Who cares about Advanced Driver Assistance?

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Samenvatting

Who cares about Advanced Driver Assistance?

Rijtaakondersteunende systemen komen steeds meer op de markt. Alhoewel het aantal verkochte systemen nog beperkt is neemt de variëteit en functionaliteit toe. Deze bijdrage beoogt inzicht te geven in de verschillende aspecten die de verdere invoering bepalen. Het behandelt, vooral op basis van resultaten uit het EC project ADASE II, aspecten op het gebied van ontwikkeling van de markt, trends in R&D, overheidsbeleid, scenario's voor marktintroductie, juridische aspecten en verwachtingen van effecten op het gebied van verkeersveiligheid, doorstroming en comfort. Concluderend kan worden gesteld dat de invoering van rijtaakondersteunende systemen zich in een zeer pril stadium bevindt, die gekenmerkt wordt door onzekerheid over effecten en risico's. Fabrikanten zijn onzeker over financiële risico's en gebruikersaspecten en kiezen voor een terughoudende marktintroductie. Overheden en wegbeheerders willen meer inzicht in effecten op de verkeersveiligheid en doorstroming (betrouwbaarheid, voorspelbaarheid) alvorens ze kunnen besluiten tot maatregelen om de invoering te faciliteren, stimuleren of te reguleren. Het reduceren van de onzekerheid voor fabrikant , overheden en wegbeheerders kan worden bereikt door veldstudies, effect bepaling en de ontwikkeling van een raamwerk voor samenwerking tussen fabrikanten, overheden en wegbeheerders.

Summary

Who cares about Advanced Driver Assistance?

ADA systems are becoming increasingly available in the market. Although the number of ADA systems sold is small, the variety and functionality of systems is increasing. This paper aims to contribute to the different aspects that affect the introduction of ADA systems. It reviews, in particular based on results of the EC project ADASE II, aspects about development of the market, trends in R&D, public policy, scenarios for market introduction, legal aspects and the expected effects on traffic safety, throughput and comfort.

We conclude that the introduction of ADA systems in a very early stage, in which uncertainty is a key issue. Car manufacturers are uncertain about financial risks and the usability of ADA systems and employ a conservative strategy for market introduction. Governments and road operators need more certainty about the impact of ADA systems on traffic safety and throughput (reliability, predictability), before they can decide to take measures to facilitate, stimulate or regulate the introduction of ADA systems. Reduction of uncertainty for car manufacturers, governments and road operators can be accomplished through field operational tests, impact assessment and development of framework for cooperation between car manufacturers, governments and road operators.

1. Introduction

Since the early 90-ies Advanced Driver Assistance (ADA) systems have been the subject of many R&D projects. In particular attention was paid to Adaptive Cruise Control (ACC): a system that automatically maintains speed and headway. ACC is expected to increase the comfort of the driver, and reduce fuel consumption. At a traffic flow level ACC is expected to improve safety and reliability of traffic flows. The long expected market introduction of ACC finally took place in Europe in 1999 on luxury cars, intended to be used on light to moderate motorway traffic only. Nowadays, ACC is available as an option on several luxury car models and on trucks, and other ADA systems are being gradually introduced.

But how and when might ADA systems indeed induce significant changes in car driving and road traffic? When will ADA systems be able to contribute to problems regarding congestion and traffic safety? How can stakeholders influence this process? If we would agree that ACC is not a selling hit (yet?), would we classify the introduction of ACC in the market as typically slow or just normal?

In this contribution we take a closer look at the different factors that influence the development of ADA systems, based on work conducted in the ADASE-II project (Berghout & Bootsma, 2004). The development of ADA systems may be considered different from the introduction of other in-car systems because they directly influence the basic car driving controls. This introduces new questions concerning product development, impact assessment and policy making. In this paper we will review different issues that deal with the introduction of ADA systems. By reviewing these issues we aim to contribute toward a realistic view on and expectations of ADA systems.

