ADASE

Advanced driver assistance systems in Europe

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0.1	12.12.03	Initial template by IMC
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Project overview

The preparation of the market introduction of Advanced Driver Assistance Systems (ADAS) requires a holistic process and therefore all major players in the ADASE 2 environment have been involved. The working structure of ADASE 2 has been established as a thematic project network.

Together with transport authorities, road providers, E&S industry and automotive industry five workshops on the key areas of importance in the deployment of ADAS were organised.

The cluster management guaranteed the strategic alignment with the ADASE roadmap. With the help of regular concertation meetings access to experts was established and a bi-directional flow of information and feedback was achieved. An effective network between the different running or upcoming cluster projects has been established. The preparation of standards, legal and liability issues have been discussed and harmonised in close contact to EUCAR, CLEPA, ERTICO, political bodies and organisations active in neighbouring fields. By analysing the ideas generated within the expert workshops, future needs regarding technological, societal and economic aspects were be identified and activities have been formulated to fill in the gaps.

From the Expert Workshops also the communication and dissemination strategy was be de-rived. By use of different media such as web, newsletter etc. the gathered information has been made available for all users of ADASE 2 community.

1 Project objectives and approach

Efficiency of transport is a prerequisite of economy and human activities. It has to be sustainable with regard to ecology and quality of life. ADASE II investigates the future path for active safety with advanced transport systems. Advanced Driver Assistance Systems (ADAS) are concepts to improve transport safety, efficiency and comfort without additional loads on resources (energy and land use) or on environment and quality of life.

The main objectives of ADASE II are to use the state-of-the-art knowledge to generate corresponding road maps and guidance, to facilitate the information exchange within the cluster of projects related to ADA systems and transport, to organise in-depth expert workshops on selected topics and to disseminate the resulting findings and information to all relevant users and user groups and the general public.

Within the cluster management the information exchange between relevant running and upcoming projects was guaranteed. In the three annually ADASE cluster meetings access to experts in the related projects was established and the bi-directional flow of information and feedback was attained. Furthermore the meetings facilitated the exchange of ideas, scientific/technical approaches in an informal environment. Also we should not underestimate the benefits of the established networks. They also helped in creating a "community of European experts". To achieve acceptance of these actions a targeted approach was followed, which involved the projects and provided them with clear benefits from participation.

The preparation of the market introduction requires a holistic process and therefore all major players in the ADASE II environment had to be involved. Together with transport authorities, road providers E&S industry and automotive industry ADASE II therefore organised five workshops on the key areas of importance in the deployment of Advanced Driver Assistance Systems. These are:

- Human machine interaction and interface (HMI),
- Architecture and technology roadmap,
- Road infrastructure design and road-vehicle, vehicle-vehicle communication systems,
- Sensor technologies,
- Effects on safety, throughput and comfort (presentation of preliminary effects).

ADASE II prepared the workshops by providing input from the state of the art studies, road maps and architecture. In the workshops the requirements were derived and the gaps towards the implementation of ADASE were detected. By analysing the ideas generated within the expert workshops, future needs regarding

technological, societal and economic aspects were identified. In addition the ADASE objectives were harmonised with respect to political bodies and organisations active in neighbouring fields. Also the preparation of standards and possible legal and liability issues are discussed in close contact to EUCAR, CLEPA and ERTICO. Further links to the eSafety community were established. From the expert Workshops the communication and information dissemination strategy was derived.

The generation of public and political awareness in the functions, performance and efficiency of ADASE II is mandatory. By use of different media such as web, newsletter etc. the gathered information was disseminated world wide and be available for all of the possible users of ADASE.

ADASE II combines new vehicle technologies and innovative vehicle control with telematic links to traffic management centres, other vehicles, and service providers. ADASE II is a thematic network on Active Safety and Driver Assistance Systems. The project aims at co-ordinating, enhancing and further disseminating the research activities at national and international level in these fields.

As a consequence an active safety standard will be reached, which not only minimises collision causes but also prevent accidents to happen. With the introduction of such technologies a significant decrease in accidents is expected all across Europe.

However, experience from the first phase of ADASE has shown that obstacles in the implementation of these innovative systems are to be expected in non-technical areas. Public awareness, focussed initiatives for technology development, preparation of standards are needed for an early market introduction.

1.1 Summary of the main achievement

ADASE 2 (Advanced Driver Assistance Systems in Europe) as an EC IST funded thematic network eases the introduction and implementation of Active Safety systems.

The major project milestones coincide with the expert workshops on:

- Human machine interaction and interface
- Architecture and technology roadmap
- Road Infrastructure design and road-vehicle, vehicle-vehicle communication systems and applications,
- Sensor technologies
- Effects on safety, throughput and comfort (presentation of preliminary effects).

It prepares the baseline and offers the following mile stones towards a common view and global architecture:

- Creating public awareness and foster the ADASE community; ADASE as “brand name” by organising ADASE Cluster meetings;
- State of the art, state of practise and -policy studies worked out by an interdisciplinary ADASE team;
- Identification of further needs and gaps via five Expert workshops in the fields of :
- Further needs for the human machine interface,
- Architectural and standards prerequisites,
- Sensor essentials,
- Communication between the vehicles as well as between vehicles and infrastructure,
- Analysis and evaluation on impact and efficiency of ADASE functions in a political context,
- The functional road pap dependencies serve as guide line for future work and gap analyses;
- Building up a harmonised multidisciplinary road map as a guide and framework for the overall ADASE environment.

The achievements clearly demonstrate a solid basis ready to be interfacing with the upcoming co-operative systems!

1.2 Description of work

The preparation of the market introduction of Advanced Driver Assistance Systems (ADAS) requires a holistic process and therefore all major players in the ADASE II environment have to be involved.

The working structure of ADAE II was established as a thematic project network. The completeness of the partners was guaranteed by selection of the core team as well as the invitation of additional sponsoring partners.

Together with transport authorities, road providers, E&S industry and automotive industry - the core team organised **five workshops on the key areas of importance** in the deployment of ADAS.

Within the **cluster management** the strategic alignment with the ADASE roadmap was guaranteed. In the concertation meetings access to experts was established and a bi-directional flow of information and feedback was achieved by the set up of this network between the different running or upcoming cluster projects. The preparation of standards, legal and liability issues were discussed and harmonised in close contact to EUCAR, CLEPA, ERTICO, political bodies and organisations active in neighbouring fields.

By analysing the ideas generated within the expert workshops, future needs regarding technological, societal and economic aspects was identified and activities were formulated to fill in the gaps. These finding were also input to new upcoming FP6 projects.

From the Expert Workshops also the communication and dissemination strategy was derived. The generation of **public awareness** in the functions, performance and efficiency of ADASE II was mandatory. By use of **different media** such as web, newsletter etc. the gathered information was available for all of the possible users of ADASE II. On all important and relevant conferences ADASE was presented and the feedback were positive!

1.3 Approach followed to achieve project objectives

The ADASE project was following the **holistic approach**. As one important outcome from ADASE 1 - deployment workshop the non technical barriers were identified as the main obstacles towards the accelerated introduction of ADASE!

