway
Infrastructure	Straight line
Local driving goal	Drive straight on
Traffic	Fluid
Weather	Overcast or sunny
Lighting	Day
External events	None

Table 7: Humanist scenario example

3.2.3 Lists of characteristics

Driver's characteristics	
Studied population(s)	Young / elderly Professional / non professional Telematic system user / non telematic system user
Type of characteristic	Gender Age Driving Experience Telematic system usage Personality features (examples given in annexe 4 and do not include health problems)
System characteristics	
System tested	Phone Navigation ACC Lane keeping
Man Machine interaction	Dependent from system tested
Interaction mode	Visual, haptic, audio,

Driving Situation characteristics	
Road context	Motorway Bypass Urban area Rural
Infrastructure on Motorway	Entry Straight on line thorough Exit Toll Knot
Infrastructure on Urban area and on rural road	Straight on line Crossroad without traffic light Crossroad with traffic light Crossroad with stop sign T-junction without traffic light T-junction with traffic light T-junction with stop sign Roundabout Right bend Left bend Crosswalk Crossing a bicycle lane Danger area (schools ...)
Local driving goal	Drive straight on Turn without traffic Turn across traffic Overtaking Lane change Stationing
Traffic	Indifferent Light Medium Heavy
Weather	Sunny Overcast Raining Fog Snow
Lighting	Day Low angle sun Twilight or Dawn Night Lit Night Unlit
External events	None Pedestrian Vehicle arriving at the left …

Table 8: List of possible characteristics in Humanist scenario

FUNCTION / ISSUE	In-built	Informing	Warning	Assisting
Example	ABS ASC Collision mitigation	Route guidance Mobile phone	LDWS ISA Advisory	ACC
Focus	Vehicle stability	Information to the driver	Warning the driver	Aspects of longitudinal and lateral control
Driver's locus of control	None	Full	Depends	Overrideable
System supplier	OEM	OEM aftermarket Nomadic	OEM aftermarket	OEM
Safety issue	Technical	Distraction	Understandability	Controllability
Typical human interface	None (or via existing controls)	Screen + Audio	Buzzer, Symbol	Button Small display Existing controls