2. A review of different aspects that affect the introduction of ADA systems

Advanced Driver Assistance (ADA) systems are defined as systems that support a drivers' tasks (see van Arem & Smits, 1997).In general, the following driving tasks can be identified:

- Navigation (finding and following a route from A to B)
- Manoeuvring (lane change, turning)
- Operational (speed, headway, heading)

- Emergency manoeuvres

ADA systems are in aimed at the manoeuvring, operational and emergency driving tasks. Different levels of support are possible:

- Informative systems (warning)
- Supporting systems (e.g. active gas pedal)
- Systems actively taking over driving tasks (e,g, automated headway keeping)

The eSafety Working Group (EC, 2002 & 2003) expects that ADA systems can contribute to the EC goals of reducing road fatalities by 50%. They support this expectation by referring to the fact that human failures contribute to 95% of the accidents, and that technology can help drivers to respond faster and adequate to dangerous situation and by making traffic smoother. The PReVENT consortium, which is working in the 6FP on the development of ADA systems as 'Preventive safety system' is expecting that ADA systems can help prevent 10-15 % of traffic accidents. (PReVENT, 2004). As a consequence, incident related congestion can be reduced significantly and the reliability and predictability of travel time be improved. Finally ADA systems can contribute to cleaner traffic by homogenizing traffic and by reducing congestion, resulting in fuel consumption savings of at least 15% (Vanderschuren, van Arem & Zegwaard, 1997). To the car drivers, ADA systems offer comfort, safety and fuel cost savings.

If the benefits are so obvious, why are there so few car models on the market offering ADA systems? Why isn't the government subsidizing the introduction of ADA systems? Van Twuijver (2004) estimates that from the market introduction around the year 2000 until June 2003, ACC was sold in the Netherlands on some 450-600 cars. Although this may not be a high number, Van Twuijver reports from interview results of Dutch drivers with ACC that the usefulness of ACC is well appreciated.

Are ADA systems developing slowly? In order to properly understand the potential development of ADA systems, we need to acknowledge that the development is a complex process for which we will review the following aspects.

- the development of ADA systems that are available in the market.
- the main trends in the R&D into ADA systems.
- public policy on ADA systems
- market introduction scenarios
- legal issues

- technology roadmap and effects

We conclude with a short discussion and recommended actions to accelerate the introduction of ADA systems.

3. Advanced Driver Assistance systems in the market

The aim of this chapter is to describe the situation about the ADA systems already available on the market, on the basis of the information collected by ADASE II partners for the three main market areas: Europe, Japan and USA (Saroldi, 2003).

The first step in the introduction on the market of ADA systems can be considered to be the Collision Warning system in the USA for trucks and buses. Optionally, this system includes also a side looking short range radar, which detects side obstacles. As another option, the system can also be connected to engine control in order to control speed and follow a slower front obstacle. This function is called “Smart Cruise”. The next step was the introduction of Adaptive Cruise Control (ACC) systems for cars. This system was introduced firstly inside Japan, and then in Europe for the car market. ACC systems are based on a front looking sensor with a maximum detection range of around 100 m. Based on front vehicle information, the ACC system regulates own vehicle speed by acting on engine control and braking system.

These introductions were followed by introductions of other functions. The first Night Vision system has been introduced in the US market in the year 2000. The Lane Departure Warning system has also been introduced in the year 2000, in Japan by some car manufacturers and in the US on trucks. This system intends to prevent involuntary lane departure. A camera based system is detecting the lane borders, and an acoustical warning message is generated to the driver when he is leaving the lane. In some applications, the driver is given a feedback on the steering wheel in order to help him stay in the lane.

More recently, in the year 2003 two new driver assistance functions have been announced for the Japanese market, that is automatic parking, which helps the driver entering into a parking slot in a parallel manoeuvre, and pre-crash collision mitigation system, which has the goal to reduce the damages of an accident by acting on the safety belts before the accident occurs and to automatically braking in case of an imminent collision that cannot be avoided. Moreover, from some manufacturers ACC is given in combination with lane warning system, showing the trend of integration of functionalities and systems. Finally, the

Stop & Go system, giving support to the driver for the longitudinal control in queues, will probably be the next system introduced on the market.

Considering the ADAS that are already on the market, we can derive some common elements regarding market introduction. It is seen that the introduction of ADAS usually starts from luxury cars or trucks. The luxury cars or trucks are the entry point, subsequently the introduction is expanded gradually to medium level cars. ADA systems 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. It is seen that the ACC is the most common system. However, safety systems (in particular lane departure warning) are increasing their role on the market. The market penetration of ADA systems is low but increasing. Market introduction of ADA systems is in its initial phase. Moreover it is seen that the market introduction is not following a common linear flow. ADA systems are being introduced in different market areas with different strategies testing customer reaction. Finally, integration between different systems is expected. In the near future integration is expected with sharing of sensors for multiple functions.

