HoliDes

Holistic Human Factors **Des**ign of Adaptive Cooperative Human-Machine Systems

D9.1 – Requirements Definition for the HF-RTP, Methodology and Techniques and Tools from an Automotive Perspective

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List of Acronyms

UC = Use Cases

TS = Target Scenarios

HF = Human Factors

WP = Work Package

FV = Following Vehicle

LV = Leading Vehicle

NA = Not Available

ACC = Adaptive Cruise Control

CTA = Cross Traffic Assistant

HMS = Human Machine Systems

HMI = Human Machine Interaction

RTP = Reference Technology Platform

AUT = Automotive

LCA = Lane Change Assistant

LOA = Level Of Automation

TBD = TO BE Determined

FCW(S) = Forward Collision Warning (System)

EV / HV = Ego Vehicle / Host Vehicle

C-LCA = Cooperative Lane Change Assistant

ADAS = Advanced Driving Assistance Systems

PADAS = Partially Autonomous Driving Assistance Systems

AdCoS = Adaptive Cooperative Human-Machine Systems

HF-RTP = Human Factors Reference Technology Platform

HoliDes = Holistic Human Factors Design of Adaptive Cooperative Human-Machine Systems

Executive Summary

The following document describes the generation of target scenarios, use cases and the derivation of requirements for the Automotive domain in the HoliDes project, a European Union Project, which aims at the development and qualification of Adaptive Cooperative Human-Machine Systems (AdCoS).
The methodology is described as well as the used terminology. In the "Annex II: List of Requirements"**Errore. L'origine riferimento non è stata trovata.**, a complete list of the currently used requirements can be found.

1 Introduction

In the HoliDes project, an interdisciplinary approach to the cooperation and adaptiveness in human-machine-interaction is taken. Research institutes as well as partners from the industry cooperate together in order to build up a human-centred view on development methods and tools, in particular the opportunity of using a reference technology platform similar to the ones used in CESAR [1] and CRYSTAL [2]. As a first part of the introduction, an overview over the HoliDes Project is given. The second part of the introduction presents the structure of the document. The second part of this document deals with the use cases and target scenarios of the automotive domain, which is WP9, and the third and last part deals with the requirements which are the core of the corresponding deliverable for this document.

1.1 Overview of HoliDes Project

HoliDes addresses the development and qualification of Adaptive Cooperative Human-Machine Systems (AdCoS), where many humans and many machines act together, cooperatively, in a highly adaptive way. They adapt to each other status and to the context (internal or external), in order to guarantee fluent and cooperative task achievement. Such systems with higher levels of automation are urgently needed to enhance safety and to increase the confidence of human operators.

Adaptiveness in cooperative Human-Machine systems (HMS) on the health, aeronautics, control rooms, and automotive market is still limited. The development and especially the qualification and certification of AdCoS involving several interactive embedded systems are not yet well-mastered in industrial development.

The lack of adequate means of compliance with human factors and safety regulations may force the designers to simplify systems in order to make them certifiable. This clearly compromises the huge potential that AdCoS could have on increasing overall safety. In order to unleash this potential, HoliDes will research affordable means of compliance which enable to formalize adaptation strategies on global many humans - many machines levels and local HMI levels in a coordinated way. This will be achieved by developing techniques and tools on five research dimensions:

1. automated AdCoS reconfiguration based on e.g. real-time predictive human models;
2. holistic formal (human and machine) modelling and accelerated analysis;
3. new empirical task, exploration, and validation analyses of AdCoS;
4. a formalized synergetic empirical and model-based methodology;
5. integration of all techniques & tools in a Human Factors Reference Technology Platform (HF-RTP) to foster interoperability and to support human factors along the whole engineering life-cycle.

The HF-RTP will be closely connected to the technically oriented CESAR RTP to enable holistic development and qualification from both perspectives of human factors and technical systems design.

1.2 Structure of the document

The first part of this document deals with the target scenarios (TS) and use cases (UC) defined in the automotive work package in the HoliDes project, WP9. The methodology of the TS and UC generation is described. The derivation of requirements from these TS and UC is then detailed further. To detail the requirements as much as possible, the characteristics and the corresponding terminology is explained further.
In the "Annex II: List of Requirements", a complete compilation of requirements can be found.

2 Description of Target-scenarios and Use-cases

2.1 Purpose of Target-scenarios

The general purpose of the target-scenarios (TS) is to define the problem – in terms of desired/undesired outcome – that a system or a function aims to address. TS form the basis for the definition of Use-cases (UC), which in turn define how the addressed function is intended to prevent the targeted accidents or mitigate their consequences. Then, the UC serve as the basis for the definition of requirements.

In order to be able to derive the UC directly from TS in a straightforward way, the members of WP9 followed a general methodology, first developed in previous work in other EU funded projects (such as INTERACTIVE [5] and HAVE-it [3]) and the conceptual framework defined in the Swedish project FICA2 [4].

2.2 Target-scenarios Definition

TS can be defined in many different ways, emphasising different aspects of either cause or outcome of a situation. The overall goal is to capture the events leading up to a critical or risky event, or also to a "positive" situation (i.e. the system acts as expected). TS can be defined at two levels: Level 1 TS provide general information on the frequency and severity of general accident types (to be used, for instance, for early prioritisation of target scenarios), whereas Level 2 TS are intended as the direct basis for the UC definitions.

2.2.1 General methodology

At Level 1, the TS are described based on simple pictograms illustrating the accident type (derived from the chosen typology) and a general narrative (a short "story" describing a typical flow of events).

At Level 2, three complementary representations were used in order to capture all relevant aspects of the Level 2 TS:

- Narrative
- Sketch

- Sequence diagram.

The first point, "*Narrative*", describes the flow of events at a detailed level, including the hypothesised causal mechanisms behind the risky/critical situation. This takes also into account the human-agents and machine-agents, as well as the environmental factors. As the number of factors and parameters (e.g. road conditions, speed ranges, driver states etc. in the automotive domain) that can possibly be included is extremely large, the main rule is to only include the information that is relevant for explaining the causal mechanisms behind the accident. From the automotive domain, an example of narrative TS could be the following:

> "A following vehicle (FV) is driving behind a lead vehicle (LV) in an extra-urban area at a speed *v* of about 50kph at a time headway *THW*[2] of about 2s. The FV driver briefly looks towards an in-vehicle display. During the off-road glance, the LV brakes sharply to stop with deceleration $a \leq -2m/s^2$, due to traffic cue ahead. When closing in on the stopped LV, the FV driver's gaze is drawn back to the road by perceptual cues in the peripheral field of view (the optical expansion of the LV). When detecting the emergency situation, the FV driver brakes sharply but the margin to the LV is too small to avoid a rear-end collision" (from INTERACTIVE and D3COS projects [5], [6]).

Concerning the second point of the aforementioned list: "*Sketch*" refers to a pictorial representation that further illustrates the flow of events defined in the narrative, in terms of machine-agent paths and dynamics.

Finally, as third point, the "*Sequence diagram*" describes the sequence of events and key interactions between different agents (e.g. drivers, vehicles or road infrastructure elements) in a scenario over time.

2.3 Use-cases Definition

As mentioned in the previous sections, the UC aim at describing and specifying the functional behaviour of a function/feature and they are defined

[2] Time headway is defined as the time necessary for a following vehicle (FV) to travel the current bumper-to-bumper distance to a lead vehicle (LV), at the current speed.

starting from the scenarios, specifically from the level 2 of the TS (see previous paragraph). In particular, the following formal definition can be used: "A description of a specific sequence of interaction between the user(s) and a technical system to achieve a specific goal." In the present context of HoliDes, a UC refers to a description of how a machine-agent is intended to interact with the human-agent in a particular target scenario in order to prevent an accident (or any other undesired outcome). Under this viewpoint, TS define the problem and UC define how it should be solved by the function/system in interaction with the user. This means that the level 2 target scenarios only concern the flow of events leading to the undesired outcome, whereas the use cases define how the function is intended to alter this flow of events in order to prevent the critical situation.
The UC are the main basis for the definition of requirements in the WP6-9. Moreover, the TS and the UC will serve as a basis for the further definition of the test-scenarios.
A UC may include several alternative flows of events, which represent different possible solutions to a similar problem. Alternative flows may include different possible interactions for similar UC or an escalating sequence of events. A separate UC should be defined when the corresponding target scenarios differ fundamentally.

2.3.1 General methodology

The UC of each member of WP 9 were collected in an excel table, following certain pre-defined criteria. These criteria were grouped into three main sections:

(i) Characteristics and Information about the Use-cases,
(ii) Scenario Description Attributes, and
(iii) Scenario Graphical Description.

These topics are described briefly below.

2.3.1.1 Characteristics and information

This section defines information that pertains to a particular use case. Each piece of information is important in understanding the purpose behind the UC.

The different fields are described as follows:

- **Name** ⇒ unique name that complements the ID.
- **Identifier** (ID) ⇒ reference naming convention to identify the UC and make easier their traceability.
- **Category** ⇒ classification of the type of TS and UC (namely, type of functions).
- **Description** ⇒ (longer) descriptive statement of the TS and UC.
- **Pre-condition** ⇒ What must be true before the use case is started.
- **Success-end condition** ⇒ What must be true after the use-case is completed.
- **Trigger event** ⇒ Action or time event that starts the use-case; often this is the first step for the UC.
- **Minimal guarantee** ⇒ Description of what must be avoided. If not, the UC has failed.
- **Author – Date** ⇒ the author of the UC and the date of creation.

Concerning the ID, the convention is: *WP#_DOM_UC#_PAR_v#*, where:

- WP# ⇒ Work-package name, where the UC is considered.
- DOM ⇒ "domain which the UC is referred to. It can be:
  - AUT = Automotive
  - AER = Aeronautics
  - HEA = Health
  - CTR = Control Rooms"
- UC# ⇒ number of use-case (progressive value)
- PAR ⇒ Partner, author and responsible of the UC
- v# ⇒ version of UC

An example from AUT domain (with reference to the EXCEL table) is: *WP9_AUT_UC1_CRF_v01*.
This means that is created in WP9, related to AUT domain, it is the first use-case, the creating partner is CRF and this is the first version.

2.3.1.2 Scenario attributes

The main field of this section is the "**Main Success Scenario**", which describes the steps that are taken from trigger event to goal completion when everything works without failure. It also describes any required clean

up that is done after the goal has been reached. The steps include "*Actor*" (the name of the actor, namely the participants/agents involved) and "*Action*" (the description of what the actor is doing).
In addition, there are other two related fields: "**Features**" and "**Environmental conditions**".
The first one concerns the description of a specific situation and the type of area in which the use-case is occurring (e.g. in AUT domain, if it is an urban-road or a motorway, and the traffic density, respectively).
For the second part, we indicate specific conditions related to weather, such as sunny or raining, light or dark, visibility, etc.
Finally, the last field is the "**Scenario extension**", where it is indicated how each step in the *Main Success Scenario* can be extended. In other words, it indicates how things can go wrong. The extensions are followed until either the *Main Success Scenario* is re-joined or the *Failed End Condition* is met. The "*Step*" refers to the *Failed Step* in the *Main Success Scenario* and has a letter associated with it (e.g. if Step 1 fails the *Extension Step* is 1a).
The "*Condition*" is referred to what caused the branch to occur.
The "*Action*" describes the action necessary to be performed.

2.3.1.3 Graphical Description

In this section of the file, we have a picture of the starting TS. This can be enriched by a sequential diagram, describing the flow of events.
Then, we have additional information, describing which are the (human and machine) agents involved, the tasks they have to accomplish and the resources available for each agent and for the goal of the scenario under description.
Finally, we have the alternative scenario, namely if a variation can occur about how a step is performed. Here the "*Variable*" indicates what has to be changed or modified, while in the "*Variations*" column there is the list of all the possible ways in which the variable in the previous column can be varied.

2.3.2 Main results

The main overall UC focuses on cooperation between a human and a machine (cooperation one-to-one). Concerning the adaptation, the focus is on external situations (environment around the vehicle) and/or the internal situations (e.g. cognitive state of the driver). The main system considered is a Lane-change Assistant (LCA).

The main UC concerns an overtaking manoeuvre with 4 traffic participants (see schematic display below).