- So in this context **all of the major stakeholder** in this field had to be involved **in the core team**!
- The focus of the **project must not be limited on technical issues** but had also to take in account the legal, societal, regulatory and political topics.
- Due to the innovative quality of ADASE an intensive promotion of the ADASE functions has to be established – Develop the fragmented technological scene forwards to **a strong European main stream as Corporate Identity ADASE** .

The **organisational approach** was to collect the state of the art, discuss and synchronise the results with running projects in the concertation meetings and expert workshops and initiate by use of the **cluster management** further actions and plan the dissemination.

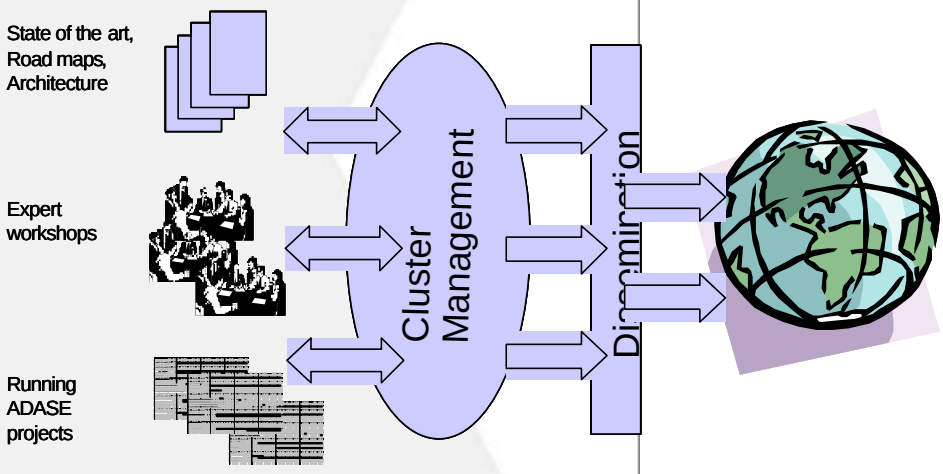


Fig. clustermanagement

The **promotion activities** were established by use of different media such as **printed flyers, news letters, web sites and of course by active participation in all important relevant conferences**.

1.4 Consortium composition and roles

Under the co-ordination of DaimlerChrysler the ADASE 2 consortium combined the extensive knowledge of leading European car manufacturers, vehicle component manufacturers, traffic institutes, road operators and governmental bodies. Due to the interdisciplinary character of ADASE all of these mayor players in the field had to be involved in this project an actively take part in the activities.

In the activity area for political and public awareness RWS and CETE established the links to and the consideration of public inputs. Also the access to different traffic modes are taken in account.

One of the driving forces for traffic safety and efficiency on motorways are the road providers. Cofiroute formulated the infrastructure requirements coming up from the road operator perspective.

Enabling technologies represent the prerequisite for advanced driver assistance systems and thus ADASE 2. CLEPA as the E&S industry association acted as a harmonisation platform for the European suppliers in the ADASE 2 environment to provide the suitable technologies.

The European car manufacturers (BMW, Centro Ricerche Fiat, DaimlerChrysler, Jaguar, PSA and Renault) including their research organisation EUCAR are the driving forces for the ADA functions and onboard architectures in ADASE 2. Here safety, comfort and efficiency for all of the traffic participants played the most important role!

2 Project results and achievements

2.1 State of the art, road maps and requirements

The objective of the work package was to provide a common framework for the deployment of ADAS. This work package analysed the state of the art and to further expanded the ADASE road map as developed in the predecessor project ADASE 1.

In the different areas the state of: -the art, -practise and -policy was investigated and the appropriate needs derived!

The work in the state of the art in addition with the expert work shop results enabled the group to update the road map.

2.1.1 State of the art of ADASE

The objective of the state of the art is to provide an update of the state of the art of Advanced Driver Assistance Systems and to study Advanced Transport Systems in Freight and Public transport. The state of the art does not additionally focus on the status of the technology, but it attempts to contribute to the insight in the developments of the functionalities in Driver Assistance Systems. Subsequently also an intercontinental comparison has been done.

Within the project the State of the Art serves as a basis for other work packages dealing with technology, implementation, policy and technology roadmap development. Externally it can be used in communication actions to stimulate and coordinate R&D and implementation actions.

The information in the State of the Art is gained through the ADASE-II consortium, analysis are performed on characteristics of the research and development projects.

The information used in the State of the Art has been obtained from a survey among members of the ADASE-II consortium and has been restricted to 37 R&D projects on ADA related systems for road transport, for passenger cars, freight transport and public transport. The projects are characterised by the functionality of the system, the focus of the research (technology, HMI, etc.), extension of overtake of control (advisory vs. fully automated), vehicle type (passenger cars, public transport), project type (desk research, demonstration, etc.), stakeholders, implementation status, main objective (safety, throughput, etc.), and the applicable road network.

From this survey it was observed that most projects do not focus on one or more specific ADAS functionalities such as safe speed or pedestrian protection, but instead pay attention to a whole range of

functionalities. Figure E1 presents the number of projects focussing on general ADAS or a specific ADA functionality versus research areas such as HMI or technology development.