4. R&D into Advanced Driver Assistance systems: trends

This chapter reviews the current technological development on Advanced Driver Assistance (ADA) systems in R&D environments (Berghout et al., 2004). The information was obtained from a survey among members of the ADASE-II consortium and has been restricted to 37 R&D projects on ADA related systems. The projects are characterised by the functionality of the system, the focus of the research (technology, human machine interface (HMI), etc.), level 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 ADA functionalities such as safe speed or pedestrian protection, but instead pay attention to a whole range of functionalities. Figure 1 presents the number of projects focussing on general ADA systems or a specific ADA functionality versus research areas such as HMI or technology development.

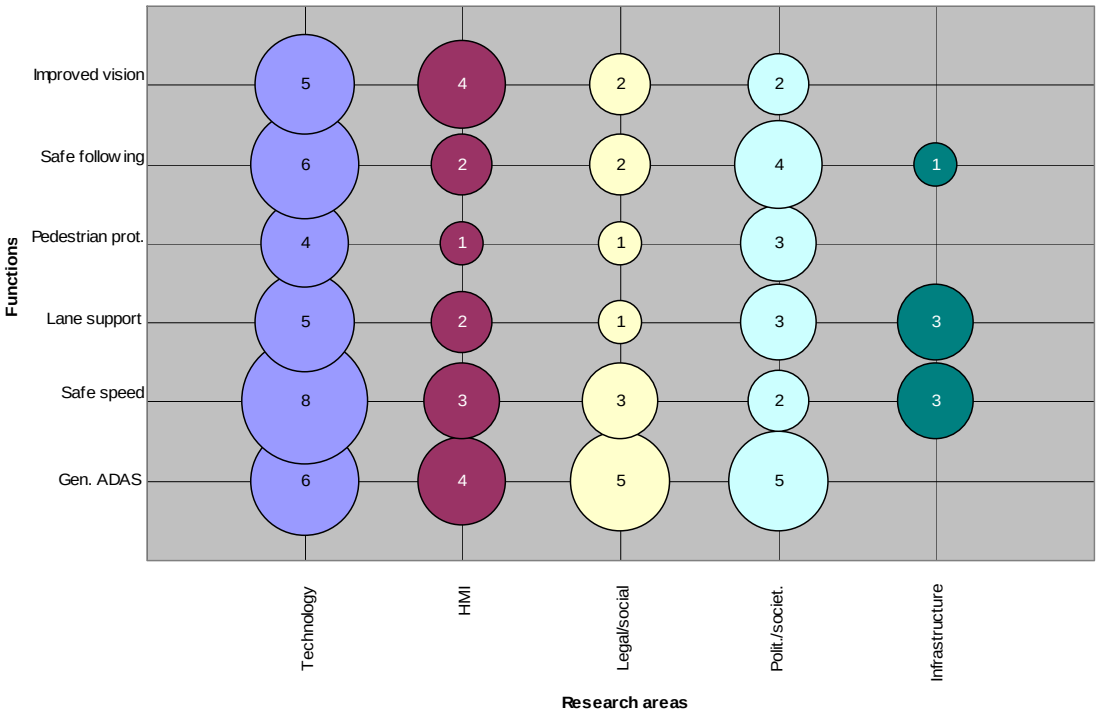

Figure 1: Functions per research area

The emphasis is clearly on technological development. It was also observed that most projects are demonstration type projects in which certain technologies are demonstrated.

From this review it can be concluded that safety has become the main motivation for R&D into ADA systems in the EU. Improvements in throughput, environment or comfort are pursued much less often. 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 a review 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.

5. Public policy on Advanced Driver Assistance systems

This chapter offers an overview of the European boundary conditions on political awareness (Ostyn, Gendre & Marchi, 2003). It focuses on government related issues with respect to ADA systems. The overview is given for both individual countries as well as the EU. It also includes a comparison with Japan and the USA. It shows how the member states and the EU

position their research policies and which priorities they have according to service and application types. The overview was made by structured questionnaires, which aimed to classify policy issues according to the roles described by Jansen (1995):

- *Monitor*, keeps track of the technological developments in the area and tries to take these into account when making transport policy.
- *Framework body*, determines the rules and conditions which influence innovation.
- *Implementor*, applies new products in its own process.
- *R&D agent*, promotes Research and Development directly.
- *Innovation agent*, promotes successful implementation of R&D products.
- *Developer*, carrying out in-house R&D.