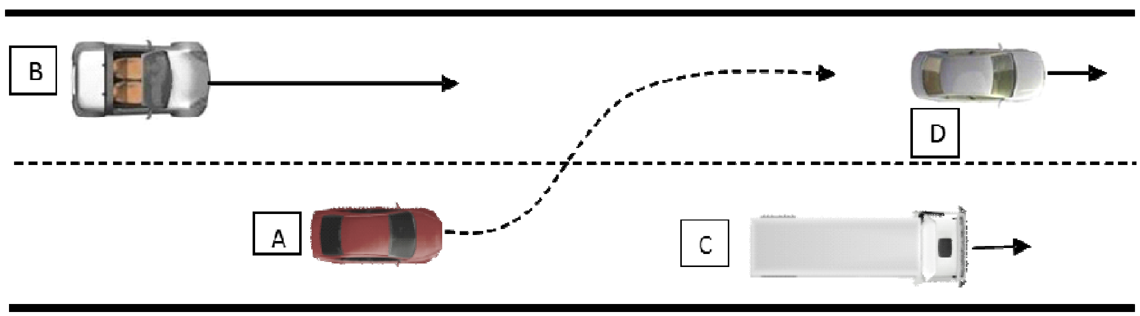

Figure 1. Use Case.

The AdCoS here consist of four cars with machine agents (e.g. ADAS/PADAS) and human agents (drivers). In particular, Car A (red) wants to change the lane to overtake the truck (C). During this manoeuvre a collision against car B has to be avoided.
There can be different conditions (e.g. extra-urban/motorway) and situations (e.g. middle traffic density, sunny day, with clear and good visibility).
The potential risky behaviour is that the driver on vehicle A is not aware of oncoming vehicle in the adjacent lane and thus a collision with agent B is possible, especially if EV (the agent A) changes lane suddenly.
Then, of course, many variations are possible, depending on different weather conditions, internal and external scenarios and types of road.

Current PADAS work without mutual interaction and adaptation. In HoliDes these systems have to be managed as a "unique supporting system" which adapts to the behaviour of the different agents.
Agents have to interact: cooperation or competition (due to the limited and sharable resources) have to mutually understand their intentions and goals, in order to increase safety and traffic efficiency. Thereby, the system should support the human when needed.
The development of adaptive harmonized systems addresses a twofold aspect to:

- Generation of warnings/advice.
- Shift to longitudinal and lateral control of the car from human to machine (and back) according to the capacity, load and intentions of driver (LOA).

In AUT domain, AdCoS will be developed and qualified on test-vehicles provided by CRF and IAS, as well as on driving simulators provided by DLR, IFS, REL.

In addition, ATOS partner proposes an application to monitoring the UC simulation proposal in WP9 (Support Agent in LC manoeuvre). In particular, this systems allows you view the state of each car and its devices, monitoring alarms, video streaming (p. ex. a webcam installed in the vehicle), location and so on, also allowing to show it easily to the customers, partners and others in a demo.
It is possible to communicate with a vehicle in real time, receive/send alarms from/to vehicle, receive AdCoS signals from the vehicles and take the control in an emergency situation.
It be developed in a Open-source solution easy to understand and without any installation, only access web; for example, it can developed in a responsive design web (for all types of devices) and show it from different kinds of devices (tablet, a big screen or others).

3 Requirements

Requirements are an essential part of product design. A requirement describes any physical or functional performance of a product or a service. In contrast to UC, requirements do refer to a specific characteristic aspect of a performance and do not describe the whole UC, but rather a small aspect of it.

Inside HoliDes, the four WP 6-9 set the project constraints through specification, design and realisation of the applications. The boundaries to the performance criteria of HoliDes systems are:

- Performance of demonstrators: reduction of accident risk and attenuation of severity (with the coverage of safety relevant driving situations); enhancement of cooperation and adaptation; etc.
- User acceptance.
- Integration of strategies and HMI.
- Cost effectiveness.
- Performance of specification/development, where the HF-RTP will provide a Requirement Management platform that in particular will make processes from all AdCos domains visible, and thus, exploitable. Instances derived from the HF-RTP will allow a flexible assembly of tools for technology and human-centred work-flow design of AdCoS applications and its integration in the demonstrators.
- Application of a common evaluation framework;
- Assessment of impacts

Starting from system level, they first analyse scenarios and use-cases, then they define the requirements based on that. As following step, these work-packages develop the architecture and deliver specifications.

In addition, the benefits of the applications (implemented in the demonstrators) in terms of usability and safety will be investigated. This development process will end up in functional prototypes and serve as a basis for further commercialisation of the applications developed in HoliDes

3.1 Guidelines for requirements collection

Very often, the writing phase of requirements is underestimated in a project development, but it is necessary to consider that if you don't get the requirements right, it doesn't matter how well you execute the rest of the

project. Furthermore, requirements development is a discovery and invention process, not just a collection process. Thus, the most important question when writing requirements is: "Is anybody else able to understand my requirements?" and not: "Do I understand my requirements?".
Inside the HoliDes project, the following scheme can be applied:

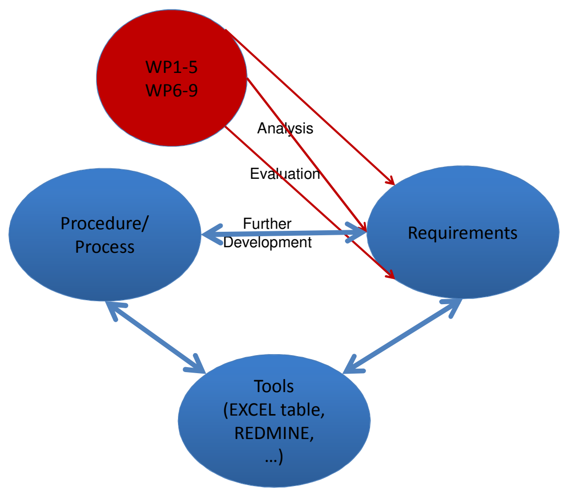

Figure 2: sketch of requirements process.

The characteristics of (good) requirements can be identified by the acronym **SMART**, which means:

- S ⇒ *Specific*.
- M ⇒ *Measurable*.
- A ⇒ *Acceptable*.
- R ⇒ *Realizable* (Realistic & Achievable).
- T ⇒ *Traceable*.

In order to achieve the SMART paradigm, requirements in HoliDes must fulfil the following criteria:

1. Abstract ⇒ Each requirement should be implementation independent.
2. Unambiguous ⇒ Each requirement should be stated in such a way so that it can be interpreted in only one way.
3. Traceable ⇒ For each requirement, it should be feasible to determine a relationship between specific documented statement(s) of need and the specific statements in the definition of the system given as evidence of the source of a requirement.

4. Verifiable ⇒ Each requirement should have the means to prove that the system satisfies the requirements. Note that "Verifying" a requirement does not always mean technical "testing". It also may mean reviews and inspections (e.g. documentation quality requirements).
5. Unique ⇒ A requirement must be present exactly once. Duplicate requirements have a tendency of becoming inconsistent.

Further requisites are harder to verify but also important:

- Complete ⇒ A complete requirements specification must precisely define all the real world situations that will be encountered and the system's responses to them.
- Consistent and correct ⇒ the requirements are free from contradictions.

These indications mean that requirements can be refined (changes can always happen, since the requirements might be vague). It is important to use a simple and concise language to formulate a requirement, defining the expected quality factors for a requirement or a requirements repository and elaborate a verification checklist. It is good also to re-read all the requirements and verify their individual comprehensibility, removing all the ambiguities and verifying the necessity of the requirements (justification). Finally, it is fundamental to check that the requirements can be verified.

Although most of the examples and illustrations of the document focus on accident analysis and generalise in undesirable behaviour, nevertheless we believe that, in order to provide a more covering and complete requirements framework, it would be advantageous to describe the desirable behaviour of system and operators (and of other agents) as well.
In fact, the identification of desirable behaviour provides an opportunity to analyse target scenarios, use cases and requirements in terms of how we wish the system and the operator can act together in a constructive collaboration. Moreover, including both aspects in the analysis will help to obtain the holistic view which is a big part of the HoliDes project.
The scheme is proposed in the sketch below:

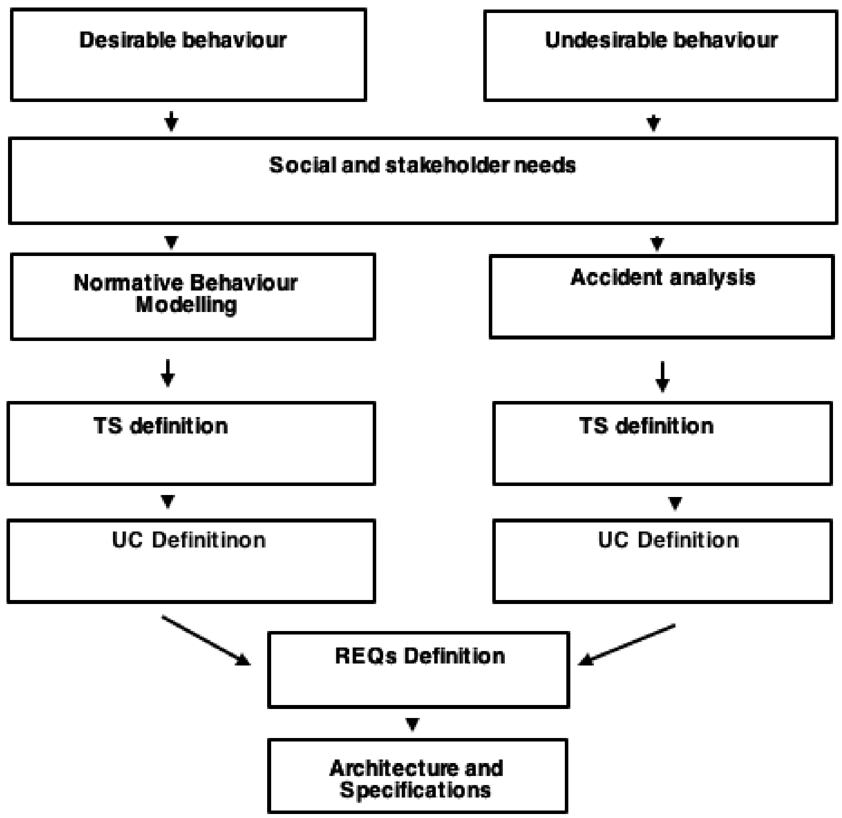

Figure 3: sketch of two-sided requirements analysis.

This procedure should allow the analysis methodology to cover desired behaviour of human and machine as well as more undesirable ones.

3.2 Guidelines for terminology

For filling the excel table (Annex II: List of Requirements), the following guidelines had to be taken into consideration.
Each requirement is identified by an "**identification code** (ID)", based on the similar ID of the use-cases (first column of the table). The ID is expressed in the form: *WPx_[Company]_DOM_REQyy_vz.z*.
It has the following characteristics:

- WPx = number of WP (1-9)
- Company = beneficiary name of the partner, owner of the requirement
- DOM = Domain where the requirement is applicable
- REQyy = serial number of the requirement

- vz.z = version of the requirement and the related refinement

It is worth to remember here that the four domains are indicated by:

- AUT = Automotive.
- HEA = Health.
- AER = Aeronautics.
- CTR = Control Rooms.

The second column, "**Name**", is the unique name that complements the ID.

In the third and fourth columns, we have, respectively: "**Definition**", which is a concise description of the requirement (two-three lines max); "**Rationale**", which is an explanation why this requirement is necessary.

"**Relevance**" (fifth column) gives the priority assigned to the requirement. In details:

- **H**= *High* ⇒ means "*Essential to have*" (No implementation of the related AdCoS, methods and tools otherwise).
- **M** = *Medium* ⇒ means "*Important to have*" (Degraded performances of AdCoS, methods and tools otherwise)
- **L** = *Low* ⇒ means "*Nice to have*" (The requirement with this priority will open up to the partners interested to add new or additional features to the system. This will be evaluated case by case).

Then, there is the column "**Development Process Step**", which indicates the different level of the process development, which the REQ is referred to. In particular:

- AD ⇒ Architect. Design
- DD ⇒ Detailed design
- LLT ⇒ Low level test
- LLI ⇒ Low level integration
- SI ⇒ System integration
- V ⇒ Validation

The column "**Classification**" represents the category of the requirement:

- SW= Software
- HW = Hardware
- COM = Communication
- PER = Perception

- Other for HoliDes (TBD)

The "**Type**" item (eight column) defines the kind of requirement, considering three possibilities:

- **F** ⇒ *Functional* (desired functions of the system).
- **NF** ⇒ *Non-functional* (desired qualities of system, such as testability, maintainability, scalability, etc.).
- **O** ⇒ *Operational* (conditions under which the system needs to be operational).