Table 9: Explanation of System/Function Aspects

4 Humanist Methodology Tools

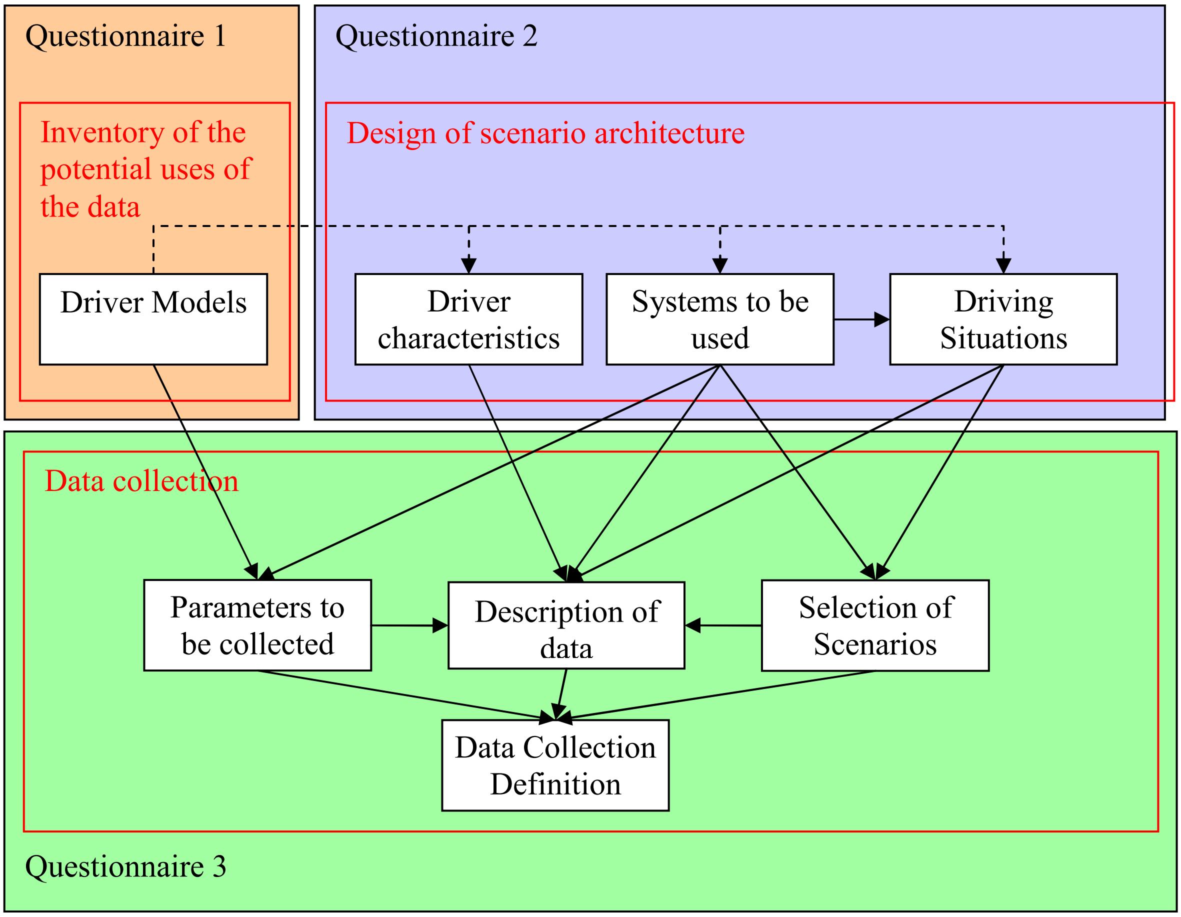

Figure 3 : Methodology tools to define the data collection

To conduct the methodology defined in the humanist project to describe the scenario, some tools have to be developed. Thus, three questionnaires have been created to collect the information needed to achieve the objectives of the task C.2 “Specification of driving contexts in relation to assistance systems functions“. Each of them is focused on one of the methodology’s 3 tasks.

The first questionnaire is focused on the description of the models themselves. It is designed to collect information about the kind interaction modelled (driver-vehicle-environment), the type of the model (conceptual, correlation, simulation), the modelisation level of the model (driving basic control, behavioural strategy, adaptation strategy, cognitive processes modelling) and the type of technical theories used (control theory model, statistical models, and knowledge based models). This questionnaire can be found in annexe 1.

The second questionnaire is focused on the different elements needed to define the scenario. Its first part defines the ADAS or IVIS system used and the man machine interaction selected. Then, its second part defines the driving situation characteristics. Finally, its third part defines the driver’s characteristics. These two last parts are very important to take into account the driver and his behaviour in a specific driving situation. This questionnaire can be found in annexe 2.

The third questionnaire is focused on the parameters to be used by the models. It will be an input for the future work to select the scenarios that will suit as well as possible the needs of the majority of the models. Then, the data description will be done using the selected scenarios. Thus, it will be possible to define the required parameters and the data collection. This questionnaire can be found in annexe 3.

5 Conclusion

In order to improve the behaviour models developed inside HUMANIST network, a common methodology for defining scenarios environment has been created. This methodology is the continuity of the TF C.1 work. Indeed, after the inventory of the entire possible HUMANIST driver's models, it is important to collect common data that could be used by some of them.
Thus, HUMANIST scenario architecture was created using several concepts coming from both Aide and Advisor projects and some other more specific concepts that take into account the driver's variability.
Then, several tools required to collect information about driver's models have been defined. They are based on three questionnaires that allow us to summarize information inside the Humanist network and to select the most relevant and realistic scenarios needed to define the future data collection.
Finally, this methodology will be used to coordinate the future data collection inside the HUMANIST network.

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Annexe 1: Driver's model questionnaire:

Short description of the objectives of the model:

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

Question 1: This model is focused on the interaction between:

- Driver
- Driver / Vehicle
- Driver / Environment
- Vehicle / Environment
- Driver/ Vehicle/ Environment

Question 2: the type of modelling is:

- Conceptual: the model is used to organize the knowledge of the researchers. It is a conceptual frameworks helpful to define the hypotheses of the research, the direction of new researches, …
- Correlation: the model is used to verify some hypotheses, to validate the effects of some variables, to explain some observed phenomena.
- Simulation: the model is implemented. It is useful to test the hypotheses taken in its conception, with real driving data.

Question 3: The modelisation level of this model is focused on:

- Driving basic control: which studies specific driving action like steering wheel strategy.
- Behavioural strategy: which studies more complex behaviour.
- Adaptation strategy: which studies some driver's behavioural change in relation with motivation, emotion, perception of risk …
- Cognitive processes modelisation: which infers some internal states of driver's to explain behaviour.

Question 4: The technical theories used are:

- Control Theory model: this gives quantitative output of a driver's action.
- Statistical models: this gives an estimation of correlation or an estimation of the driving situation.
- Knowledge based models: this gives symbolic information on the driver's internal states.