The results show (see Figure 2) that almost all countries have a monitoring policy for which they do a technological watch and wait for tangible results before they invest in ADA systems. A few countries are more proactive and have in particular invested in projects like Intelligent Speed Adaptation (UK, Sweden, Netherlands, Flanders, France). Concerning the priorities of current research, the main fields of interest for the public authorities are Safe speed and Pedestrian & Two-wheeled vehicle protection.

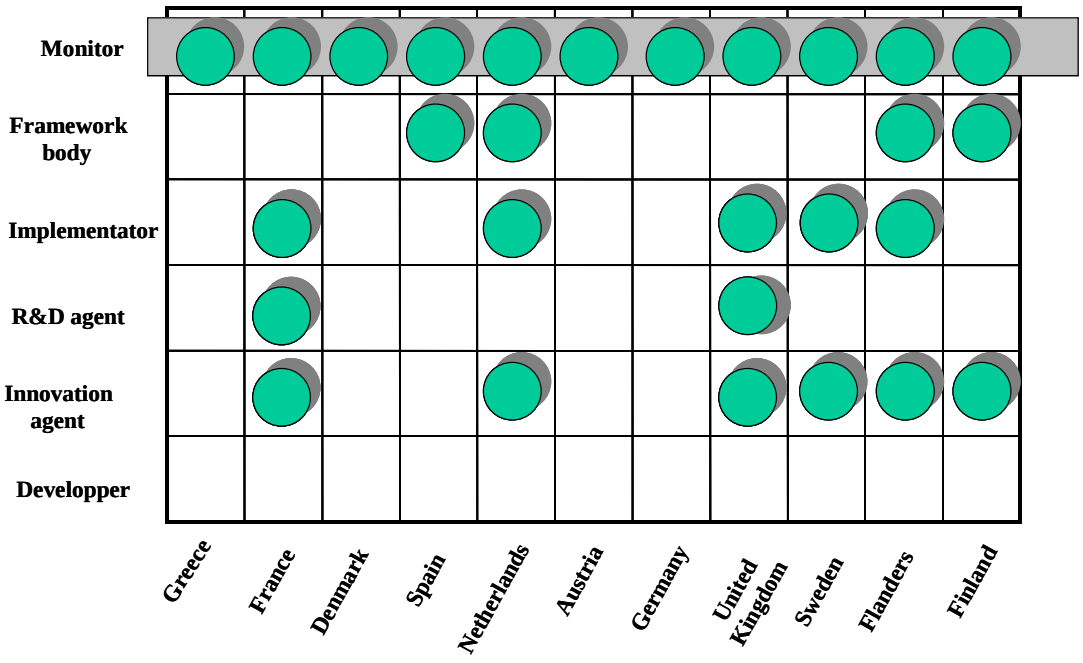

Figure 2. Member states position of their research policies

It is seen that the deployment of ADA systems does not systematically call for a priori intervention of national governments. However, the potential effects ADA systems have are promising for safer and better utility of roads. Moreover, new systems should be safely incorporated in the whole traffic system. This justifies an alert attitude from national governments.

The eSafety-initiative (EC, 2002) is a joint initiative of the European Commission (DG Transport and Energy and DG Information Society), the industry and other stakeholders. It aims to accelerate the development, deployment and use of Intelligent Integrated Safety Systems that use information and communication technologies, in order to increase road safety and reduce the number of accidents on European roads. Actions proposed at the EU level may be divided into three categories; promoting Intelligent Vehicle Safety Systems, adapting the regulatory and standardisation provisions and removing the societal and business obstacles.

In a workshop devoted to policy issues, the roles and interests of several EU member states have been discussed with the roles and interests of the automotive industry and suppliers of ADA systems. Five representatives from public authorities of The Netherlands, Germany, Sweden and the UK presented their vision on the priorities of ADAS deployment, strategy and accompanying measures. Subsequently, five representatives from Automotive Industry - PSA, Renault, FIAT, BMW and DaimlerChrysler gave feedback on the political issues discussed after the presentations of the public authorities and presented the actual barriers and the political issues, like legislation, intellectual property. 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 their perceived 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, but it should help solve a governments' problems. The automotive industry emphasizes the comfort of ADA systems as a selling point, but 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 is recommended to develop a European or world wide understanding and agreements on ADA visions. 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.