In "**Proof**", it is described how you will show that the requirement is fulfilled.

The column "**UC Reference**" indicates the use-case ID, which the requirement refers to, as defined by the different WPs, in the form: *UC_WPX_y.z* (more than one use case can be listed). Where:

- *WPX*: number of the WP where the UC has been created.
- *y*: serial number of the requirement.
- *z*: version of the requirement.

Moreover, for each requirement, the following information is given in the table: "**Responsibility**", which means the beneficiary partner who created this requirement; "**Author**", who is the person creating and responsible for the requirement.
The last three columns and the first (ID) are important and used also for the traceability of the requirements, when they have to be refined in cycle 2 and 3 of the HoliDes project.

3.3 Requirements

The requirements in WP9 were focused mainly on functional requirements, although some non-functional requirements have been added also.
As the HoliDes project is mainly focused on the human factors in the development process, requirements deal with different constructs such as driver distraction, mental workload, multimodal information display, situation and mode awareness, trust in automation, and of course adaptive automation and their integration into development requirements.
Technically, the requirements deal with different systems and sensors. For a complete listing, see "**Errore. L'origine riferimento non è stata trovata.**".

The requirements have been reviewed during a Workshop of WP1, taking place on 16th of January 2014 in Berlin, as first step; they will be reviewed as a second time by a TWT member of WP1 after the first adaptation of the requirements. In parallel, all work-packages WP2-5 will analyse the requirements in the context of their work.

4 Conclusions

In conclusion, it can be stated that the requirements in WP9 have been derived through an established best practice method generated through other EU projects. The rules have been established by each participating organization, following guidelines and the SMART paradigm. UC and TS have been used following a top-down process of requirement generation and in order to be as holistic as possible without losing the view on details. Industry and research partners have collaborated to provide a first draft of requirements as early as possible, and they have been reviewed through a defined evaluation process.

As requirements are not only the first, but also the fundamental step in product design, the throughout following of the defined processes and guidelines form an initial approach towards the common goal of integrating the human-centred view into a reference technology platform.

References

[1] http://www.cesarproject.eu/
[2] http://www.crystal-artemis.eu/
[3] Flemisch, F. and Schieben, A. (Eds.). (2010). Validation of preliminary design of HAVEit systems by simulation (Del. 33.3). HAVE-it public deliverable to the EU commission; Brussels
[4] Ljung A. M. and Engström. J. (In press). A conceptual framework for requirement specification and evaluation of active safety functions. To appear in Theoretical Issues in Ergonomics Science
[5] http://www.interactive-ip.eu/
[6] http://www.d3cos.eu/

5 Annex I: target-scenarios and use-cases for different partners

In this section, a short description of the other possible UCs is illustrated. At the moment, the priority has been given to the lane-change UC, as described in the main text (see figure 1, as well).

5.1 Cross-traffic Scenario and Use-Cases

An agent (RED vehicle, the EV) is approaching an intersection. The system aims at supporting the driver in order to avoid collisions with crossing vehicles at intersections (in the example, with Participant 2, the GREY vehicle), by providing a warning or by suggesting the appropiate speed, as sketched in the figure:.

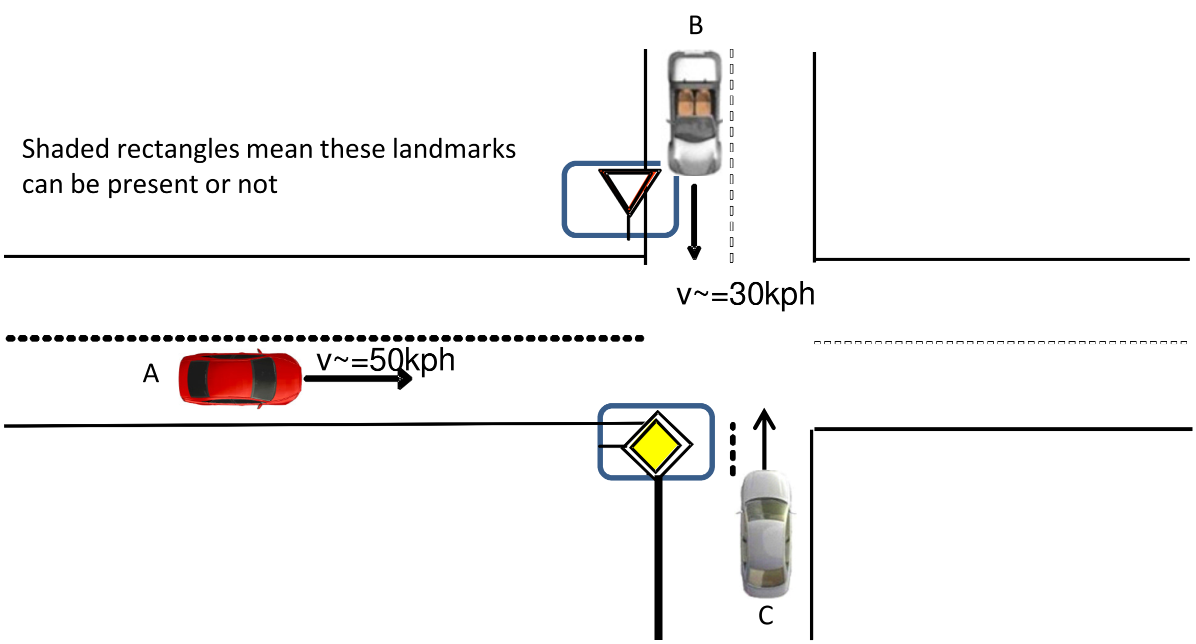

Figure 4: cross-traffic assistant UC, from CRF partner.

Agents A (red vehicle) and B (grey vehicles) are approaching the intersection: their task is to cross it in the fastest and safest way, respecting traffic rules, with no risks and minimizing the wasted time due to

unnecessary stops. The resources are room and time availability in the intersection; presence of landmarks indicating the priorities; vehicles braking/accelerating capacity.
Approaching an intersection, with other vehicles coming in, the RED vehicle can have (or not) the priority in the intersection.
The risky behavior consists in the fact that agent A is not aware of oncoming vehicle in the adjacent lane, thus a collision with agent B, given no maneuver. Moreover, possible dangerous situation happens if some agents makes rules violation.
If every participant respects the traffic rule, the CTA application does not provide any warnings, the right speed for avoiding any risks is possibly suggested.
If the human-agent in the RED vehicle is distracted and so not aware of the other vehicles incoming from the left and right sides ("give priority" landmarks can be present or not), this can lead to a potential critical situation. The CTA is able to warn the driver in an appropriate way (taking into account the cognitive state) and suggesting the right speed to cross the intersection.

5.2 Frontal Collision Scenario and Use-Cases

This UC is based on the one sketched in figure 1 and related to the one described by TAK partner in annex 3.

Figure 5: UC representation for FCW + LCA applications (CRF partner).

The HV is approaching very fast a slower vehicle (agent C); if the lane-change maneuver for overtaking is not possible (since the adjacent lane is not free and thus the risk of collision with agent B or D would be too high), the FCWS is activated, warning the driver. If most serious situation, the vehicle can also brake autonomously (Emergency Braking, EB), in order to avoid the impact or, at least, to deduce its effects.
Depending on the internal scenario (e.g. human-agent distracted or not), some variations are possible, as in the other UCs.

5.3 Lane-Change + ACC Scenario and Use-Cases

For the figure, it is similar to the previous ones:

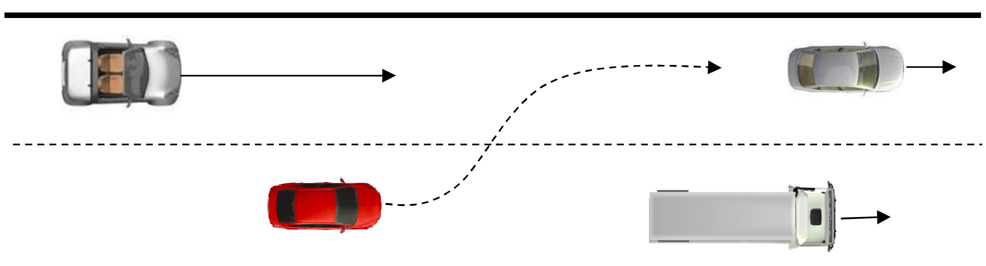

Figure 6: UC representation for TAK partner.

However, now we have two functionalities: ACC and LCA.
In particular, the following situations can be identified:

1. TAK1: A human agents (A) wants to overtake, blind spot warning detects another vehicle in the overtaking lane (C), ACC detects collision range violation with vehicle in front (B), ADAS initiates car following and informs driver, lane change after passing of C.
2. TAK2: Overtaking not advised by ADAS, driver overrides → ADAS intervenes with warnings to prevent collision (driver has to react)
3. TAK4: Distracted driver A is unaware of slower B → ACC slows down, informs driver
4. TAK5: ADAS constantly informs driver about d_{AB} and possible lane change, initiates lane changes automatically.
5. TAK6: Blind spot warning forces driver A to steer back (and interrupts lane change), collision warning gets active.

