1 Publishable summary

1.1 Project objectives

The objective of AdaptIVe is to develop and demonstrate new functionalities provided by partially-automated and highly-automated vehicles. These applications cover different speed regimes and driving scenarios and aim at improving safety, energy efficiency, dependability and user-acceptance of automated driving. In order to meet this general objective, work in AdaptIVe focus on seven major tasks:

1. Extend the range of possible situations for the application of automated driving

   ● Focus on supervised automated driving in highway scenarios, urban-traffic and close-range manoeuvres.

2. Enhance the perception and communication capabilities

   ● Implement features regarding the sensor platform, communication to other vehicles or to the infrastructure.

   ● Improve safety in potentially dangerous situations by cooperative manoeuvres.

3. Develop solutions for cooperative control addressing driver needs

   ● Ensure continuous interaction between human and automation.

   ● Obtain and evaluate guidelines for implementation.

4. Design and demonstrate resilient behaviour for the applications

   ● Develop fail-safe architecture and an automated function to bring the vehicle on a halt.

   ● Implement support functions according to the infrastructure and driver capabilities.

5. Improve the safety and adaptability of automated driving

   ● Integrate solutions for driver status monitoring.

6. Develop and apply specific evaluation methods

   ● Develop new methods for the technical and the user-related assessments.

   ● Evolve new methods for the analysis of safety and environmental impacts at European level.

7. Provide guidelines on legal aspects

   ● Analyse the legal framework for an introduction of partially and highly automated system into the market.

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● Establish requirements for the safety validation and specifying qualifications for system availability.

1.2 Work performed

Work in the period was focused on the definition and harmonisation of functions, and in particular the finalisation of use cases and requirements. In this way, the consortium established a good basis for the next development of automated driving functions. The vertical subprojects (SP4-5-6) worked especially on the first concepts for the demonstrators, while the horizontal subprojects (SP2-3-7) addressed key issues in the areas of Legal Aspects, Human Factors and Evaluation Methods. The integrated project management devoted efforts to operational aspects, technical management support, external liaisons and dissemination.

The main activities performed in the technical subprojects are as follows:

SP2 Response4: SP2 completed the work on the classification of automated driving levels, with special attention to general criteria for the analysis of on-board functionalities. The basis for the chosen scheme are the SAE definitions. The reference scenarios for the work on legal aspects were finally settled. A first version of the glossary was implemented, with the idea to use this as a working document during the project. SP2 also established relationships with corresponding initiatives in the US, due to the importance of common approaches in the regulatory and safety domains.

SP3 Human-Vehicle Integration: the use case design, as a basis for understanding how the driver and the automated system interact in the specific situations, was concluded and documented. After setting-up a suitable methodology, the work was concentrated on the specification and description of 23 use-cases, which required close interactions with the developers. The use-cases have been conceived also as a means to prepare the following definition of requirements and to enable common approaches. A dedicated workshop has been organised, including test sessions with subjects in a simulated driving environment able to reproduce most of the functionalities under development.

The work on functional Human Factors Requirements started according to the plan with an analysis of the scientific literature and some existing concepts recently presented by OEMs. A structure has been developed for the functional Human Factors requirements which will serve as the basis also for the guidelines for designing the interaction between drivers and automated vehicles. This structure will also be used to define the specification of the demo-vehicles' architecture (SP7). In parallel, a collection of research questions was initiated inside AdaptIVe; in this context, a frame for organising the different topics and to define priorities have been developed, following the same logic as the structure of the functional Human Factors requirements structure . Regarding the evaluation phase, a first set of experiments have been

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carried (simulator studies, surveys and focus group interviews) out by SP3 partners to investigate some of the key issues that were derived from the collection of Research questions. Data analyses and conclusions from the experiments will serve as important input to the functional Human Factors requirements, to the planned experiments and to the HMI development in the demonstration vehicles.

**SP4 Automation in close-distance scenarios / SP5 Automation in urban scenarios /
SP6 Automation in highway scenarios**:
These vertical subprojects contributed to the on-going common activities regarding the legal aspects, classification of automation levels, the research questions for Human-Vehicle Integration and the functional requirements, including the preparation of deliverables. Moreover, they investigated first concepts for the demonstrators, including an analysis of suitable technologies. The work on system specifications started for all the demonstration vehicles and was finalised in Deliverable D1.6. The key topics under investigation were the overall architecture with fault tolerant concepts, sensor technologies and vehicle controls. Some specific on-going studies apply to the mapping of unknown areas in a parking environment (SP4), strategies for perception (all) and cooperative approaches based on V2X communication (all).

SP7 Evaluation: the major activity of SP7 was the definition of the evaluation requirements. A literature review of previous projects related to automated driving respectively transport with was the initial step. The focus of the literature review was on the evaluation methods that had been applied in these projects. The literature review provided the basis for the definition of the evaluation requirements and the definition of the evaluation methodology. The evaluation methodology in AdaptIVe covers four evaluation areas: technical, user-related, in traffic behaviour and impact assessment. The definition of the evaluation methodology started with the formulation of the research questions to the methodology itself. Afterwards the focus of the evaluation for each assessment depending on type of automated driving function was described. The evaluation requirements describe different aspect that have to be considered for the evaluation of automated driving function. Aspect covered by the requirements are among others signals to be logged during the test, questionnaires in order to identify barriers for the testing of the demonstrator vehicle and requirements related to the execution of test like safety aspects and required test effort.

In the subproject **SP1 – IP Management,** work focused on facilitating the interactions among partners, so that common methods of work can be followed in the specification and development processes. Nine SPL meetings have been chaired in the period, to check the status of technical activities and discuss on general topics regarding administration, dissemination and project work.

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In the period, SP1 has been highly engaged in contacts with external institutions, networks and projects, due to the growing interest rising worldwide for automated driving.

The following activities can also be highlighted:

- IP management: preparation and conduction of the kick-off meeting, set-up of the collaboration tool and on-line document repository, IP process handbook, establishment of the Technical Expert Group, delivery of progress report, preparation of first amendment, maintenance of project archive and collaboration tool.

- Technical Expert Group: support in the definition of functions and use cases, coordination and editing for D1.5, peer reviews of deliverables, overview for V2X communication.

- Dissemination: work on the definition of a dissemination strategy, developing a dissemination plan. Development and continuous update of the project website and project factsheet. Definition of project corporate design.

- Conferences: participation to several workshops and events, in particular the ITS European Congress.

1.1 Results achieved so far

The following main results have been obtained in the period.

- Framework for the development of the AdaptIVe functions in the different scenarios and with different levels of automation; assignment of the functions to the demonstrator vehicles

- Detailed definition of use-cases, including the main flow of events and possible alternative flows.

- Definition of functional and operational requirements, followed by initial system specifications.

- Basic design choices for demonstrator vehicles and related equipment.

- Progress in the analysis of legal aspects and establishment of a classification scheme for automated driving and parking, including reference scenarios for the study of legal aspects.

- Glossary and definitions of key terms.

- Analysis of the state-of-the art on driver-vehicle interactions for different levels of automated driving.

- First set of research questions to be addressed in the experiments on Human Factors.

- Definition of evaluation requirements (internal-report i-6); groundwork for the AdaptIVe evaluation framework.

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- Dissemination of project ideas at several national and international events (including: ITS Europe-Helsinki, Automated Vehicle Symposium-S.Francisco, ITS World-Detroit).