Question 5: The inputs of the model are:

- Events outside the vehicle
- Driver visual/ perceptive strategies
- Driver subjective assessments
- Driver expectancies
- Driver physiological measurements
- Driver actions
- Previous experiences of drivers
- Other: ….

Question 6: The outputs of the model are:

- Driver visual strategy predictions
- Driver subjective assessment predictions
  - Which one:
- Driver physiological predictions
  - Which one:
- Driver actions
  - Which one:
- Statistical predictions of behaviour
  - Which one:
- Other: ….

Annexe 2: Scenario design questionnaire

Part 1: Systems tested questionnaire

Question 1: Which kind of driver's assistance system use do you want to modelize

- Any system is possible
- ACC
- Navigation system
- Lane keeping
- Other:

Question 2: Which kind of interaction do you want to modelize

- System:
- Interaction description:

Part 2: Questionnaire on driving situations

Question 3: Which kind of driving context do you want to test

- Indifferent
- Motorway
- Bypass
- Urban area
- Rural
- Other: ….

Question 4: Which kind of infrastructure

- Indifferent
- Entry
- Straight on line thorough
- Exit
- Toll
- Knot
- Straight on line
- Crossroad without traffic light
- Crossroad with traffic light
- Crossroad with stop sign
- T-junction without traffic light
- T-junction with traffic light
- T-junction with stop sign
- Roundabout
- Right bend
- Left bend
- Other: …

Question 5: kind of Local driving goal

- Indifferent
- Drive straight on
- Turn left
- Turn right
- Overtaking
- Lane change
- Stationing
- Other: …

Question 6: Which kind of Traffic

- Indifferent
- Light
- Medium
- Heavy
- Other: …

Question 7: Which kind of Weather

- Indifferent
- Sunny
- Overcast
- Raining
- Fog
- Snow
- Other: …

Question 8: Which kind of Lighting

- Indifferent
- Day
- Low angle sun
- Twilight or Dawn
- Night Lit
- Night Unlit
- Other: …

Question 9: Which kind of External events

- None
- Pedestrian
- Bike
- Vehicle arriving at the left
- Vehicle arriving at the right
- Oncoming traffic
- Overtaking manoeuvres

- Other: …

Part 3: Questionnaire on driver characteristics

Question 10: Kind of driver

- Indifferent
- City vehicle driver
- Truck driver
- Motorcycle driver
- Bus driver
- Other:

Question 11: Gender

- Indifferent
- Male
- Female

Question 12: Age

- Indifferent
- Or Age min: Age max
- Or at least:
- Or at the most:

Question 13: Driving Experience

- Indifferent
- Less than 2 years
- 2 to 5 years
- More than 5 years
- Other: ….

Question 14: Profession

- Indifferent
- Taxi
- Commercial traveller
- Other professional traveller
- Non professional driver
- Other: ….

Question 15: Km per year

- Indifferent

- Less than 5000 km
- 5000 to 15000 km
- 15000 to 30000 km
- More than 30000 km

Question 16: Which kind of perceptual characteristics do you want to measure?

- Visual accuracy
- Auditory accuracy

Question 17: Which personality characteristic do you want to measure?

- Type:
- Method used to measure:
- Criteria of inclusion in the panel:

Question 18: Which other characteristic do you want to measure?

- Type:
- Method used to measure:
- Criteria of inclusion in the panel:

Annexe 3: Questionnaire on parameters used by the model

Question 1: Which kind of parameters do you need about the driver?

- Driver video recording
  Which view: Necessity: Obligatory/Preferable/Optional
  Which view: Necessity: Obligatory/Preferable/Optional
  ………
- Driving actions measurements
  Which one: Necessity: Obligatory/Preferable/Optional
  Which one: Necessity: Obligatory/Preferable/Optional
  ………
- Physiological measurement
  Which one: Necessity: Obligatory/Preferable/Optional
  Which one: Necessity: Obligatory/Preferable/Optional
  ………
- Driver's subjective assessments
  Which one: Necessity: Obligatory/Preferable/Optional
  Which one: Necessity: Obligatory/Preferable/Optional
  ………
- Questionnaire
  Which one: Necessity: Obligatory/Preferable/Optional
  ………

Question 2: Which kind of parameters do you need about the road environment?

- Road video recording
  Which view: Necessity: Obligatory/Preferable/Optional
  Which view: Necessity: Obligatory/Preferable/Optional
  ……….
- Level of traffic
  Which precision: Necessity: Obligatory/Preferable/Optional
  Which precision: Necessity: Obligatory/Preferable/Optional
  ……….
- Precise positions of other vehicles
  Which precision: Necessity: Obligatory/Preferable/Optional
  ……….
- Cartographic positioning
  Which cartographic information:
  Necessity: Obligatory/Preferable/Optional
  Which cartographic information:
  Necessity: Obligatory/Preferable/Optional
  ……….