6 Annex II: List of Requirements

ID	Name	Definition	Rationale	Relevance	Dev.Process step	Classification	Type	Proof	UC Reference	Responsibility	Author
WP9_[TAK]_AUT_REQ01_v1.0.	Blind-Spot visual indicator placement	The Blind-Spot visual indicator should be placed in the field of view of the driver.	The Blind-Spot visual indicator should be clearly visible at all times to ensure detection of the warning by the driver.	H	DD	PER; HW	F	Requirement is fulfilled when user test or expert evaluation shows the indicator placement to be such, that the indicator can be perceived in all relevant driving conditions, environmental conditions and workload conditions.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ02_v1.0.	Minimize visual noise from irrelevant devices	visual noise from irrelevant devices shall be minimized and warnings shall be designed to be perceivably different from other visual warnings	By minimizing visual noise and designing for distinctness of warning the perception and recognition of the visual warning is provided.	M	DD	HW, PER	NF	Requirement is fulfilled when visually interfering noise from other non-portable devices is held at a minimum and the warning from the visual blind-spot indicator can be shown to be generally recognizable as such by the user.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ03_v1.0.	Minimize visual blind-spot indicator interference with car environment	The visual blind spot indicator should be designed to minimize interference with the driver's perception of car's environment and the traffic situation.	By minimizing interference with information about the traffic situation and the car environment the correct detection of the visual blind-spot indicator is ensured. Also, the level of distraction caused by the indicator is minimized, which will improve Situation Awareness.	M	DD	HW, PER	NF	The requirement is fulfilled, when it can be shown by user tests or expert evaluation that the placement and design of the visual blind-spot indicator do not, or only minimally interfere with the driver's perception of the traffic situation and no significant degradation of Situation Awareness measured by SAGAT can be found.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ04_v1.0.	Communication of information about car noise to acoustic blind-spot warning	Information about engine/environment/infotainment/conversation noise-levels should be communicated to the warning device.	This information shall be used by the acoustic blind-spot warning to determine output volume levels and ensure detection of the warning by the driver	M	DD	SW	F	The requirement is fulfilled when it can be shown that qualitative and quantitative information about engine/environment/infotainment/ conversation noise-levels can 1) be provided and 2) be communicated to the acoustic blind-spot warning system.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ05_v1.0.	Consistency and reliability of blind-spot warning communication channels	Blind-spot warnings should always be communicated through the same channel	The blind-spot warnings should be distinguishable from other warnings and non-warnings coming from sound sources and visual sources in the car. To ensure distinctness and recognizability of the warnings, consistent feedback channels should be used.	M	DD	SW, HW	F	The requirement is fulfilled when it can be shown, that independent of the situation and the environmental conditions, consistent locations for visual, auditory and haptic feedback about blind-spot warnings are used.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ06_v1.0.	Avoid inappropriate orientation reactions from blind-spot indicator	The visual and acoustic blind-spot indicators should be designed to guide attention in an appropriate way, i.e. towards the direction of view that facilitates the detection of previously not detected traffic participants. The visual and acoustic blind-spot indicators should not induce an unguided orientation reaction.	By considering auditory and visual source placement and Icon/Earcon design for the blind-spot indicator, the detection of traffic participants that the driver was previously not aware of can be facilitated in comparison to unspecific warnings. In very urgent cases an unspecific warning can however also be appropriate.	M	DD	HW, PER	NF	The requirement is fulfilled when it can be shown that driver's reactions to blind-spot indicator warnings are specific and reaction times are not delayed over normal reaction times for warning devices.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ07_v1.0.	Communicate blind-spot warning urgency	The urgency of a blind-spot warning should be determined and then communicated to the blind-spot audio/visual feedback interface	Design of audio/visual feedback from the blind-spot warning system shall reflect urgency of the situation. Intensity and frequency of warning shall increase with urgency of required action.	M	DD	SW, PER	F	Fulfillment of the Requirement is shown when urgency of a situation can be measured TLC and lateral TTC by the system and communicated to the warning system.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ08_v1.0.	Blind-spot indicator design to reflect situation and propose appropriate action	Blind-spot indicator designs shall reflect the actual situation (speeds and relative positions of objects) and propose appropriate actions to the user by indicating directions and user actions that avoid collision.	User's action selection should be supported by proposing appropriate actions to decrease the number of action alternatives available to the user and thereby speed up reaction times and increase appropriateness of actions.	M	DD	SW, PER	NF	Requirement is fulfilled when it can be shown by user tests or expert evaluation, that the indicator design reflects the situation at hand and proposes appropriate reactions to the driver and that reaction times are not delayed over normal reaction times for warning devices.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ09_v1.0.	Blind-Spot detection reliability	Blind-spot detection should be reliable and detection failures (failure to detect object in blind-spot/wrong detection of object in blind-spot) should be minimized. If complete reliance is impossible, prediction of the reliability by the driver should be supported by avoiding irregularity of detection failures. The reliance shall have low specifity and be applicable to all driving conditions.	To build trust in the blind-spot detection it should be consistently reliable and designed to give appropriate warnings in all driving and environmental conditions.	H	DD	HW, SW, COM	NF	The requirement is fulfilled when high reliability of detection and low situation specifity of detection rates are shown.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ10_v1.0.	Communicate state/readiness/performance of blind-spot detection	The current state, including the readiness of the detection and the current and past performance of the detection shall be communicated to the blind-spot indicator interface	By providing the driver with an indication of the current state of the blind spot detection assistant greater trust in the systems reliability can be induced.	L	DD	SW, COM	F	The requirement is fulfilled when it can be shown that the system is able to determine its current state and communicate this state to the user interface	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ11_v1.0.	Seriousness of Design	Colors, layout and quality shall be designed to give the impression of high seriousness and reliability of the blind-spot indicator by using cool colors, a balanced layout and materials with a high quality-impression.	Greater trust in the system's capabilities and hence greater reliance/greater use of the system can be induced by designing for high seriousness of the systems appeal.	L	DD	PER	NF	The requirement is fulfilled when it can be shown by user testing and focus groups that the systems appeal and design induce trust in the systems capabilities and subjects perceive the system to have high quality.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ12_v1.0	Use appropriate and consistent speech output	System shall use commands only for urgent situations. System shall use speech parameters such as rhythm, speed and information content to convey a feeling appropriate to the information. System shall use natural or synthetic speech output consistently. System should not mix natural and synthetic speech.	The speech output requirements induce greater trust by reflecting the users situation and the content of the information conveyed through the speech output.	M	DD	SW, COM, PER	F	The requirement is fulfilled when it can be shown, that the speech output is deemed appropriate by the users. Appropriateness can be measured by acceptance/satisfaction measures.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ13_v1.0	Limit number of displayed items	The number of items in a display that are displayed at one time shall be limited to 3-4. When more information needs to be provided, integrated items/hybrid displays should be used, that convey information about an overall state rather than multiple system states.	This limitation takes into account the capacities and limitations of the user's working memory.	M	DD	SW	NF	This requirement can be shown to be fulfilled when the number of actively displayed items on a display are limited to 3-4 .	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ12_v1.0	Avoid misdirecting saliency	System shall not use salient colors, flashing signals or loud/pervasive sounds when no action is required or no attention needs to be allocated to a different area	By avoiding misdirecting saliency the users attention can stay focused on the task at hand and is not inappropriately guided to currently not important areas.	H	DD	PER	NF	The requirement can be shown to be fulfilled when the appropriateness of salient cues in the car is positively evaluated by a group of five experts.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ15_v1.0 (fused with WP9_ATOS_AUT_REQ02_v0.1)	Use multimodal feedback	System shall use multimodal cues (e.g. visual + auditory + tactile) to alert user of an impending or acute change in a system state and/or communicate information and warnings	Using multimodal feedback helps to increase Situation Awareness and ensures perceptibility of warnings and information in diverse environments. The driver's attention should be guided, if necessary, towards the road.	M	DD	HW, SW	F	To fulfill the requirement, the System should be capable of providing multimodal feedback through two or more channels.	WP9_TAK_AUT_UC1-7_v1.0	TAK, ATOS	Essers, González

WP9_[TAK]_AUT_REQ16_v1.0	Provide easy mental model of systems functions	System surface-features shall be designed to be as simple as possible and to provide information about what the system does in a simple way, possibly using metaphors and analogies	Design for appropriate and easy-to-learn mental model to provide better understanding of the systems capabilities and limitations	M	DD	SW, HW, PER, COM	NF	Requirement is fulfilled when it can be shown by user testing that an appropriate mental model of the systems functions, capabilities and limitations can be formed during a short time of use. This can be done via card sorting structuring technique.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ17_v1.0	Help the user predict future states of the system and objects in the environment	System shall use visualizations that help predict future states of participants in a traffic situation. System shall visualize relevant participants and their predicted paths and/or possible conflicts.	The above described visualizations will help the user maintain Situation Awareness.	L	DD	SW, COM, PER	F	The requirement can be shown to be fulfilled when the System is capable of predicting future states of objects in the environment and visualizations of these predicted states/paths can be shown to be easily understood by users through user-testing.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ18_v1.0	Use Hybrid Data as input for adaptive automation algorithm	Ideally, the system shall use a combination of critical events, operator performance measures, operator modeling and physiological assessment of the operator to determine timing of automation mode transitions.	If adaptive automation to the user's needs and the environment conditions is to be implemented, use hybrid methods to determine the timing of transitions between system states to ensure the user will be aware of the mode change and ready for potentially required actions.	L	DD	SW, HW	F	The requirement is fulfilled, when it can be shown that an adaptive automation algorithm incorporates several of the methods proposed above and the system is able to reliably determine the driver's state and from this derive the timing for mode changes of the automation.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ19_v1.0	Communicate evolvement of alarms to the interface	System should be able to communicate insights into the evolvement of alarms and warnings to the user interface	By using likelihood warnings and incorporating information about the evolvement of alarms before the actual alarm, Situation Awareness of the User shall be increased and the appropriateness of reactions to alarms be ensured.	L	DD	SW	F	The requirement is fulfilled, when it can be shown that the evolvement of alarms and warnings is communicated to the user interface, displayed in a manner that can be easily understood by the user and used to increase the appropriateness of reactions to alarms and warnings.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ20_v1.0	ACC visual indicator placement	The ACC visual indicator should be placed in the field of view of the driver.	The ACC visual indicator should be clearly visible at all times to ensure detection of the warning by the driver.	H	DD	PER; HW	F	Requirement is fulfilled when user test or expert evaluation shows the indicator placement to be such that the indicator is generally perceivable in all relevant driving conditions, environmental conditions and workload conditions.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ21_v1.0	Minimize ACC indicator interference with car environment	The visual ACC indicator should be designed to minimize interference with the driver's perception of car's environment and the traffic situation.	By minimizing interference with information about the traffic situation and the car environment the correct detection of the visual ACC indicator is ensured. Also, the level of distraction caused by the indicator is minimized, which will improve Situation Awareness.	H	DD	HW, PER	NF	The requirement is fulfilled when it can be shown by user tests or expert evaluation that the placement and design of the visual ACC indicator do not, or only minimally interfere with the driver's perception of the traffic situation and no significant degradation of Situation Awareness can be found.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ22_v1.0	Communication of information about car noise to acoustic ACC warning	Information about engine/environment/infotainment/conversation noise-levels should be communicated to the warning device.	This information shall be used by the acoustic ACC warning to determine output volume levels and ensure detection of the warning by the driver	M	DD	SW	F	The requirement is fulfilled when it can be shown that qualitative and quantitative information about engine/environment/infotainment/conversation noise-levels can firstly be provided and secondly be communicated to the acoustic ACC warning system.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ23_v1.0	Consistency and reliability of ACC warning communication channels	ACC warnings should always be communicated through the same channel	The ACC warnings shall be distinguishable from other warnings and non-warnings coming from sound sources and visual sources in the car. To ensure distinctness and recognizability of the warnings, consistent feedback channels should be used.	H	DD	SW, HW	NF	The requirement is fulfilled when it can be shown that independent of the situation and the environmental conditions, consistent locations for visual, auditory and haptic feedback about ACC warnings are used.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ24_v1.0	Avoid inappropriate orientation reactions from ACC indicator	The visual, acoustic and haptic ACC indicators should be designed to guide attention in an appropriate way, i.e. towards the direction of view that facilitates the detection of previously not detected traffic participants. The visual, acoustic and haptic ACC indicators should not induce an unguided orientation reaction.	By considering auditory and visual source placement and Icon/Earcon/Tacton design for the ACC indicator, the detection of traffic participants that the driver was previously not aware of can be facilitated in comparison to unspecific warnings. In very urgent cases an unspecific warning can however also be appropriate.	M	DD	HW, PER	NF	The requirement is fulfilled, when it can be shown that driver's reactions to ACC indicator warnings are specific and reaction times are equal or lower than normal reaction times to warnings.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ25_v1.0	Communicate ACC warning urgency	The urgency of an ACC warning should be measured and then communicated to the ACC audio/visual/haptic feedback interface	Design of audio/visual/haptic feedback from the ACC warning system shall reflect urgency of the situation. Intensity and frequency of warning shall increase with urgency of required action.	H	DD	SW, PER	F	Fulfillment of the Requirement is shown, when urgency of a situation can be measured by the system and communicated to the warning system. Typical measurements are longitudinal TTC, THW, Human risk feeling (combination of TTC and THW)	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ26_v1.0	Ensure perceptibility of haptic indicator	Haptic Indicator should not interfere with information used to perceive steering response; Haptic indicator should be clearly distinguishable from haptic noise; Haptic indicator should be clearly distinguishable from other haptic indications.	To ensure the haptic cue is perceived and to avoid confusion, the haptic indicator should be perceivable in all road conditions and distinguishable from other haptic events.	M	DD	HW, PER	NF	The requirement is fulfilled when it can be shown by user testing that the haptic cue is perceivable even under extreme conditions, can be clearly distinguished from other haptic events and is correctly attributed to the intended action.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ27_v1.0	ACC detection reliability	ACC detection should be reliable and detection failures (failure to detect object in front/wrong detection of object in front) should be minimized. If complete reliance is impossible, prediction of the reliability by the driver should be supported by avoiding irregularity of detection failures. The reliance shall have low specifity and be applicable to all driving conditions.	To build trust in the ACC's detection it should be consistently reliable and designed to give appropriate warnings in all driving and environmental conditions.	H	DD	HW, SW, COM	F	The requirement is fulfilled when reliability of detection and low situation specifity of detection rates are shown.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ28_v1.0	Communicate state/readiness/performance of ACC detection	The current state, including the readiness of the detection and the current and past performance of the detection shall be communicated to the ACC indicator interface	By providing the driver with an indication of the current state of the ACC greater trust in the systems reliability can be induced.	L	DD	SW, COM	F	The requirement is fulfilled, when it can be shown that the system is able to determine its current state and communicate this state to the user interface	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ29_v1.0	ACC design to reflect situation and propose appropriate action	ACC indicator designs shall reflect the actual situation (speeds and relative positions of objects) and propose appropriate actions to the user by indicating directions and user actions that avoid collision.	Users action selection should be supported by proposing appropriate actions to decrease the number of action alternatives available to the user and thereby speed up reaction times and increase appropriateness of actions.	M	DD	SW, PER	F	Requirement is fulfilled when it can be shown by user tests or expert evaluation, that the indicator design reflects the situation at hand and proposes appropriate reactions to the driver, and that specific reaction times are minimized.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ34_v1.0	Automatic Steering Wheel Behavior	The System shall turn the steering wheel in accordance with the executed steering.	Turning the steering wheel while executing lateral vehicle control will provide feedback to the driver about the decisions and actions performed by the automation and will help to keep the operator in the loop.	M	DD	HW, SW	F	The requirement is fulfilled when the steering wheel delivers appropriate feedback about the executed lateral control of the car as determined by user testing or expert evaluation.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ35_v1.0	Ignoring Lane departure/blind spot warning w/o automatic steering	If the user ignores the lane departure/blind spot warning and continues to steer off road/into traffic the system shall issue an alarm through an appropriate channel. It shall also propose counter-actions to relax the situation.	When no automated lateral control is available, the system should warn the user about impending collisions to avoid crashes and inform the user about the seriousness of the situation.	M	DD	HW, SW	F	The requirement is fulfilled when an alarm is triggered by an impending collision caused by inappropriate road behavior of the user.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ36_v1.0	Overpowering Breaking w/ ACC: Harder Breaking	If the user senses the automation is decelerating the vehicle and uses the brake pedal, the ACC should be deactivated and longitudinal control re-issued to the driver.	When the user feels uncomfortable or unsafe with the distances and speeds maintained by the ACC, regaining of longitudinal control should be possible immediately.	H	DD	HW, SW	F	The requirement is fulfilled when the use of the breaking pedal by the user immediately terminates the automation's longitudinal control.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ37_v1.0	Overpowering Breaking w/ ACC: Accelerating	If the user senses the automation is decelerating the vehicle and uses the accelerator pedal, the accelerator pedal shall provide a to be determined resistance and a warning shall be issued by the system.	When the user tries to overpower the automation, information about the increase of risk should be given as well as feedback about appropriate action alternatives.	H	DD	HW, SW	F	The requirement is fulfilled when the system is able to provide an appropriate feedback to the user about the appropriateness of the users intentions.	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ38_v1.0	Communicate progress of overtaking maneuver	System should determine and communicate progress of overtaking maneuver to the interface.	Interface shall be able to inform the driver about the progress of an ongoing overtaking maneuver.	L	DD	SW	F	The requirement is fulfilled when the information about the prograss of an ongoing overtaking maneuver is successfully communicated to the interface.	WP9_TAK_AUT_UC1_v1.0; WP9_TAK_AUT_UC2_v1.0;	TAK	Essers