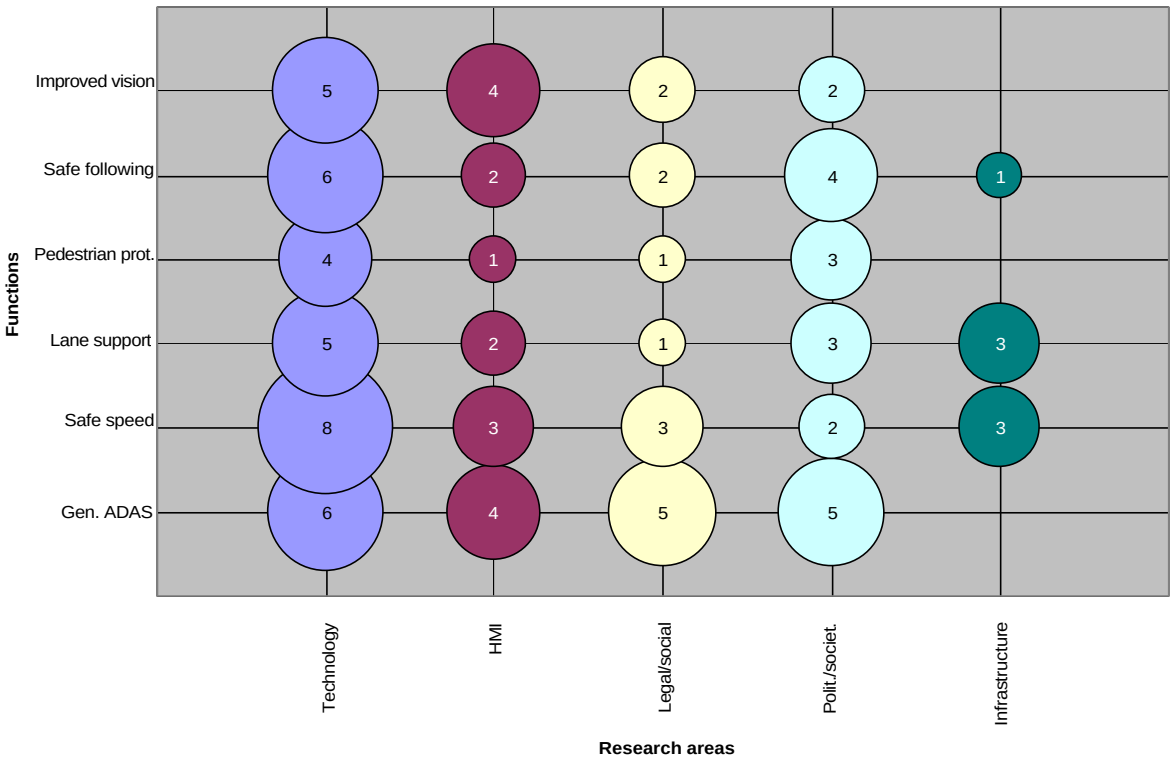


Figure E1: Functions per research area

The emphasis is clearly on technological development. It was also observed that most projects are demonstration type projects in which certain technologies are demonstrated. In all projects, governments (European or national) belong to the stakeholders. Car manufacturers and suppliers of ADAS are also widely involved, while universities and research institutes participate in half of the reviewed projects. Most attention is paid to advisory systems, only 1 project (CyberCars) focused on fully automated vehicles. The main objective of most projects is to increase safety. Increases in throughput, environment or comfort are pursued much less often.

From this State of the Art it can be concluded that safety has become the main motivation for R&D into ADAS in the EU. In this respect, safety has to be understood in a holistic sense in which attention is paid to a variety of safety aspects, such as pre-crash safety or pedestrian safety. When compared to the State of the Art performed in ADASE-I, there is an increasing interest in the technological development of systems for the detection, perception and interpretation of infrastructure and other (vulnerable) road users. Worldwide there is a sustained interest in R&D of ADA systems. Co-operative road-vehicle systems and vehicle-vehicle systems are also emerging worldwide. Finally, since 1998, several commercial ADAS applications have entered the market, such as Adaptive Cruise Control and Lane Departure Warning.

The state of the art will be used in combination with other reviews on state of practice and policy to identify main streams and issues concerning the deployment of ADA systems. Key findings more in detail are:

- Safety has become the main motivation for the R&D and implementation of ADA systems. In this respect, safety has to be understood in a holistic sense in which attention is paid to a variety of safety aspects, such as pre-crash safety or pedestrian safety. Systems focus both on the reduction of the possibility of the accidents and the reduction of the severity of the injuries of the driver and the other road users. These motivations can also be found in the State of Policy (ADASE-II Deliverable 2C).
- Concerning functions and research areas, there is an increasing interest for the development of enabling technologies for detection, perception and interpretation of the infrastructure and other road users. In particular there is an increasing interest for the detection of vulnerable road users. This indicates an increased awareness for the safety around the vehicle.
- In the development of the ADA systems, effects the on the traffic system (seen in throughput), the environment and comfort play a minor role. This indicates a white spot. This white spot could become an issue for the governmental bodies and road authorities in their decisions to stimulate the introduction of ADA systems.
- Worldwide there is a sustained interest in and R&D into ADA systems; this means that there will be adequate knowledge available for the implementation of these systems.
- Several applications that were in a R&D phase in a previous review in 1998 are now commercially available, such as Adaptive Cruise Control, Lane Departure Warning, and automated public/collective road transport. These applications can be the “icebreakers” for other applications; more people get familiar with and interested in ADA systems. Moreover they will learn to use these systems. This can accelerate the introduction of new applications.
- Cooperative systems are emerging worldwide, both cooperative in a vehicle, between vehicles and between vehicles and infrastructure. This supports the need for standardised communication and a worldwide architecture to enable global cooperation in the developments of ADA systems. Moreover, this implies that more cooperation between car manufacturers and road authorities is required to enable vehicle-to-infrastructure communication.
- It is seen that many different kind of partners – like governments, universities and car manufactures - are involved in the development of ADA applications. This indicates a broad support of these developments.

- Compared to the previous State of the Art (performed in the ADASE I project) it is seen that the attention for research and demonstration of fully automated passenger cars has significantly decreased; to a certain extent the technological feasibility has been shown, but the barriers to deployment are large. Liability, heavy infrastructure investments and unsure user acceptance (especially concerning platooning) could be the main reasons for that.

2.1.2 State of practice of ADASE

Inside the Project an analysis has been performed about the Advanced Driver Assistance Systems that have been introduced on the market.

As a first step, a collection of information has been done about the market products using a form that was distributed to partners. The compilation of the information lead to an overview of the functionalities available on the market and to the definition of common trends related to market introductions.

These common elements are summarised in the points below:

- ***introduction of ADAS usually starts from luxury cars or trucks***

This is the entry point, then the introduction is expanded gradually to medium level cars.

- ***ADAS are usually available as optional, safety features can be given as standard equipment on some model version***

In some cases, ADAS are sold as after market, at least in a first introduction phase; this introduction path corresponds usually to more simple systems that can be easily added on the vehicle.

- ***ACC is the most common system***

However, safety systems (in particular lane departure warning) are increasing their role on the market.

- ***market penetration is low but increasing***

Market introduction of ADAS is in its initial phase. ADAS are however increasing in number of equipped vehicles and functionalities, and are expected to play an important role for safety related features, that as we have seen are introduced as standard equipment on some models.

- ***market introduction is not following a common linear flow***

ADAS are being introduced by OEMs in different market areas with different strategies testing customer reaction.

- ***integration between different systems is expected***

In the near future integration is expected with sharing of sensors for multiple functions. This approach has already been initiated.

The results of this task are described in the deliverable D2B “State of Practise”.

2.1.3 State of policy of ADASE

2.1.3.1 Features of the national policies

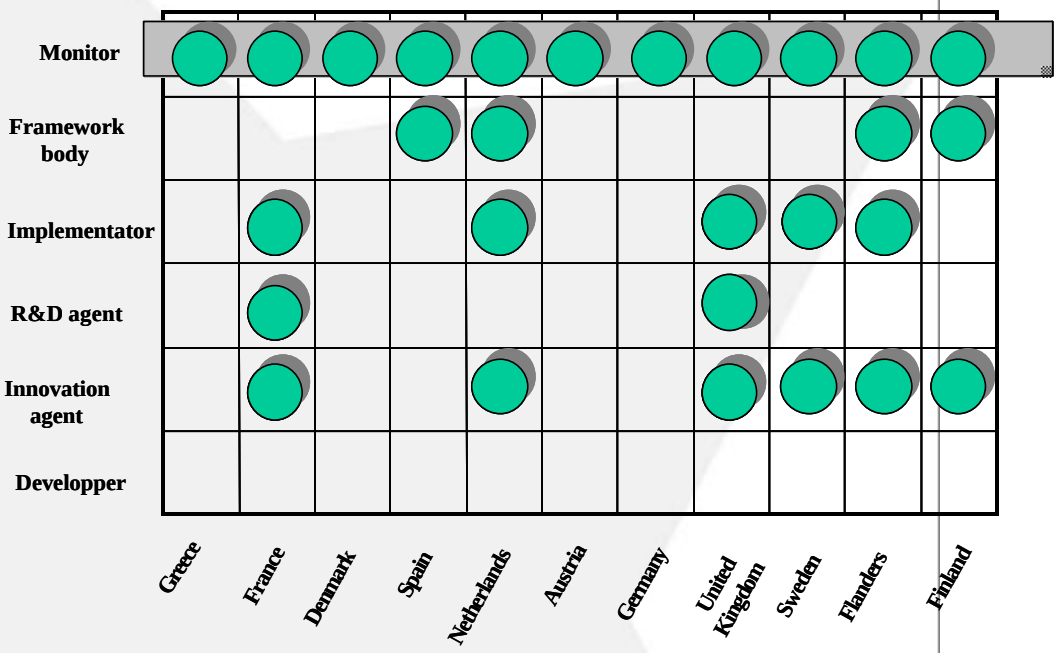


Figure 1: research policy roles

Two main types of policy can be distinguished:

A monitoring policy: these countries do technological watch and are waiting for tangible results before to invest in ADAS.