6. Market introduction scenarios of ADA systems

A key condition for the deployment of ADA systems is the existence of a market. The EC projects RESPONSE and RESPONSE2 were intended to support the market introduction of ADA systems. In particular in RESPONSE2 (2004), different market introduction scenarios into the year 2010 were reviewed and analysed.

The scenarios were development in a number of sessions of interacting groups of experts, primarily car manufacturers, suppliers and research institutes associated to the RESPONSE2 project. The first step was aimed at finding descriptors that are relevant for the market introduction of ADA systems into the year 2010. For each of these descriptors a review of the factors affecting the developments was given on the basis of a review of literature. In order to extract the dominant factors as a basis for final scenario development, participants were asked to give scores to each factor with respect to level of certainty (0=highly uncertain, 2= certain) and the impact (0= unimportant, 2= very important) . Each participant could assign 17 points to level of certainty and 17 points to level of impact. Table 1 gives the descriptors as well as the scores on uncertainty and impact.

Evaluation of the results (see Table 1) by the same group led to the conclusion that Financial risk (2), Usability (6) and Risk of product liability (14) were the key factors. Next, financial risk and usability were selected as key factor for scenario development.

Table 1: Market scenario descriptors, level of uncertainty and impact (RESPONSE2, 2004).

Descriptor	Total of all participants	
	Uncertainty	Impact
1. Marketing activities	8	18
2. Financial risk (recall, image problems)	21	31
3. Cost/ADAS unit	13	23
4. Economic volatility	21	12
5. Average economic growth in the EU	27	15
6. Usability of ADAS systems	19	30
7. Consumer demand for safety	14	21
8. Safety consciousness in public	13	19
9. Ageing drivers	0	6
10. Customer acceptance threshold	21	19
11. Customer understanding of the system limits	24	20
12. Number of accidents with major injuries	22	21
13. Compatibility of ADAS in integrated systems	24	15
14. Risk of product liability	23	30
15. Ownership of infrastructure	16	8
16. Regulatory environment	23	15
17. Amount of legislation	18	13

Four scenarios were developed based on combinations of high or low financial risk with a high or low level of usability. We review some key elements of the scenario low financial risk and high level of usability, which -for evident reasons- was considered as most desirable. In this context usability was described as both the perceived and actual benefit to the user. A high level of usability was could be achieved by technological advances especially in the field of sensors and image processing as well as human centered testing. It was expected that in 2010 Adaptive Cruise Control would be extended with a Stop & Go functionality allowing driving also in stop & go traffic, with lane departure warning and emergency braking. Initial market penetration was established on trucks, following by high-end passenger cars. The number of accidents was expected to decrease. ADA systems would work effectively and intuitively, and satisfy high expectations of the users.

The financial risk was described as the variety of company risks, which result from the development of ADA systems with the aim of marketing and distributing them. The first risk is associated with the direct market volume. Other risks are associated with liability and recall actions. In the ’low risk high usability’ it was assumed that consumer satisfaction would be high, resulting in a steady development of the market, as well as a low level of complains and product liability claims.

The RESPONSE2 project recommends to proceed by starting a risk-benefit analysis at a microscopic level using data form accident databases as well as the development of ‘Code of practice’ aimed at a common understanding of in particular tow concepts relevant to product liability: ‘Reasonable safety’ and ‘Duty of Care’.

The most preferable market introduction scenario of ADA systems described by RESPONSE-2 has two key factors: a high level of usability and a low financial risk to the manufacturer. At this moment, ADA user benefits are not clear yet and financial risks are present. It can therefore be expected that car manufacturers will employ a conservative strategy: stimulate the further development of the technology, clarify the ADA user benefits and leveraging financial risks.

7. Legal issues

The introduction of a new sort of product such as ADA systems raises new questions with respect to the legal framework. We shortly review these issues based primarily on the work in van Wees (2003), which reviews ADA systems in relation to product liability, traffic liability and automobile insurance.