WP9_[TAK]_AUT_REQ39_v1.0	Display information about appropriateness of return to lane	System shall determine the safety and appropriateness of a return to the right lane and communicate this information to the interface.	Interface shall be able to inform the driver about the appropriateness of returning to the right lane.	L	DD	SW	F	The requirement is fulfilled when the information about the appropriateness of returning to the right lane is successfully communicated to the interface.	WP9_TAK_AUT_UC1_v1.0; WP9_TAK_AUT_UC2_v1.0;	TAK	Essers
WP9_[TAK]_AUT_REQ40_v1.0	Communicate information about lane detection performance	System shall determine the quality of lane detection in the current environment and communicate that information to the interface.	Interface shall be able to inform the driver about the performance of the lane detection	L	DD	SW	F	The requirement is fulfilled when the information about the performance of the lane detection is successfully communicated to the interface.	WP9_TAK_AUT_UC1_v1.0; WP9_TAK_AUT_UC2_v1.0;	TAK	Essers
WP9_[TAK]_AUT_REQ41_v1.0	Communicate Information about vehicle's intention	System shall determine its intentions and communicate this information to the interface. (e.g. "I will probably overtake the next car"; "I will stay behind this car")	Interface shall be able to inform the driver about the intentions of the vehicle.	L	DD	SW	F	The requirement is fulfilled when the information about the intentions of the vehicle is successfully communicated to the interface.	WP9_TAK_AUT_UC1_v1.0; WP9_TAK_AUT_UC2_v1.0;	TAK	Essers
WP9_[TAK]_AUT_REQ42_v1.0	Acceleration /Deceleration of AAC	System shall use acceleration/deceleration rates that are comfortable for the driver (except for emergency situations)	Requirement is meant to ensure a comfortable driving experience and enhance the feeling of safety for the driver when ACC is controlling the cars speed.	M	DD	SW	F	The requirement is fulfilled when the following behavior of the ACC can be shown through user testing to be comfortable and feel safe to the driver	WP9_TAK_AUT_UC1-6_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ44_v1.0	Following distance for AAC	System shall use following distances for other vehicles that are comfortable and safe for the driver. The distances shall be dependent on driver comfort, breaking power of the vehicle, breaking conditions (i.e. road surface type, temperature, weather conditions...)	Requirement is meant to ensure a comfortable driving experience and enhance the feeling of safety for the driver when ACC is controlling the cars distance to other vehicles.	M	DD	SW	F	The requirement is fulfilled when the following behavior of the ACC can be shown through user testing to be comfortable and feel safe to the driver	WP9_TAK_AUT_UC1-6_v1.2	TAK	Essers
WP9_[TAK]_AUT_REQ45_v1.0	Road Bend steering behavior	System shall adhere to a curve negotiation that is comfortable for the driver (i.e. not strictly stick to lane center but straighten up the bends like a human driver would)	To ensure a comfortable driving experience and enhance the feeling of safety for the driver when negotiating road bends, the system should adopt a human-like driving style	M	DD	SW	F	The requirement is fulfilled when the steering behavior of the lane keeping assitant can be shown through user testing to be comfortable for the driver.	WP9_TAK_AUT_UC1-6_v1.3	TAK	Essers
WP9_[TAK]_AUT_REQ46_v1.0	Feedback about closed data input	The system shall give out information about closed data input when the selected input channel is no longer available for information input by the user	When the driver tries to input data (e.g. turn the steering wheel), but the automation is at this moment not able to process this information, the user should be informed to increase trust in the automations capabilities	L	DD	SW	F	The requirement can be shown to be fulfilled when the system is able to display information about closed data input	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ47_v1.0	Availability of Prompts	If the task requires a particular sequence of user actions, prompting for the currently required steps should be provided	Prompts will guide the user to appropriate actions and reduce mental workload	L	DD	SW	F	Sequences of actions are supported by appropriate prompts (as determined by expert evaluation)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ48_v1.0	Unambiguous Abbreviations	Abbreviations should be safe against confusion	Use of unambiguous and standardized abbreviations will improve learnability and reduce misuse of functions	L	DD	SW	NF	Standardized abbreviations are used, new abbreviations are validated by user testing	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ49_v1.0	Data grouping for comparison of data	If data has to be monitored and compared by the user, this data should be available in close proximity	Proximity compatibility will reduce glance durations and workload	L	DD	SW, PER	NF	Appropriate grouping of data is validated by expert evaluation and user testing (reduced glance duration, reduced workload)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ50_v1.0	Data grouping according to frequency of use	Often used data should be available in close proximity	Proximity compatibility will reduce glance durations and workload	L	DD	PER	NF	Appropriate grouping of data is validated by expert evaluation and user testing (reduced glance duration, reduced workload)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ51_v1.0	Color and form coding	Color coding should only be used in conjunction with form coding	By double coding data, the perception of the data is improved and additional information for color-blind people is provided	M	DD	PER	NF	Combination of color and form coding is validated by expert evaluation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ52_v1.0	Color coding of safety colors	Color coding of warning and alerts relevant for safety should be clearly distinguishable from other color coding (red=danger; yellow=warning; green=safe)	Use fixed color coding for safety colors to improve reaction times to warnings and avoid unnecessary orientation reactions	M	DD	PER	NF	Color coding of safety colors is validated by expert evaluation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ53_v1.0	Blink coding application	Blink coding should only be used when immediate actions are required from the driver. Blinking frequency should be between 0.5 and 2 Hz.	By limiting blink coding to immediately required actions, reactions times can be improved and unnecessary orientation reactions avoided.	L	DD	PER	NF	Application of blink coding is validated by expert evaluation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

		A maximum of 3 different blinking frequencies shall be used in the system.									
WP9_[TAK]_AUT_REQ54_v1.0	Self-explanatory user interface	All controls (buttons, icons, …) and terminology on user interface should be self-explanatory. If label is used, place label below icon.	Reduce learning time and avoid accidental activation of unwanted functions by using self-explanatory icons and labels	L	DD	PER, HW	NF	Understandability of pictograms and labels is validated by expert evaluation and user testing (reduced learning time, reduced unwanted activations)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ55_v1.0	Recognizability of control areas	Interactive control areas should be recognizable as such by consistent placement and clear indication through lines, colors, contrast or materials	Design interactive areas to look/feel interactive and to induce appropriate use. Avoids disuse and facilitates learnability.	L	DD	PER, HW	NF	Validated by user testing (shorter learning period) and expert evaluation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ56_v1.0	Automatic data input validation	All input data shall (as far as possible) automatically be checked for correctness and consistency before an execution of functions depending on this data is started	By checking input data for consistency, unintentional inputs can be detected and abuse of the automation can be limited	M	DD	SW,HW	NF	Software validation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ57_v1.0	Content of error messages	Content of fault messages should inform the driver about the nature of the fault and propose corrective actions	By giving the driver information about the error and proposing corrective action, Situation Awareness is supported and reaction times can be reduced	L	DD	SW	NF	Validated by expert evaluation.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_[TAK]_AUT_REQ58_v1.0	Error correction handling	Indication or Warning shall inform about a planned/executed corrective action, information about anticipated consequences shall be provided. Information should be presented in consistent location and removed as soon as the warning condition is no longer applicable	Error correction handling should inform the driver about the error handling process to avoid automation surprises and increase Situation Awareness.	L	DD	SW, PER	NF	Validated by expert evaluation and user testing (test for number of automation surprises)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ59_v1.0	Recall of help information	Help information shall be available to recall at any time. More specific help information shall be provided for repeated recalls	Make help information easily accessible to help the user develop a better fit of his or her mental model to the system. Regard multiple requests for help as a need for a deeper understanding of processes of the system.	L	DD	SW	NF	Validated by expert evaluation.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ61_v1.0	Processing feedback	System should indicate when a command has been accepted and is being processed. Feedback about the progress and potential duration shall be provided before and during the process, when expected processing time is higher than TBD seconds. If actual processing time greatly exceeds	By providing the user with feedback about ongoing processes Situation Awareness can be increased and automation bias/complacency (inappropriate reliance on the automation) can be reduced	L	DD	PER, COM	NF	Validated by expert evaluation and user testing (test for Situation Awareness and mental model of system processes)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

		expected processing time, information about this shall be provided.									
WP9_[TAK]_AUT_REQ62_v1.0	Road symbol use	Symbols used in the system should correspond to national road signs BUT ONLY if the warning or action is directly linked to these road signs. Also, accepted car symbols on the basis of ISO 2575 shall be used.	By using standardized road signs as symbols in the system, learning time is reduced.	L	DD	PER	NF	Validated by expert evaluation.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ63_v1.0	Fast changing/qualitative values display	Fast changing and qualitative values shall be displayed in an analog form (i.e. no digital number values). An increase in value shall correspond to a change from left to right/bottom to top or a clockwise increase	Display fast changing and qualitative values in analog display with population-consistent increase/decrease directions to reduce mental workload of the driver and reduce number of glances/glance duration required for understanding of data	L	DD	PER	NF	Validated by expert evaluation and user testing (reduced number of glances/glance duration/correctness of mental model)	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ64_v1.0	Fault tolerance behavior	System shall use minimal correction (just the amount necessary to avoid collisions) for user input error. User shall be supported in finding and avoiding false input by preventing input that will lead to undefined conditions, informing	High fault tolerance of the system helps to build trust in the automations capabilities and increases the frequency of use of the automation	L	DD	SW, COM	NF	Software validation	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

		about corrections and giving the opportunity to postpone error treatment for non-critical errors.									
WP9_[TAK]_AUT_REQ65_v1.0	Avoid unintentional activation of controls	Placement and design of controls should be aimed at avoiding unintentional activation or misuse by other persons other than the driver (inside and outside of car).	Reduces unintentional activation of functions and misuse of functions	L	DD	HW, SW	NF	Validated by expert evaluation.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ66_v1.0	Size of characters	Reading distance of the driver should be considered to determine minimum size of characters. Characters shall at least be the distance from eyes to display in meters divided by 0.3, giving the height of characters in millimeters.	Avoid eye strain and ensure readability of words and characters on the interface.	L	DD	SW	NF	Validated by expert evaluation/anthropometric measurement.	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ67_v1.0	Data supply	All data which shall be displayed to the driver should be reachable by the system.	A data model should be specified which is suitable for the demanding task of displaying complex data.	M	DD	SW	F		WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers
WP9_[TAK]_AUT_REQ68_v1.0	Latency of touch events	The system shall not have a latency of touch events which is higher than 120ms.	To improve the look-and-feel, a fast reacting system is essential. Modern touchscreens perform in a range of 70-120ms of latency after a touch input event.	M	DD	HW, SW	NF	Validation by user experience and testing	WP9_TAK_AUT_UC1-7_v1.0	TAK	Essers