Question 3: Which kind of parameters do you need about the system use?

- System:
- Parameter:

- Necessity: Obligatory/Preferable/Optional
- System:
- Parameter:
- Necessity: Obligatory/Preferable/Optional

……….

Question 4: Which other parameters do you need about the driver?

- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional
- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional

……….

Question 5: Which other parameters do you need about the road environment?

- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional
- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional

……….

Question 6: Which other parameters do you need about the system use?

- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional
- Type:
- Method used to measure:
- Necessity: Obligatory/Preferable/Optional

……….

Annexe 4: Summary of major findings from literature review of driver characteristics

Personality

Key Findings: Major aspects of personality which relate to driving include;

- Sensation seeking: Sensation seeking is a personality 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). Sensation seeking is mediated in the brain by the neuro-regulators; catecholamines, dopamine, and norepinephrine (Zuckerman, 1999). Wilson (1990) illustrates that those individuals who score highly on scales which measure sensation seeking are also more likely to commit traffic violations, are more impulsive and are less likely to use their safety belts.

- The general trait of sensation seeking is composed of four components;
- Thrill and adventure seeking➔ attraction to thrill and dread.
- Experience seeking➔ aspiration to undergo variety of novel experiences.
- Disinhibition➔ loss of self control.
- Boredom Susceptibility➔ intolerance toward monotonous, repetitious or predictable people and events.

- Thrill and adventure seeking has been found to predict risky driving behaviours more so than the other dimensions of sensation seeking (Jonah, 1997).

- Normlessness: Human behaviour is constrained by rules that govern particular interactions, some are social in nature others are statutes in law. Deviant behaviour is generated when society does not give sufficient normative constraint or direction to its members, or when the society presents goals that its structure of opportunity cannot fulfil. Anomie (Durkheim, 1897) refers to the general state of normlessness pervading modern society. Opportunity structure (Merton, 1968) posits that U.S. society places enormous emphasis on material success and on certain accepted means of achieving this goal e.g. working, saving, and investing. Unfortunately the structure of most societies does not allow all members the same access to these opportunities and so many engage in deviant behaviours. Deviants are those who are singled out in society for rejecting the socially sanctioned means of achieving these goals and have adopted lifestyles that are considered undesirable by more conforming members.

- Locus of Control: Rotter (1966) Internality- Externality scale (I-E) has been related to risky driving. Scale measures the extent an individual feels in control of behavioural outcomes. The relationship between locus of control and safe driving is based on the notion that externality is related to a lack of caution and a failure to take precautionary steps to avoid the occurrence of unfavourable events on behalf of the driver. This is due to a belief that these events will occur regardless of the driver's actions.

- Anger, aggression and road rage: The propensity to feel angry when driving predicts lapses in concentration while driving, minor losses in vehicle control, close calls, aggressive driving, risky driving, physically aggressive driving anger expression, verbally aggressive driving anger expression and use of the vehicle to express anger (Lajunen, and Parker, 2001; Deffenbacher, Huff, Lynch, Oetting, and Salvatore, 2000; Deffenbacher, Lynch, Oetting and Yingling, 2001; Underwood, Chapman, Wright and Crundall, 1999). High anger drivers have been shown to travel at higher speeds, maintain shorter headways and have shorter times to collision in low impedance situations and were twice as likely to crash as low anger drivers in situations that facilitate anger (Deffenbacher, Deffenbacher, Lynch and Richards, 2003). A distinction should be made between road rage and aggressive driving (Yu, Evans and Perfetti, 2004), although often treated as synonyms they should be discussed as separate concepts with each one influencing the other. The reciprocal nature. Deffenbacher, Lynch, Oetting and Swaim (2002) identified four ways in which drivers can express their anger whilst driving. These are defined as:

- Verbal aggressive expression including shouting and swearing directed towards other drivers.
- Personal physical aggressive expression that includes physical fighting and any way in which the driver uses themselves to engage other drivers.
- Use of the vehicle to express anger that includes flashing headlights and cutting in front of other drivers.
- Adaptive/ constructive expression which is the use of positive coping strategies to manage driver aggression such as attempting to relax, or drive within the laws of the road.

- The more aggressive forms of anger expression are found to positively correlate significantly with driving related anger, aggression and risky behaviour whereas adaptive expression of anger is shown to relate negatively to these factors (Deffenbacher et al, 2002).

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