A few countries are more proactive and have in particular invested in Intelligent Speed Adaptation projects (UK, Sweden, Netherlands, Flanders, France)

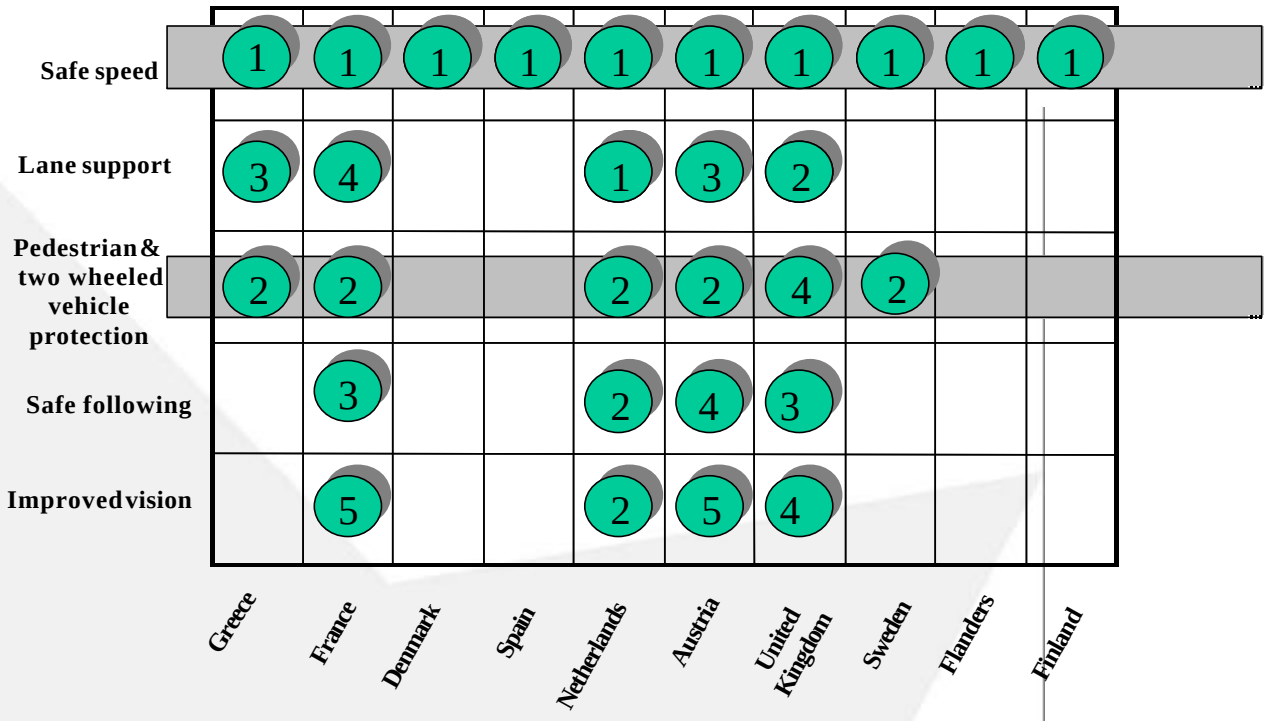


Figure 2: Priorities of the research currently conducted or to be conducted.

As can be seen in figure 2, the main fields of interest for the public authority are Safe speed and Pedestrian & Two-wheeled vehicle protection.

It is not a surprise, as intelligent speed adaptation (ISA) has been tested in pilot projects in France, Flanders, the Netherlands, Sweden and the U.K.,

2.1.3.2 Recommendations for national governments on improving implementation of ADA systems

Advanced Driving Assistance Systems deployment does not systematically call for a priori intervention of national governments. However, if for example the members states and public authorities in general want to avoid an uncontrolled proliferation of embarked applications such as internet access and office workplace, which are likely to augment drivers' distraction and go against road safety objectives, they will need to intervene according to an established policy.

- Following are the proposals brought forth in the ADASE2 project and the survey for how national governments can improve opportunities for the successful implementation of ADAS policies. Establish a supportive national policy framework

Develop a national policy framework for ADAS systems that supports and influences national goals – and local goals in the case of strong decentralization – as well as car manufacturer objectives, and user needs and acceptance of the system.

It is important that this national policy framework be “internally coherent”, i.e. within the road safety sector, integrating infrastructure investment, traffic management and road operation policy, and “externally coherent” integrating road safety policy and policies in other sectors such as legal, finance and environment.

In their policy framework, governments should define their priorities with respect to system deployment.

- Improve institutional coordination and cooperation in the field of ADAS

The ADA domain calls for a global approach and for a strong co-operation between the various ministries and institutions concerned.

In particular, co-ordinated management of infrastructure, environment, safety, and economics is necessary so as to reach the whole strategic political goals.

Moreover, a vertical co-ordination between the national and local levels is essential to proper ADAS deployment.

In particular, as ADA systems will need more and more to interact and exchange information with the infrastructure, this vertical coordination will beincreasingly important, as most of the road infrastructures are managed at the local level.

- Encourage effective participation of all stakeholders, partnerships and communication

Involve users (e.g. the media, associations, etc.) in the upstream definition of ADAS deployment strategies so as to ensure better acceptability. End-users also need to participate early on in the test phases, such as HMI validation.

It is clear that proper ADAS deployment requires more than a governmental approval. Changes of driving attitudes and more generally of user relation towards the vehicle are to be taken into account; this will necessitate to involve all concerned stakeholders, more and better than they are today.

With respect to this important point, questions to be addressed shall include:

- users' views on usefulness or necessity of the proposed ADA functions
- HMI design
- understanding of ADAS functions and usage by the users
- anticipating of other (ADA equipped or not) drivers and users

A strong partnership with the car and in-car equipment industry will also be essential so as to reach a consensus on ADAS goals and policy (i.e. roadmap), and on the functions to be deployed in priority.

As a general fact, a key point for a successful deployment will be to communicate and inform about ADAS, what they do, what they bring to the end-users and potentially also to the authorities. National governments should leverage education about these new driving aids and secure the support of the general public and the local decision makers

- Provide a legal and regulatory framework

A legal and regulatory framework that provides guidelines for government action on all levels and involvement of the automotive industry is essential for effective implementation of ADAS policies.

- Provide fiscal and financial support

The governments could fund focused R&D actions complementary to the private research programmes.

They could also take fiscal measures so as to foster systems that have proven their benefits in terms of safety.