WP9_IFS_AUT_UC1_v1.0-1	Towards WP1 (general support function): Connections /interfaces with RTP developed in WP1 with the 2 main tools/SW(RT-MAPS provided by Intempora and Pro-SIVIC provided by CIVITEC) supporting the IFSTTAR Driving Simulation Platform	Having in WP1 the logic of possible connections on tools / software (already existing or to be developed during the project) is crucial and/or define standardized interfaces able to support a "distributive" approach and efficient connections between sub or external components is needed	Driver model to be developed at IFSTTAR and AdCOS to be simulated on the IFSTTAR Driving Simulation Platform will be supported by RT-MAPS and Pro-SIVIC. As a consequence, it is crucial for IFS modeling work that these tools will be connected (or will be integrated / a part of) the RTP-HF to be developed in WP1	H	From AD to Validation	SW / COM	F/O	Functional and then technical tests of data flow exchanges	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Towards WP1 (general support function): Replaying functions support in the RTP	The RTP platform should allow to support replaying of simulations cases/tests	In order to explore alternative scenario involving driver model and Adcos, in different driving conditions	H	From AD to Validation	SW / COM	F/O	Functional and then technical test	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet

WP9_IFS_AUT_UC1_v1.0-1	Towards WP1 (general support function): Synchronized Recording functions in the RTP	Data synchronization coming from different simulation tools (e.g. driver models, car sensors, road environment simulation, Adcos, etc.) should be recorded in a synchronized way	In order to analyze and compare set of simulations	H	From AD to Validation	SW / COM	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Virtual Car simulation and Controls	Having a virtual car able to be dynamically piloted by the driver model	Required to use the IFS driver model in the RTP for virtual simulation	H	From AD to Validation	SW	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Road Environment and Traffic Scenarios simulation : database (corresponding to the Traffic scenarios defined in WP9)	Having road environments and traffic events corresponding to the WP9 scenarios, where the driver model can drive a virtual car.	Required to use the IFS driver model in the RTP for virtual simulation	H	From AD to Validation	HW / COM	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Road Environment simulation : connection /interface with IFS driver model	Driver mental model building / updating in a synchronized way with the Simulated Road Environment and Event (traffic scenarios)	Required to simulate IFS driver model Situation Awareness in the RTP	H	From AD to Validation	COM	F/O	Pattern recognition can classify data reliably	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Eye-tracking system/data set	Recording/using of eye-tracking to assess driver' visual distraction	Required to support IFS monitoring functions (e.g. Analyze /Use of eye-tracking data generated by IFS driver mode)	H	From AD to Validation	HW	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet

WP9_IFS_AUT_UC1_v1.0-1	Algorithm for analyzing eye movements and visual distraction	Analysis of eye-tracking data as a mean of assessment of visual distraction of the driver / IFS model	Required to support IFS monitoring functions(e.g. visual Scanning analysis)	H	From AD to Validation	SW	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Driver model performance observation & analysis algorithms	Analysis of suitability of different testing conditions through evaluations or other "parallel task"-typical double task to assess performance without driving (control conditions)	Required to support IFS monitoring functions	H	From AD to Validation	PER	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Virtual simulation of car sensors (radar, camera, telemeter)	As components of AdCos1 to be simulated and tested with the RTP during the Project	Required to simulate AdCos in a realistic way in the IFS simulation platform	H	From AD to Validation	SW	F / O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Algorithms for Adcos (or support for Adcos Simulation)	TBD: from Target System definition to be simulated to algorithms to be developed for driver monitoring and adaptive & cooperative assistance / HMI	Required to simulate / virtually design and test adaptive an cooperative driving assistance in WP9 with the IFS simulation platform	H	From AD to Validation	SW	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet
WP9_IFS_AUT_UC1_v1.0-1	Car-To-Car communication simulation	As component of AdCos2 to be simulated and tested with the RTP during the Project	Required to simulate AdCos in a realistic way, in the IFS simulation platform	H	From AD to Validation	SW	F/O	Functional and then technical tests	WP9_IFS_AUT_UC1_v1.0-1	IFS	Thierry Bellet

WP9_TWT_AUT_REQ01_v0.1	Recording instruments /microphones to be installed inside the car/ simulator	Microphones should record auditory signals for analyzing sound level, sound spectrum and sound localization	In order to analyze the auditory distraction potential, sound signals need to be recorded and analyzed	H	AD	HW	O	Appropriate configuration, eventually several microphones	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ02_v0.1	Algorithm for analyses of sound signals	The algorithm should be able to analyze sound level, sound spectrum and sound localization	In order to make predictions about the auditory distraction potential, the recorded sound signals need to be analyzed	H	DD	SW	F	High classification quality, good separation of sources and estimation of distraction levels	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ03_v0.1	Car simulation with operating vehicle speed range and different route options	The system should be operative for ego-vehicle speed in the range of 0-150 km/h with urban route and motorway conditions	Sound conditions could influence driving differently depending on the demands of the situation, i.e., urban route vs. Motorway driving	H	DD	SW, HW	F	Basic content simulator, including variation and simulation of sound sources in car.	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ04_v0.1	Algorithm for analyses of distraction	Distraction level classifier algorithm for feedback app	The driver should be informed about his/her distraction level in order to prevent further distraction	H	SW / V	SW	F	Pattern recognition and feedback works reliably	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ05_v0.1	Recording instrument	The system should record sound environments for application in experimental conditions (playback condition)	In order to test audio based distraction, different sound levels need to be simulated with one possibility of playing the sound environment back	M	LLT	HW / COM	F	Sound signals should have a good Signal to noise ratio	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio

WP9_TWT_AUT_REQ06_v0.1	Actors for simulation of real background conversation /sounds	Simulation of real conversation situations or real background noise within the car	In order to test audio based distraction, different sound levels need to be simulated with one possibility of using real people for creating a more real situation	M	LLT	COM	F	Pattern recognition can classify data reliably	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ07_v0.1	Eye-tracking instrument	Recording of eye-tracking information as a control measurement for distraction of the driver	Since eye-tracking signals have been investigated in detail during driving tasks, inferences with regard to distraction levels can be drawn quite reliably; thus, this measure can used for a) supporting distraction predictions and/or b) for validating distraction predictions only based on the sound level	L	SI	HW	F	Filtered eye-tracking data can be recorded over larger head-pose ranges	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ08_v0.1	Algorithm for analyses of eye movements	Analysis of eye-tracking information as a control measurement for distraction of the driver	Since eye-tracking signals have been investigated in detail during driving tasks, inferences with regard to distraction levels can be drawn quite reliably; thus, this measure can be used for a) supporting distraction predictions and/or b) for validating distraction predictions only based on the sound level	L		SW	F	Eye-gaze can be related to points in 3D world. Calibration of setup in simulator and car.	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio

WP9_TWT_AUT_REQ09_v0.1	Behavioral pre-studies of planned testing conditions	Analysis of suitability of different testing conditions through evaluations or other "parallel task"-typical double task to assess performance without driving (control conditions)	In order to detect the influence of the different conditions on driving, control measurements need to be assessed; in order to choose the most suitable conditions, behavioral pre-studies should be conducted before testing these conditions with the driving simulation	L/M	DD	PER	F/O	Investigated paradigms must show a significant effect in simulators.	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ10_v0.1	Head Pose Detection/Tracking	Real-Time head pose analysis/ tracking over large pose range, e.g. 3D sensors	Eye-gaze and head pose are potentially correlated. Head-poses can probably be detected over a larger viewing sphere. Speech direction correlates largely with head movements. Potential source for validation and training the audio recognition module	L	SI	SW/ HW	F / O	Measurements device (camera, TOF) can be installed in simulator / car and can process data ideally in real-time	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ11_v0.1	Facial mouth movement detection	Driver's mouth movement activity monitoring. Correspondence analysis, estimation of priors, to enhance driver related distraction levels. Requires analysis of facial movements.	In mixed/shared passenger environments it might be helpful to know the source of the noise level which helps making more specific level between global distraction levels and the contribution of driver's self-involvement in conversation.	M	LLI	SW	F / O	Finding a correlation of driver's mouth movement and driver's audio signal.	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio

WP9_TWT_AUT_REQ12_v0.1	Automatic external context cues, like lane following/ changing behavior	Yields measures for actual driving performance	Distraction events should be gated around various critical driving events.	L	SI	SW	F	Access to internal data-buses of cars with corresponding functionality, of to simulator content.	WP9_AUT_UC1_TWT_v01		Cristobal Curio
WP9_TWT_AUT_REQ13_v0.1	Synchronization of various measurement sources	All required data should come in synchronized in order to relate to the same event in time.	Various data sources are directly related to distraction. Other sources than audio input directly relate to distraction but in combination as well. Driver related (Observations of driver) and driving related information (lane-keeping) can implicitly tag important events and helps learning structured models that adapt to individual driver's profiles. Overall, the rationale is to rely on a rich corpus of data for data mining.	H	AD/ SI	SW	F	All data comes in synchronized with appropriate time-stamp formats.	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_TWT_AUT_REQ14_v0.1	Feedback rendering modality of estimated distraction level	The estimated output level can be used to be integrated with other driving functionalities or as direct visual feedback as level of distraction	The estimated distraction level can be used as a warning signal (thresholds) or as input fused with other distraction level estimators in the context of hazard.	M	SI / V	HW / PER	NF	Predicted warning levels correspond to subjective and quantitative levels of distraction	WP9_AUT_UC1_TWT_v01	TWT	Cristobal Curio
WP9_ATOS_AUT_REQ01_v0.1	Multiple warning management	Different warnings should be shown with a categorized status	Set warnings allow the user identify quickly the information he needs		Detailed design	SW, COM	NF	Setting warnings and showing their results.		ATOS	Nacho González

			to look at								
WP9_ATOS_AUT_REQ02_v0.1	Multimodality	HoliDes system uses multiple modalities to inform the driver	While driving, driver's attention should be focused on the road, not on the information	H	Archit ect. Desig n	SW	N F	Testing multiple modalities to inform the driver (voice, alarms).		ATOS	Nacho Gonzál ez
WP9_ATOS_AUT_REQ03_v0.1	Voice input/outp ut	The driver can interact with the HMI via voice	The driver should be focused in the driving activity	L	Detail ed desig n	SW, COM	N F	Testing the HMI voice recognizing system.		ATOS	Nacho Gonzál ez
WP9_ATOS_AUT_REQ04_v0.1	HMI shortcuts	The user must be able to manually access all HMI functions from any panel	Driver's intuition is the best learning process for the interaction with the HMI	M	Detail ed desig n	SW, COM		Testing the HMI functions manually.		ATOS	Nacho Gonzál ez
WP9_ATOS_AUT_REQ05_v0.1	Updated data	The system should automatically download the most accurate and up-to-date data source	Data sources from external sources can be modified, so up-to-date data is necessary while driving	H	Detail ed desig n	SW, COM	N F	Testing and updating system data in real time		ATOS	Nacho Gonzál ez
WP9_ATOS_AUT_REQ06_v0.1	Backgrou nd running	The system continues working while disconnected and is still able to provide relevant data	Background running is necessary for providing warnings or interesting info for example when entering a tunnel	L	Archit ect. Desig n	SW, COM	N F	Sending information from the system to the vehicles in different situations (e.g. vehicle in a tunnel)		ATOS	Nacho Gonzál ez
WP9_ATOS_AUT_REQ07_v0.1	Disconnec ted warning	The user should be warned when the system operates in disconnected mode	The user should be always aware of the state of the system	L	Detail ed desig n	SW, COM	N F	Test showing the user warnings in "disconnect" mode		ATOS	Nacho Gonzál ez

WP9_ATOS_AUT_REQ08_v0.1	Services platform	The services for different actors should be heterogeneous	Heterogeneous services between different actors (cars, sensors, servers, users) it allows you a best control.	M	Detailed design	SW, COM	NF	Tools for web services tests. Showing information returned by web services, data returned, error messages and others.		ATOS	Jordi Fonoll
WP9_ATOS_AUT_REQ09_v0.1	System Security	Authentication and authorization security, messages encryption	Users profiles, user application and messages in the system ought to be safely	H	Architect. Design	SW, COM	NF	Testing by user and password. Access only with registered user and password.		ATOS	Jordi Fonoll
WP9_ATOS_AUT_REQ10_v0.1	Location vehicles	The vehicles should be localized in a map in real time	Location the vehicles in a map allow you know what it's happening at the moment	H	Architect. Design	SW, COM	NF	Showing a map with the vehicles locations.		ATOS	Jordi Fonoll
WP9_CRF_AUT_REQ1_v1.0	Operative vehicle speed range	The system should be operative for ego-vehicle speed in the range 0÷150 km/h	This is the speed range where the vehicle is intended to be used. However, a smaller speed range can be accepted.	M	AD	SW	O	The system is tested within the range, during the validation phase.	TBD	CRF	Fabio Tango
WP9_CRF_AUT_REQ2_v1.0	Driver switch on/off	It shall always be possible for the driver to switch the system on or off in an easy and quick way	The driver should have the possibility to decide when he/she wants to be supported by the system.	H	AD	SW	O	Inspection	TBD	CRF	Fabio Tango
WP9_CRF_AUT_REQ3_v1.0	Classification of driver's cognitive state	The classifier of the driver cognitive state shall be able to do that with a CR ³ (80÷85)%.	The AdCoS is based on driver's status, so this classification is used for the adaptive strategies	H	DD, V	SW, HW	F	the Correct Rate (CR) is computed, after specific tests	TBD	CRF	Fabio Tango
WP9_CRF_AUT_REQ4_v1.0	System Availability Status	The system shall indicate when the features are not available due to out of range operating condition.	The driver should know if he/she can expect support from the system.	H	AD	SW	F	Inspection		CRF	Fabio Tango

WP9_CRF_AUT_REQ5_v1.0	System Failure Status	The system shall indicate the failure status that it is not available in operating conditions.	Failures can be software or hardware failure.	H				on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ6_v1.0	Risk for collision in straight roads (Forward Collision Warning - FCW), based on a minimum of 2 levels.	The driver shall get audio, visual and haptic feedbacks in case there is a risk for collision in the longitudinal direction.	This warning asks the driver to change current trajectory.	H	AD, DD, SI, V	SW	F	on test-track		CRF	Fabio Tango
WP9_CRF_AUT_REQ7_v1.0	Risk for collision in curves (FCW), based on a minimum of 2 levels.	The driver shall get audio, visual and haptic feedbacks in case there is a risk for collision in the longitudinal direction.	This warning asks the driver to change current trajectory.	M	AD, DD, SI, V	SW	F	on test-track		CRF	Fabio Tango
WP9_CRF_AUT_REQ8_v1.0	HMI for FCW.	HMI shall be appropriate and distinguishable by the driver, with different channels and modes, depending on the internal (state) and external (environment) situation.	Different HMI strategies are required for warning and actuation, depending on drive's state.	H	DD, SI	SW, HW	NF	on test-track on test-site		CRF	Fabio Tango

WP9_CRF_AUT_REQ9_v1.0	Lane Change Inhibit.	When the driver has indicated his/her intention to change lane and there is not a side lane, or there is a side obstacle, or there is an incoming obstacle from the rear on the side lane, the driver should be warned so that he/she does not start the lane change maneuver. Driver's state shall be considered as well.	Driver support in lane changing or lane departure, depending on his/her status.	H	DD	SW	F	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ10_v1.0	Lane Change Assistant (LCA).	When the vehicle aims at leaving the current lane (e.g. for an overtaking) the system shall assist her/him, indicating the right time and moment, taking into account the internal and external situation.	Driver support in lane changing or lane departure, for overtaking maneuver.	H	DD	SW	F	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ11_v1.0	HMI for LCA	HMI shall be appropriate and distinguishable by the driver, with different channels and modes, depending on the internal (state) and external (environment) situation.	Different HMI strategies are required for warning and actuation, depending on drive's state.	H	DD, SI	SW, HW	NF	on test-track on test-site		CRF	Fabio Tango

WP9_CRF_AUT_REQ12_v1.0	The whole system shall provide the following nb of FA: -good => 1/day -acceptable => 1/3hh No MA are considered.	False Alarms (Fas) mean indication when not necessary, that is false positive. Missing Alarms (Mas) mean no indications when necessary, that is false negative.	The system must intervene when needed, but without being too intrusive and so annoying the driver with too many alarms. A tradeoff between false positive and false negative alarms has to be found, also depending on the performances of the sensorial system.	M	V	SW	O	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ13_v1.0	Different HMIs for different functions.	Two separate HMI strategies shall be provided for LCA and for FCW.	Driver has to be able to distinguish between suggestions, warnings and information coming from different functions.	H	AD	SW, HW	NF	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ14_v1.0	LCA with Front Obstacle	When the driver is changing lane in order to avoid a dangerous front obstacle, he/she should be supported in the lane change maneuver.	The goal of this function is to assist the lane change avoiding maneuver, taking also into account the driver's state.	H	AD	SW	F	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ15_v1.0	Braking with Front Obstacle.	When the driver is braking in order to avoid a dangerous front obstacle, he/she may be supported in the braking maneuver.	The goal of this function is to assist the braking maneuver to avoid the collision.	L	DD	SW, HW	F	on test-track		CRF	Fabio Tango
WP9_CRF_AUT_REQ16_v1.0	Single indication.	When the driver is facing at the same time with more conditions that could generate an indication or a warning from the system, only the most	A prioritization is needed between several information, taking into account the driver's state. Simple messages are easier to understand, especially in critical	H	DD	SW	NF	on test-track on test-site		CRF	Fabio Tango

		critical indication should be given to the driver.	situations.								
WP9_CRF_AUT_REQ17_v1.0	Configuration of sensors position.	Position and orientation of sensors mounting on the vehicle can be configured (configuration file) based on the reference perception platform's predefined coordinate system for each sensor.	This enables the possibility for the user of the perception platform to change the position and orientation of the sensors on the vehicle.	L	AD	HW	NF	Inspection Tests		CRF	Fabio Tango
WP9_CRF_AUT_REQ18_v1.0	Programming Language.	The Software shall be implemented in a compiled/interpreted programming language.	Programming languages should be appropriate for the performances required to the platform and to the system. Preference to C/C++ or even MATLAB.	M	AD	SW	NF	NA		CRF	Fabio Tango
WP9_CRF_AUT_REQ19_v1.0	Operating system independence and platform independence.	The perception modules shall be implemented in a programming language which is independent of the operating system (use of cross-platform libs is recommended).	If the programming language depends on a dedicated operating system or hardware platform, it is very difficult to industrialize it later on. If a non-cross platform library is needed this should be agreed later between the development partners.	L	AD	SW	NF	Inspection		CRF	Fabio Tango

WP9_CRF_AUT_REQ20_v1.0	Standardized interfaces.	SW shall have interfaces to the sensor and actuators side that are standardized and published.	Later industrialization as well as EMIC internal cooperation of different hardware suppliers can benefit from published interfaces.	L	AD	SW	NF	Tests		CRF	Fabio Tango
WP9_CRF_AUT_REQ21_v1.0	**Field of View. (Same as IFS).**	The environmental sensors should cover a field of view all around the vehicle (360deg). As for IFS, Blind Spots (BS) around the vehicle should be small enough, such that a vehicle (1.5m wide, 3.0m long) can be detected at a distance of 0.5m in any direction around the vehicle. The detection range for a passenger vehicle should be from 0.3m up to 200m range.	Necessary to ensure a reliable maneuver planning.	H	SI	HW	NF	A vehicle (1.5m wide, 3.0m long) can be detected at a distance of 0.5m in any direction around the vehicle.		CRF	Fabio Tango
WP9_CRF_AUT_REQ22_v1.0	**Object detection and tracking. (Same as IFS).**	The sensorial system shall be able to detect relevant traffic participants (cars, motor bikes, trucks) travelling in the same direction all around the vehicle, only if they are not occluded by other obstacles, up to a range of 150m. The object tracking algorithms shall	The sensorial system has to output tracked and filtered obstacles data (untracked /unfiltered detection data pre-processing, e.g. clustering and removing of distortions, could be realized inside the sensors). Necessary to ensure that preceding, following and overtaking vehicles in the	H	SI	SW	F	Tested by comparison of recorded data against a set of labeled reference data.		CRF	Fabio Tango

		detect, track and classify these traffic participants with a reliability of 95%.	host lane and neighboring lanes are detected, to provide a reliable maneuver planning.								
WP9_CRF_AUT_REQ23_v1.0	**Boundary objects. (Same as IFS).**	The environmental sensors shall be able to detect boundary objects (such as rail guards, fences, trees, cones, reflector posts, …) in a distance of 0.3m up to 150.0m.	Necessary to take into account the road boundary for maneuver planning.	H	SI	SW	F	Tested by comparison of recorded data against a set of labeled reference data.		CRF	Fabio Tango
WP9_CRF_AUT_REQ24_v1.0	**Road markings. (Same as IFS).**	The environmental sensors shall be able to detect road markings (lanes). The detection range is tbd.	Necessary to assign detected objects to lanes and for positioning of the host vehicle in the ego lane.	H	SI	SW	F	Tested by comparison of recorded data against a set of labeled reference data.		CRF	Fabio Tango
WP9_CRF_AUT_REQ25_v1.0	Coordinate system for sensor detections.	The radar should transmit the object position information referred to a sensor located polar coordinate system. Furthermore, each sensor's coordinate system as well as its origin must be known and fixed in order to convert the sensor measurements into a unified coordinate	The origin of the ego vehicle's coordinate system should be decided and fixed. Candidates for this selection are the center of gravity of the vehicle, the middle of the front bumper or another fixed point.	M	AD	PER	F	NA		CRF	Fabio Tango

		system in the perception platform.									
WP9_CRF_AUT_REQ26_v1.0	Position and calibration.	The position of the sensors has to be known, and it has to be calibrated.	Technical solution in detail to be decided later on (transfer of position to sensor necessary, where / how the information is deposited).	L	AD	HW	NF	NA		CRF	Fabio Tango
WP9_CRF_AUT_REQ27_v1.0	Time stamping.	The concept for time stamping is under discussion. If the sensors should delivered time stamped data, they are required to: (1) allow external time synchronization; (2) deliver time-stamped data.	This is especially necessary if different sensors cover the same area. The detailed way the time stamping takes place will be investigated in the specifications phase. This requirement does not state where (sensor or perception) the data should be time stamped. It is unlikely that all sensors can deliver synchronized time stamps.	M	DD	SW	F	Inspection		CRF	Fabio Tango
WP9_CRF_AUT_REQ28_v1.0	Update rate.	The sensorial system shall give an updated object report at a fixed rate.	New object reports need to be generated at a sufficient rate to handle the dynamics of the intended scenarios of the applications. The details will be fixed in the	H	DD	PER	F	Test		CRF	Fabio Tango

			specification phase.								
WP9_CRF_AUT_REQ29_v1.0	ID maintenance.	The IDs of the detected objects should be maintained while object is travelling through the field of views covered by the radar. This is done by the radar tracking system and only applies to this specific output.	Important, in order not to loose the tracked object (which can be confused with a new one, otherwise).	M	DD	PER	F	on test-track on test-site		CRF	Fabio Tango
WP9_CRF_AUT_REQ30_v1.0	Detection of moving and stationary objects.	This feature is needed by different applications with different needs. Some may be only interested in moving vehicles, some others also for stationary ones, etc.	Moving and stationary objects have to be detected. Note that the sensors necessary to achieve that can include more than one type. The general sensorial system should allow the transmission of the following object data: • fixed ID over life time • position • object velocity and acceleration • stationary/moving label • confidence values / quality measures • covariance matrices • forward or oncoming classification (moving objects).	H	DD	PER	F	on test-track on test-site		CRF	Fabio Tango