- Provide safety indicators

Elaborate performance indicators with respect to road safety would enable proper system evaluation.

- Provide suitable infrastructures

Governments should support the adaptation of infrastructures that could co-operate with future in-vehicle ADA systems. A sound upstream design of road-vehicle interactions could ease early deployment of innovative systems

2.1.4 Integral deployment Road maps and review

The roadmap of the ADASE2 project shows the future research activities of Advanced Driver Assistance Systems in Europe. The derived matrix reveals the complexities of the technological, societal and legal aspects related to the various systems. The contribution to the guessed safety enhancement is mentioned. Thus, technological gaps and future research needs can be identified in the given overview.

To reach the goal of an up-to-date roadmap, the previous ADASE1 approach is extended in many other aspects and the systems are adapted. In order to ensure actuality, different sources of information were included.

The concertation meetings of ADASE 2 are such an important source to collect data about the newest developments in the European research activities. (ADASE2 Deliverables D4A – D4C) Further on, the knowledge discussed in the expert workshops on the various themes are taken into account. (ADASE2 Deliverables D3A – D3E) At least the discussions between the ADASE partners and especially the specialists, who are involved in the most research projects funded by the EC and various other e.g. national funded projects, lead to an overall view of the research activities of the field of driver assistance systems. The project results concerning the state of the art and the state of practice are included into the reflections, in order to get a broad background of knowledge. (ADASE2 Deliverables D2A - D2C) The roadmap development process itself is explained later on in detail.

Thus, the most important aspects of driver assistance are taken into consideration. These aspects are not only focussing on technological topics. The relevant aspects, which were identified, are:

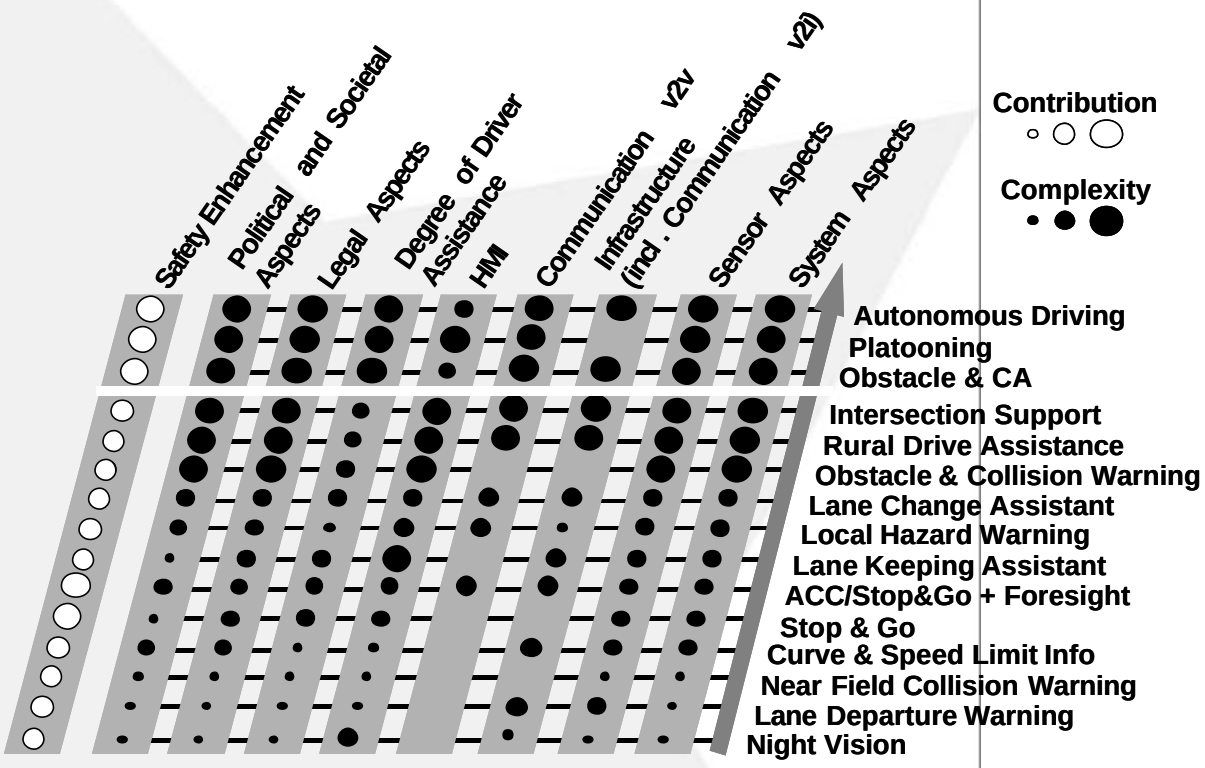
- System and system algorithms,
- Sensor,
- Infrastructure (including Communication between vehicle and infrastructure),
- Communication between vehicles,
- Human machine interface (HMI),
- Degree of driver assistance,
- Legal aspects,
- Political and societal aspects,
- Safety enhancement.

These aspects are stated beneath in detail.

In order to estimate the importance of the listed aspects for the different ADAS, the complexity concerning the demands is shown in the adapted ADASE2 roadmap.

This approach allows a holistic view on the correlation of the listed aspects and selected ADAS. Thus, the stakeholders of different disciplines are able to identify the future needs of their working areas.

The resulting overall roadmap is shown in the following figure.



Picture x: ADASE2 roadmap.

In each case the complexities of the systems concerning these aspects are shown by the size of the dots. The size of the dots is classified in three steps. Thus, it becomes clear that complex systems with a high need for further research activities can be identified by an accumulation of big dots.

The overall consideration of all these aspects and the functionality of the systems should lead to an assessment of the estimated safety benefit.

It has to be stated, that this ADASE2 approach is a research related roadmap. The order of the shown systems is established regarding the research stages. The last shown systems (Obstacle and Collision Avoidance, Platooning and Autonomous Driving) are displaced, because they are visions, which cannot surely be realized in the future on normal roads.

2.2 Expert workshops

The objective of this work package was to take up the results of State of the Art and to discuss and expand the contents at an expert level in dedicated workshops. So the consultancy of a Europe wide network was established.

2.2.1 Human machine interaction and interface

The workshop on Human Machine Interaction and Interface, held in Brussels on October 28th 2002, has been organized by Centro Ricerche Fiat and it has been hosted in the facilities of the European Commission.

The objectives of the workshop were to identify the research needs in the area of Human Machine Interface for Advanced Driver Assistance Systems (ADAS) and to identify technical and scientific gaps to be filled with respect to the current and expected R&D activities in this field.

Using the technique of the brainstorming, research needs in the area of HMI have been collected from the participants and then clustered. The experts attending to the workshop, more than 30, gave their input on stickers about the following question: "**Which are the research needs that have to be addressed for the introduction of driver support systems in order to increase traffic safety?"**

The answers were then organized in order to identify main clusters. The three main clusters that have been identified this way indicate clearly the needs within three relevant steps of the HMI research and development:

- ✓ the design and the integration phase (where an HMI is designed, developed and integrated into the vehicles);
- ✓ the evaluation phase (where the methods to assess both the usability and the acceptability of an HMI are applied);
- ✓ the supporting measures (which are related to the actions according to which the laws, the standards, the code of practices, etc. can tailor and handle the HMI design, development and test phases).

The collection of these needs has then be considered within the initiative to build a Human Machine Interface Integrated Project (AIDE, coordinated by Volvo), that has then been submitted and approved as IP.The procedure adopted, the results of the workshop and the identified needs are described in deliverable D3A "Report on Expert Workshop on Human Machine Interaction and Interface"

2.2.2 Infrastructure design, and road-vehicle communication systems and applications

On February 5-6 2003, the third workshop of ADASE II took place in Paris, France. The topic of the workshop, organized by Cofiroute, was Vehicle to Vehicle, Vehicle to Infrastructure communications and the related applications. The objectives of this workshop were:

- Present the state of the art of:
  - Current communication technologies
  - Possible Architectures
  - Possible Services and Applications
- Establish the needs of Advanced Driver Assistance Systems (ADAS)
- Determine future actions and co-operative measures

The following conclusions were drawn:

- Applications providing informational content such as AIDA and RTA are foreseeable in the near future. Probably based on DSRC (which benefits from the strong standardization and interoperability effort that have been made recently), these early cooperative driving systems will attempt to increase the driver's awareness, and therefore anticipation, or the road conditions. The AHSRA concept in Japan will also provide active content and continuous communications over a large zone.
- The widespread use of global positioning system (GPS / GALILEO) is also another foreseeable trend. Also satellite broadcasting services will be deployed all over Europe.
- Cooperative ADAS probably needs more maturing. Some interesting technological breakthrough have been made with the appearance of high data rate medium and long range communication medium adapted to high speed mobile applications. Standardization of the communication media, protocols, behaviours and the development of a common telematics platform are precursors to many commercial telematics applications. The development of CALM is a major step in this direction.
- The legal framework for many of the active (directly effecting vehicle functions) driving assistance system, such as speed management or blind merging, is too uncertain for these systems to be realized any time soon.
- The work to be completed is mostly one of standardization and mutual agreement amongst the different parties involved on the use, behaviour and dissemination of these systems.

Based on these conclusions is the following white spots and needs were identified:

Standardisation needs

- The communication medium, to ensure that all vehicles and infrastructure can communicate together
- The behaviour of the communication, to prevent the saturation of communications
- A dictionary of traffic events and conditions, to ensure the right treatment by all systems.

Actions

- Set up a co-operation between ADASE and CALM
- Extend the roadmap for communication systems
- Standardise the inter vehicles communication
- Develop a business model prior to market introduction
- Focus on legal issues.

2.2.3 Sensor technologies for advanced driver assistance systems

Industry is committed to support the European Commission in reaching their ambitions objective of cutting the number of road victims by half from today's approximately 40.000 per annum until 2010. Advanced technology will help to implement the functionalities required to reach that goal.

The aim of the ADASE expert workshop on Sensors & Actuators Technologies was to get an overview on presently available systems and the future trends.

The contributions from all those involved to this workshop demonstrated impressively, that enormous efforts are taken throughout the whole supply network and the OEM's to

- **develop new technologies, which support the functions needed;**
- **overcome obstacles and bottlenecks to market introduction;**
- **strive for customer acceptance and the most appropriate regulations.**

Strong focus was laid on optical sensor technology and systems, the functionalities which they support, and the sensor data fusion leading to HMI issues. A novel actuator technology was presented with the capacity to reduce requisite motors by 50%.

Actual achievements in technologies were presented, limits and problems discussed openly, bottlenecks and obstacles mentioned, as well as possible road maps for market introduction identified.

Both an encouraging political address from a vehicle manufacturer, as well as a competent final round table discussion complemented the technological contributions from the automotive suppliers.

Close to 60 experts active in the respective fields participated at the workshop.

2.2.4 Presentation of architecture and technology road map

The first expert workshop of ADASE II was organized by PSA.

On behalf of the ADASE- consortium, this Meeting has taken place on the 20th of March, 2002, from 2:00 pm. to 7:00 pm and on the 21th of March, 2002 from 8:30 am to 2:00 pm, at NOVOTEL PARIS TOUR EIFFEL hôtel.

The aim of expert workshops of ADASE2 project was to join car manufacturers, operators of mobility and communications together, in order to discuss, harmonise and initiate activities in the field of advanced driver assistance systems.

The Architecture and technology roadmap workshop had to investigate the main factors which we can consider to establish a precise description of services and systems which will be necessary to achieve future ADAS products.

The objective were harmonisation and approval of roadmap and architecture as well as the evolutions of the future needs in this area.

The first day proposed two sessions in parallel:

- ✓ A technical session focused successively on actual vehicle architecture concepts and embedded communication components.
- ✓ A global session dedicated to societal aspects by an inventory of limiting factors which limit ADAS functions deployment and after the technological offer provided by the telecommunication networks and services.

As a result of this first day, and discussions between participants, it appears that the actual scene is fragmented :

- ✓ There are only a few running ‚architecture' projects, which work on specialised topics (example EAST, CarTALK, etc.)
- ✓ Need the overall encompasing architecture
- ✓ In fact a mixed top down and bottom up approach (Yo-Yo approach)
- ✓ Refine overall architecture

Possible actions :

- ✓ Initiate a task force to develop a first overall view of a general ADASE architecture (first instances in each layer)
- ✓ Do that in co-operation with the relevant experts (ERTICO, EUCAR, CLEPA, ...)

- ✓ Check ISO working groups for approaches regarding architectures, interfaces between layers, protocols etc. What is already there (for example VEESA)
- ✓ Formulate the needs for projects?
- ✓ Use outputs of the follow up workshops (Infrastructure, sensors, legal & HMI, throughput and comfort).

The second day proposed three experiences to illustrate infrastructure deployments :

- ✓ Aims of Foresight Vehicle Technology Road mapping Project in UK
- ✓ The new A86 tunnel as an innovative design, for research and development of telematic networks to promote safety and quality customer services.
- ✓ The specific ADAS functions in the aircraft transports as a possible model for future automotive transports systems.

Thru the different participants point of views, it appeared that it is very important to standardise or to propose different solutions concerning the interface between the vehicle and the outside world.

To reach this goal , it is necessary to create a reflexion group with European experts concerning the standardisation about the interface between the vehicle and the outside world .

Concerning standardisation of onboard architectures actions are in progress now.

2.2.5 Effects of ADA systems on safety, throughput and comfort

On May 17-18, 2004 the fifth and final workshop of ADASE II took place at the properties of DaimlerChrysler in Stuttgart, Germany. The topic of the workshop was on ADAS effects on safety, throughput and comfort. The workshop was organized by the Dutch Rijkswaterstaat (AVV) and the French Ministry of Transport (CETE).

The objectives of the workshop were:

- Disseminate the results of the previous ADASE 2 expert workshops on sensor technology, overall technology architecture, infrastructure design and communication systems, human machine interfaces and legal aspects within the research community.
- Provide a forum where a preliminary assessment of the effects (on safety, throughput and comfort) of ADA systems as mentioned in the deployment roadmap will be discussed. Moreover the workshop will deal with the needs, limits and barriers influencing the effects of these systems are identified.
- Focus on a policy framework, based on the overview of policy processes and priorities of the member states that are most actively involved in ADAS deployment. A vital goal is to

find a common framework between public authorities and the automotive industry with concrete proposals for effective ADAS deployment.