WP9_OFF_AUT_REQ1_v1.0	Offline parameter and structure learning	The parameters and structure of an initial Bayesian Driver model must be learned offline in order to classify a number of (yet to be defined) maneuvers, maneuver intentions, driving styles, and driving behaviors (e.g. steering wheel angle sequences) .	Since structure learning is computational expensive, offline structure learning is preferred. Furthermore, the use of dedicated datasets for offline parameter and structure learning guarantees a well-defined functionality prior to possible online parameter adaptation.	H	DD	SW	F	Parameter and structure learning will be performed offline using dedicated datasets and machine-learning techniques.	TBD	OFF	Mark Eilers (adapted from Stefan Griesche , DLR)
WP9_OFF_AUT_REQ2_v1.0	Online parameter learning and adaptation	The Bayesian driver model must be able to update its initial (offline) learned parameters using inputs of the driver (steering angle, brake pedal position, throttle position) and available sensor data while driving assisted.	Online parameter learning is mandatory in order to adapt the initial learned Bayesian driver model to a current driver. Methods have to be defined in order to guarantee that the Bayesian driver model does not adapt to unsafe behavior. This could be achieved by only updating the parameters if the available AdCoS did not need to intervene.	H	DD	SW	F	"The functionality will be tested offline by using dedicated datasets and online on the test-track / test-site."	TBD	OFF	Mark Eilers (adapted from Stefan Griesche , DLR)
WP9_OFF_AUT_REQ3_v1.0	Available sensor information	At each point in time, the Bayesian driver model must have access to actuator and sensor information. Actuator information consist of at least: Steering angle, brake pedal position, and throttle position. Available sensor	The Bayesian driver model needs actuator and sensor information in order to function.	H	AD	PER	F	Availability of sensor information will be tested on the test-track / test-site.	TBD	OFF	Mark Eilers

		information must provide information about the state of the ego-vehicle, course of the road and surrounding vehicles and should consist of at least: vehicle speed, angular position of the ego-vehicle in the lane, distance from the lane and Time-to-Lane-Crossing, Distance from obstacles, speed of obstacles, angular position of obstacles, Time-to-Collision to obstacles, and Time-Headway to obstacles.									
WP9_OFF_AUT_REQ4_v1.0	Guaranteed maximal computation time	The Bayesian driver model must be able to return meaningful results after a fixed amount of computation time.	As computation time is limited, the Bayesian driver model must be able to return a meaningful result, even if the computation time is insufficient for exact inference. This can be achieved by the use of approximate inference techniques that can be interrupted to return preliminary results.	H	AD	SW	O	"The functionality will be tested on the test-track / test-site."	TBD	OFF	Mark Eilers

WP9_OFF_AUT_REQ5_v1.0	Guaranteed minimal computation time	The Bayesian driver model must always be granted a fixed amount of time in order to return meaningful results.	Depending on the complexity of inferences, a certain minimal amount of computation time is required in order to produce first meaningful results. The actual guaranteed minimal computation time depends on the complexity of the model and the confidence in the approximation and will be specified during design time.	H	AD	HW	O	"The functionality will be tested on the test-track / test-site."	TBD	OFF	Mark Eilers
WP9_OFF_AUT_REQ6_v1.0	Interface between Bayesian Driver Model an CRF AdCoS	The Bayesian driver model as a separate machine agent must provide an interface for the CRF AdCoS in order to allow access to the following features: Maneuver classification inference, maneuver intention classification inference, driving style classification inference, likelihood of current driving behavior, confidence in maneuver classification, confidence in intention classification, and confidence in intention	Since the Bayesian driver model is defined as a second machine agent it has to be defined how the CRF (and potential other) AdCoS can access the inferences performed by the Bayesian driver model.	H	AD	SW	F	"The functionality will be tested on the test-track / test-site."	TBD	OFF, CRF	Mark Eilers (adapted from Stefan Griesche)

		classification.									
WP9_OFF_AUT_REQ7_v1.0	Maneuver Classification	After an initial offline learning phase, the driver model must be able to classify the currently shown driving maneuver (e.g. lane-following, car-following) with a Correct Classification Rate (CCR) [3] of (80÷85)%.	The AdCoS is based on driver's status, so this classification is used for the adaptive strategies.	H	DD, V	SW, HW	F	The Correct Classification Rate (CCR) will be computed offline by using specific tests on specific datasets.	TBD	OFF, CRF	Mark Eilers (adapted from Fabio Tango, CRF)
WP9_OFF_AUT_REQ8_v1.0	Maneuver Intention Classification	After an initial offline learning phase, the Bayesian driver model must be able to classify the driver's maneuver intention (e.g. lane-change) with a Correct Classification Rate (CCR) [3] of (80÷85)%.	The AdCoS is based on driver's status, so this classification is used for the adaptive strategies.	H	DD, V	SW, HW	F	The Correct Classification Rate (CCR) will be computed offline by using specific tests on specific datasets.	TBD	OFF, CRF, DLR	Mark Eilers, Stefan Griesche
WP9_OFF_AUT_REQ9_v1.0	Driving Style Classification	After an initial offline learning phase, the driver model must be able to classify the currently shown driving style (e.g. aggressive, sporty, ecp, normal) with aCorrect Classification Rate (CCR) of (80÷85)% and provides information about the driver's profile (e.g. mean speed, mean TTC).	The AdCoS is based on driver's status, so this classification is used for the adaptive strategies.	H	DD, V	SW, HW	F	The Correct Classification Rate (CCR) will be computed offline by using specific tests on specific datasets.	TBD	OFF, CRF, DLR	Mark Eilers, Stefan Griesche

WP9_OFF_AUT_REQ10_v1.0	Likelihood of current driving behavior	The Bayesian driver model is able to assess the likelihood of the driving behavior (steering angle, brake pedal position, throttle position) given the current sensor information under the assumption of normative driving behavior.	The likelihood of the current driving behavior can be used as an indicator of potential emergencies. A very low likelihood indicates that the driver is showing non-normative driving behavior.	M	DD, V	SW, HW	F	The likelihood will be computed offline by using specific tests on specific datasets.	TBD	OFF, CRF	Mark Eilers
WP9_OFF_AUT_REQ11_v1.0	Confidence in Maneuver Classification	The Bayesian driver model must be able to provide its confidence in its maneuver classification.	Since the maneuver classification can be wrong and the AdCoS is using the maneuver classification of the Bayesian Driver model, the AdCoS must be provided a mean to assess the confidence in the classification.	M	DD, V	SW, HW	F	Correctness of confidence will be validated offline using specific datasets. Online-assessment of confidence will be tested on test-track / on test-site.	TBD	OFF	Mark Eilers
WP9_OFF_AUT_REQ12_v1.0	Confidence in Intention Classification	The Bayesian driver model is able to provide its confidence in its maneuver intention classification.	Since the maneuver intention classification can be wrong and the AdCoS is using the intention classification of the Bayesian Driver model, the AdCoS must be provided a mean to assess the confidence in the classification.	M	DD, V	SW, HW	F	Correctness of confidence will be validated offline using specific datasets. Online-assessment of confidence will be tested on test-track / on test-site.	TBD	OFF	Mark Eilers
WP9_OFF_AUT_REQ13_v1.0	Confidence in Driving Style Classification	The Bayesian driver model is able to provide its confidence in its driving style classification.	Since the driving style classification can be wrong and the AdCoS is using the driving style classification of the	M	DD, V	SW, HW	F	Correctness of confidence will be validated offline using specific datasets. Online-assessment of confidence will be tested on test-track / on test-site.	TBD	OFF	Mark Eilers

			Bayesian Driver model, the AdCoS must be provided a mean to assess the confidence in the classification.								
WP9_IAS_AUT_REQ1_V1.3	Scenario	The scenario shall be performed in public traffic.	This is required to fulfill the defined use case	M	V	OTHER	NF	-	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ2_V1.3	Scenario: Road Layout	The change in road slope shall be no more than a value that is TBD. The minimum turn radius of the road shall be not less than 200m.	This is required to ensure that the environmental sensors can always find relevant objects and the vehicle is capable to drive the defined manoeuvres in the defined scenario.	H	V	SW	NF	Manual by test engineer	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ3_V1.3	Scenario: Weather Conditions	There shall be no precipitation (rain, snow, etc.), no fog. There road surface shall be dry.	This is required to ensure safe vehicle control.	H	V	SW	NF	Manual by test engineer	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ4_V1.3	Scenario: Traffic Flow	The speed range of all traffic participants shall be in the range from 30km/h to 160km/h. There must not be any stopped vehicles.	This is required to define requirements for the detection of relevant traffic participants.	H	V	OTHER	NF	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ5_V1.3	Automatic Driving: Free driving	The automated system shall be able to bring the vehicle to a requested velocity, maintain the speed as long as there is no preceding vehicle in the ego lane. Also the	This is required to fulfil the defined use case	H	V	SW	F	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling

		vehicle shall keep the lane by lateral control. Constraints for the scenario are defined in the use case description.									
WP9_IAS_AUT_REQ6_V1.3	Automatic Driving: Approaching	The automated system shall be able to adapt the speed of the automated vehicle in case a slower preceding vehicle appears in the host lane.	This is required to fulfill the defined use case	H	V	SW	F	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ7_V1.3	Automatic Driving: Following	The automated system shall be able to adapt the speed of the automated vehicle to a preceding vehicle. The spacing shall be larger than a minimum distance which is tbd.	This is required to fulfill the defined use case	H	V	SW	F	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ8_V1.3	Automatic Driving: Lane Keeping	The automated vehicle shall be keep the vehicle in the lane. At the same time the vehicle shall keep a minimum distance to traffic participants in the neighouring lanes. This distance is tbd.	This is required to fulfill the defined use case	H	V	SW	F	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ9_V1.3	Automatic Driving: Automated Lane Change	The automated vehicle shall be able to change the lane for an overtaking manoeuvre. It shall adapt the speed	This is required to fulfill the defined use case	H	V	SW	F	From environmental detection.	WP9_AUT_UC1_IAS	IAS	M. Krähling

		according to the traffic in the neighbouring lane and maintain a safe spacing to other traffic participants.									
WP9_IAS_AUT_REQ10_V1.3	Vehicle: Sensor data	The vehicle shall provide signals from internal sensors via the CAN bus to the Automated System. These signals shall cover at least (1) the longitudinal vehicle speed, (2) the vehicle yaw rate, (3) indicator status, (4) position of the brake and gas pedal, (5) steering wheel angle.	This is required as input for the automated system to observe the ego motion of the host vehicle and the manual driver activity.	H	SI	HW	F	Manual by developer	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ11_V1.3	Long. Control	The demonstrator vehicle shall be able to be controlled (gas, brake) by the automated system in a speed range from 30km/h up to 150km/h. The accelerations shall at least range from -3.0m/s² up to 1.5m/s².	This is needed to ensure the demonstrator vehicle is capable to perform the required driving manoeuvres.	H	SI	HW	F	Test cases are TBD.	WP9_AUT_UC1_IAS	IAS	M. Krähling

WP9_IAS_AUT_REQ12_V1.3	Long. Control: Driver Override	The driver shall be able to override the automatic longitudinal control at any time. In case the driver applies the brake, the automated system shall turn off for the duration of the manual interaction.	This requirement is necessary to ensure safe operation of the demonstrator vehicle in public traffic situations.	H	SI	HW	F	Test cases are TBD.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_IAS_AUT_REQ13_V1.3	Lateral Control: Lane Change	The demonstrator vehicle shall be able to perform a lane change (lane width of 3.5m) within a time period that is TBD over the speed range from 30km/h up to 150km/h.	This is needed to ensure the demonstrator vehicle is capable to perform the required driving manoeuvres.	H	SI	SW		Test cases are TBD.	WP9_AUT_UC1_IAS	IAS	M. Krähling
WP9_DLR_AUT_REQ1_v1.0	Learning of individual driving behavior	After several manual driven overtaking maneuvers the driver model has learnt the natural driving behavior of the driver.	Since the driver model adapts the preference of maneuvers to the driver a learning phase is mandatory.	M	DD	SW	F	The driver model is done learning when a stable data set is collect. Stable here means new collected data does not significant influence the statistical distribution of the collected data so far. The test of a stable distribution is done by covariance analysis and cross validation.	WP9_DLR_AUT_UC1_v1.0	DLR	Stefan Griesche
WP9_DLR_AUT_REQ2_v1.0	Online learning	The driver model is able to improve stepwise over several overtaking maneuvers its current knowledge of the driver by considering inputs by	Since the driver model adapts the preference of maneuvers to the driver a learning phase is mandatory.	H	DD	SW	F	Simulator study and analyzing subject data and feedback. Less inputs by the driver during the travel as indicator of a increasing system understanding/trust/acceptance.	WP9_DLR_AUT_UC1_v1.0	DLR	Stefan Griesche

		the driver (steering angle, brake pedal position, throttle position) while driving highly automated. The driver model than updates its maneuver preferences.								
WP9_DLR_AUT_REQ3_v1.0	Offering safe maneuvers	Machine agent 1 only offers safe maneuvers and trajectories to machine agent 2 (driver model) as basis of the cooperation/negotiation.	Safe driving in highly automated is a mandatory fact.	H	AD	SW	O	on test track	WP9_DLR_AUT_UC1_v1.0	IBEO	Stefan Griesche