The workshop started with a keynote speech of the European Commission, a presentation on the re- and preview perspective of European initiatives on ADAS and presentations on the previous ADASE II workshops. Next, the introduction on the impact assessment was given by a presentation of the ADASE II Roadmap and the presentation of the Introduction Paper. During an active part of the session, all participants have given their input on the impact assessment of six specific systems in the Roadmap. The first day was concluded by a discussion on the impact assessment.

The second day lead off with the presentation of the State of Policy. In two successive panel sessions, the points of views on ADAS from the National Policies and the Automotive Industries were presented and discussed.

Results from the workshop

Effects on safety, throughput and comfort

It is remarkable to see that the experts from the automotive industry, suppliers, policy people from national governments, researchers and consultants overall have a fairly common opinion on the effects of the presented ADA systems. The attendees of the workshop filled in pretty similar effects estimations. The same can be said for the assessment on the more complex systems that the ADASE core team has done. Although the automotive industry merely promotes their ADA systems as comfort improving systems, positive effects on mostly safety and also throughput are expected.

Safety

Regarding the expected effects of ADA systems on safety the results are positive to very positive. For the safe speed and following function this positive result is largely due to the expected reduction in head-tail accidents. For the lateral support function aside and singular accidents are expected to be influenced substantially. The safety potential for the obstacle detection and collision warning functionality is regarded to be positive to very positive. For the intersection safety and complex situation function also a positive effect is expected, although not as high as for the other functionalities.

Throughput

The expected effects on throughput are positive. However, there is a difference between the results for the different functions. For the lateral support function and obstacle detection & collision warning only a secondary effect on throughput is expected due to the mechanism that prevented accidents lead to less congestion. For the safe speed and following functions also primary effects are

expected because of different headways, less shockwaves and smoother traffic flow. This is in addition to secondary effects. Regarding intersection support and complex situations only a mildly positive to neutral effect is expected.

Comfort

The impact of the safe speed and following systems and night vision is believed to be larger than that of the other systems. The overall expectations regarding the effect on comfort are predominantly positive.

Overall

ADA systems thus seem to have potential benefits on safety, throughput and comfort. Although the assessment is not a scientific one, the input of more then 60 European experts from several professional backgrounds and the assessment of the ADASE core team has proven to deliver a worthwhile contribution to knowledge on effects of ADA systems.

To improve the knowledge on accidentology and the effects of ADA systems, harmonised accident numbers are needed to make good comparable assessments on the same information level.

Requirements and barriers regarding ADAS implementation

The main requirements that are needed for implementation of ADA systems are to give attention to the functionality (not everyone agrees if this should be 100% or not), the user acceptance and technological (mainly sensor) requirements. The driver should be educated so they understand what the systems do and that the driver stays responsible for it's drivers task. Furthermore there are external information needs, such as route information or other information from road authorities and there are requirements for the infrastructure (such as good markings).

Looking at the barriers of market introduction, it is often mentioned that there should be more standardisation in technology and the price/value ratio should be more positive. How to deal with driver attentiveness, wide scale introduction in medium sized (and prized) cars, technological barriers, integration barriers (mainly concerning communication), harmonisation of ADA policies in Europe, liability issues and the availability and quality of data from external sources are also often mentioned as barriers.

Policy issues

The initial motivation of governments and automotive industries in relation to ADA systems is different. Most car manufacturers promote ADA systems because it improves comfort of the customer and the policy makers are interested in these systems because of the expected positive impact on road safety and throughput (and

also environmental effects). ADA systems are not very high on the policy agenda across Europe. Nevertheless governments have intentions to promote these systems when effects have been proven, on the other hands effects can not be proven if there is no (large scale) deployment of these systems.

The visions amongst the delegates of the EU member state countries Sweden, Germany, the Netherlands, the United Kingdom, France concerning road safety are different and so is the usefulness of ADA systems for road safety. Less accidents and better safety (with better throughput) is the main objective in several countries, the means how to get there can be different. Technology can help there, it should be problem solving for governments. There is for instance a difference in the way speed enforcement should be used to reach these goals. ADA systems can be beneficial, as long as the effects can be proven. Automotive industries see the comfort aspect of ADA systems as a selling point, due to liability issues it is not favourable to sell them as safety systems (although they can help for that matter). If ADA systems also are implemented with communication aspects (vehicle to vehicle or vehicle to infrastructure) it would be wise to have a European wide understanding and agreements on ADA visions between the EU countries. Also the common goals of the governments and automotive industry can be stimulated by setting up common frameworks for research and implementation and experience more with Field Operational Tests in order to let people experience the ADA systems and better estimate effects.

Overall recommendations

This ADASE II effect assessment has been a good start for analysing and comparing the effects of the ADA systems that have been dealt with. Nevertheless a more thorough and in-depth study on effects is recommended based on modelling studies, results of field operational tests and monitoring driver behaviour of ADA systems that are already on the market. Standardised and harmonised methods of accident causation analysis and effect assessment should be based upon an agreed European accident database and agreed method(s) of effect assessment. International differences in driver behaviour should be considered.

Concerning liability issues it seems wise to let the driver always be responsible for it’s driving and not let the driver be completely out of the loop.

There’s a great need for better standardisation and harmonisation between systems requirements (technological) and policies between the automotive industries, suppliers and governments. Taking part in projects like ADASE II is a good way of creating common understanding amongst each other. However more efforts are needed to create a “common language”.

Regarding the safety and comfort motivations of ADA systems governments and automotive industries should try to reach a common understanding and strengthen each other with their goals.

It is interesting to find out if comfort improving systems in itself have also a positive effect on safety.

Field Operational Tests (FOT's) can have a lot of benefits for awareness and expectation management of the benefits of ADA systems for society. In order to reach each others goals the organisation of Field Operational Tests can be a good way in which the governments and (automotive) industry can create more knowledge.

Further technological improvements are needed to increase the performance, accuracy and reliability of the ADA systems.

Establishing an European governmental platform on Intelligent Vehicles would be helpful to let EU governments learn from each other, develop, create and interact with their visions on intelligent vehicles and be a EU wide counterpart for the European Commission and automotive industries. Especially when more systems with communication applications (for instance between vehicles and infrastructure) are being developed, this is a efficient way to interact and harmonise between each other and with the automotive industry to strengthen the potential of ADA systems.

2.3 Cluster management

The objective of this work package was to run the cluster on Active Safety and Driver Assistance Systems at EU level and to organise and manage the information exchange and the harmonisation between the different sources of information relevant for ADASE II.

In the cluster management the liaison to other associations such as: EUCAR, CLEPA and ERTICO as well as to the eSafety community was established. Links to the taskforce on vehicle highway automation guaranteed the harmonisation in a early stage with the US-American community especially IVI, VII and TRB.

Main emphasis within this work package was to organise the concertation meeting. Especially the selction of the appropriate to be presented cluster projects as well as the moderation of the conceration meeting were important topics. The event minutes were together with the presentation put in the web. This represents a unique possibility in order to gain a overview on running European ADASE activities!

In the cluster management all other activities in ADASE were synchronised and discussed in a strategic context!

The results were compiled for dissemination and the future needs for ADASE were derived. These lead also to important inputs in order to initiated upcoming FP6 projects!

2.4 Dissemination

The objective of this work package was the strategic selection of the information to be disseminated and the means to actually transport the information. The information was made available on conferences, brochure/flyer, electronic newsletters and, most importantly, via the web.

Conferences

ADASE 2 was presented on numerous occasions at the big conferences, often having special sessions to present and discuss ADASE topics. Prominent examples were the 2001 ITS conference on Vehicle-Highway Automation in Australia, the 2002 EuroChina conference in Beijing, the 2002 FISITA conference in Helsinki, the ITS world congress in Chicago (2002) and the European ITS congress in Madrid in 2003.

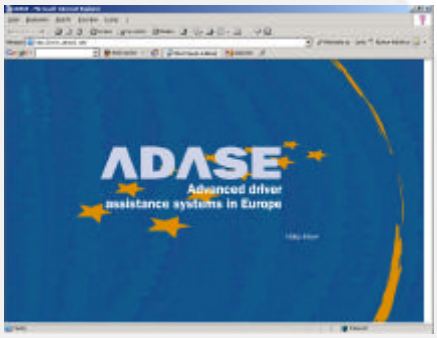
Web

The ADASE 2 website (www.adase2.net) was put into operation in early 2002. It is the major dissemination channel of the project. It aims at giving a comprehensive overview on European projects in the field of ADAS, to inform on the findings of the work related to the state of the art and road map, to report on the results of the ADASE expert workshops and to report on the regularly held concertation meetings.

The ADASE 2 web is on place one of Google (search for 'adase' or 'adase 2'). A search for 'adase & safety' leads to about 200 other relevant web entries.

On average 11,000 successful hits, 900 sessions and 450 distinct visits per month were counted in 2004 for the site.

Images of the entry page and the first content page are given below.

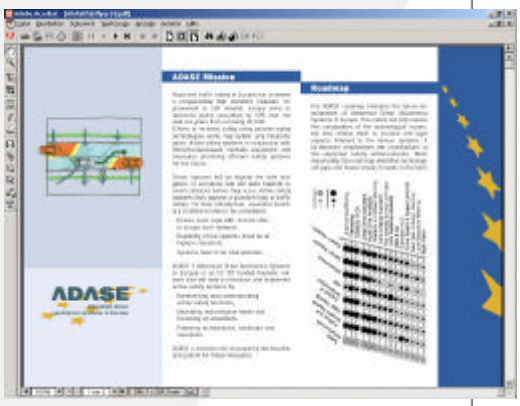


News letter

An ADASE electronic news letter is used to inform the ADASE community on special events or new results. An example of May 2004, announcing the final workshop, is given below.

Brochure / Flyer

The ADASE flyer was used to used to very successfully support presentations and dissemination at the different events and conferences. Originally designed in 2002 it was updated in 2004 to reflect the results achieved in the project life time. An image of the flyer is given below.



3 Lesson learned and future activities

3.1 Lessons learned

Will be completed after completion of the final workshop!

3.2 Future developments

Will be completed after completion of the final workshop!

4 Conclusions

Will be completed after completion of the final workshop!

References

Will be completed after completion of the final workshop!

Abbreviations

Will be completed after completion of the final workshop!

Annex 1: Deliverable and other outputs

Deliverables

A comprehensive table of the ADASE deliverables is included in the following table.

No.	Deliverable	WP	Lead	Comment	Web?
1 A	Final report	1	DCA	Draft	NO
2 A	State of the Art in ADASE	2	RWS	Final	YES
2 B	State of Practice in ADASE	2	CRF	Final	YES
2 C	State of Policy in ADASE	2	CME	Final	YES
2 D	Deployment of ADASE and road maps	2	BMW	Final	YES
3 A	Report on expert workshop No. 1 (HMI workshop)	3	CRF	Final	YES
3 B	Report on expert workshop No. 2 (Architecture workshop)	3	PSA	Final	YES
3 C	Report on expert workshop No. 3 (Communication workshop)	3	COF	Final	YES
3 D	Report on expert workshop No. 4 (Sensor workshop)	3	CLE	Final	YES
3 E	Report on expert workshop No. 5 (Policy workshop)	3	RWS	Final	YES
4 A	Minutes of the 1st ADASE concertation meeting	4	DCA	Final	YES
4 B	Minutes of the 2nd ADASE concertation meeting	4	DCA	Final	YES
4 C	Minutes of the 3rd ADASE concertation meeting	4	DCA	Final	YES
4 D	Harmonized cluster roadmap (Final report on experiences and findings)	4	DCA	Draft	NO
5 A	Project Presentation	1	DCA	No paper document	NO
5 B	Web site operational	5	DCA	Final	NO
5 C	Newsletters	5	DCA	No paper document	NO

Dissemination

A comprehensive table of conference presentations is included in the following table.

Date	Event
25.10.2001	ADASE concertartion meeting, EC, Brussels
05-06.10.2001	ITS world congress on vehicle-highway automation, Australia
20-21.03.2002	ADASE expert workshop on architectures, PSA, Paris
15-19.04.2002	Conference eurochina2002, Beijing
14-17.10.2002	ITS world congress, Chicago
28.10.2002	ADASE expert workshop on HMI, EC, Brussels
29-30.10.2002	ADASE concertation meeting, EC, Brussels
05-06.02.2003	ADASE expert workshop on communication, COFIROUTE, Paris
17-20.11.2003	IST world congress, Madrid
02.12.2003	ADASE expert workshop on sensor technologies, CLEPA, Brussels
19-20.01.2004	ADASE concertation meeting, EC, Brussels
17-18.05.2004	ADASE expert workshop on effects of ADA systems on safety, throughput and comfort, AVV, Stuttgart
24-26.05.2004	ADASE expert workshop on effects of ADA systems on safety, throughput and comfort, AVV, Stuttgart
14.07.2004	ADASE final presentation and workshop, CRF, Orbassano

Annex 2: Project management and co-ordination

The project management was performed by DaimlerChrysler as a service to the consortium.

With ADASE 2 being a Thematic Network project and the compact size of the consortium a very light management structure was chosen, that nevertheless allowed good control as well as clear reporting lines.

The project management team (PMT) performed the operational management of the project. The PMT consisted of the project manager and the work package managers of the partners. Decisions concerning the normal running of the project were be taken by the project management committee. They were always reached unanimously. A project control board, consisting of senior managers of the partners, to make final decisions had never to be called in.

The project manager from DaimlerChrysler performed the day-to-day management of the project. This included contractual commitments, and budget as well as technical control. Sub-responsibilities were delegated to:

- Project support, to provide supportive services for the project work,
- Project controlling to exercise financial and budget control, and
- Work package management, responsible for the co-ordination and planning of the tasks in the specific work packages.

To facilitate communication all project documentation (internal and external) was standardised in terms of common rules for files/report exchange, SW tools, formats, etc..

The project progress was assessed on occasion of the three monthly meetings of the ADASE project management team.

The project planning was performed by the project manager together with the work package managers (technical contents, milestones) and the project controller (budgets and resources). Work progress was reported on task level on a three monthly basis on occasion of the PMC meetings. The resulting management reports were submitted to the EC.

The deliverables were produced within the individual work packages.