Concerning product liability, van Wees (2003) reviews the implications of the European Council Directive on liability for defective products (EC, 1985). Firstly, the presentation of the ADA product is mentioned as a potential crucial element in potential claims. The driver has to be clearly informed about the functional limitations of the systems and the potential risks of unintended use. Evidently, this is the reason that ADA systems are presented not as safety systems, but as comfort systems, to prevent liability claims in cases where driver have an accident in spite of using the ADA system. Secondly, the reasonable anticipated use of ADA systems implies that manufacturers must take into account all possible users when designing a system. Manufacturers must anticipate use by novice or elderly drivers, careless use and use under risky circumstances, and decide on accompanying warning and instructions. Thirdly, van Wees (2003), mentions the time when the product was put to market as a relevant circumstance in determining the defectiveness of a product. A producer is not liable if he can prove that the state of scientific and technical was not such as to discover the existence of the defect. Van Wees (2003) however, does not conclude that product liability would be a barrier for market introduction. First of all, it prevents immature

and insufficiently tested products to be put on the market. Second, van Wees (2004) indicates that ‘case law on this subject in Europe is rather scarce’. Indeed, the approach toward a European Code of Practice for the introduction of ADA systems taken by the automotive industry in the RESPONSE project (RESPONSE, 2004) seems to point in the direction of specific arrangements for the introduction of safe ADA products as well as reduce the risk of product liability.

Van Wees (2004) also reviews the potential influence of ADA systems on the legal responsibility of drivers and car owners toward other drivers. He concludes that traffic liability regimes may need modification to eliminate any potential defense for the driver/owner resulting from the use of ADA systems. Finally he discusses that motor vehicle insurers may contribute to the success of ADA systems through their insurance policies, but that current insurance practices seems less than optimal towards safety innovations.

Based on the sources reviewed, ample attention has been paid to the relation between ADA systems and product liability. Based on the current legal framework, the product liability for ADA systems will need specific additional requirements, in particular taking into account the interaction of the driver with the product. The Code of Practice that is in development by the European car manufacturers is aimed at addressing these requirements.

8 Technology Roadmap and Effects of Advanced Driver Assistance Systems

The ADASE II roadmap in Figure 3 (Ehrmanns & Spannheimer, 2003) shows the future research activities of ADA Systems in Europe. It is based on discussions between the experts of the ADASE II project partners and results of the ADASE II thematic workshops and concertation meetings. This process leads to a matrix, which shows the research projects and the interdependencies between system functionality and complexities concerning different aspects. The derived matrix reveals the complexities of the technological, societal and legal aspects related to the various systems. The contribution to safety enhancement is based on rough estimates of the potential safety enhancement.

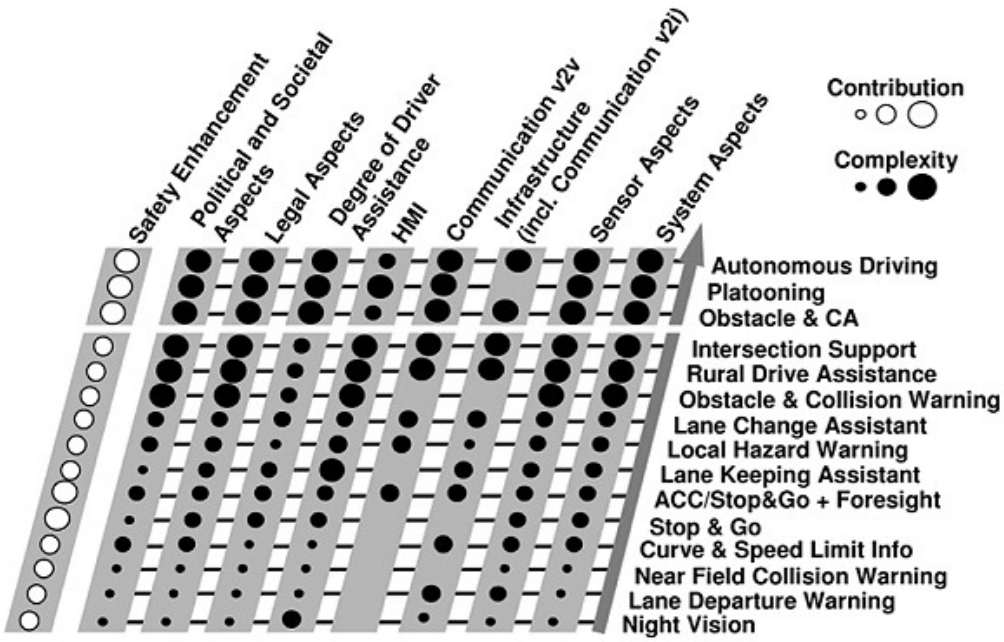

Figure 3: The Roadmap of ADASE-II

The ADASE II project addressed the need to get a better indication of the potential effects of ADA systems on traffic safety (column most left in the Figure 3) but also throughput and comfort. The project organized a workshop (Bootsma et al, 2004) based on the impact assessment framework given in Figure 4.

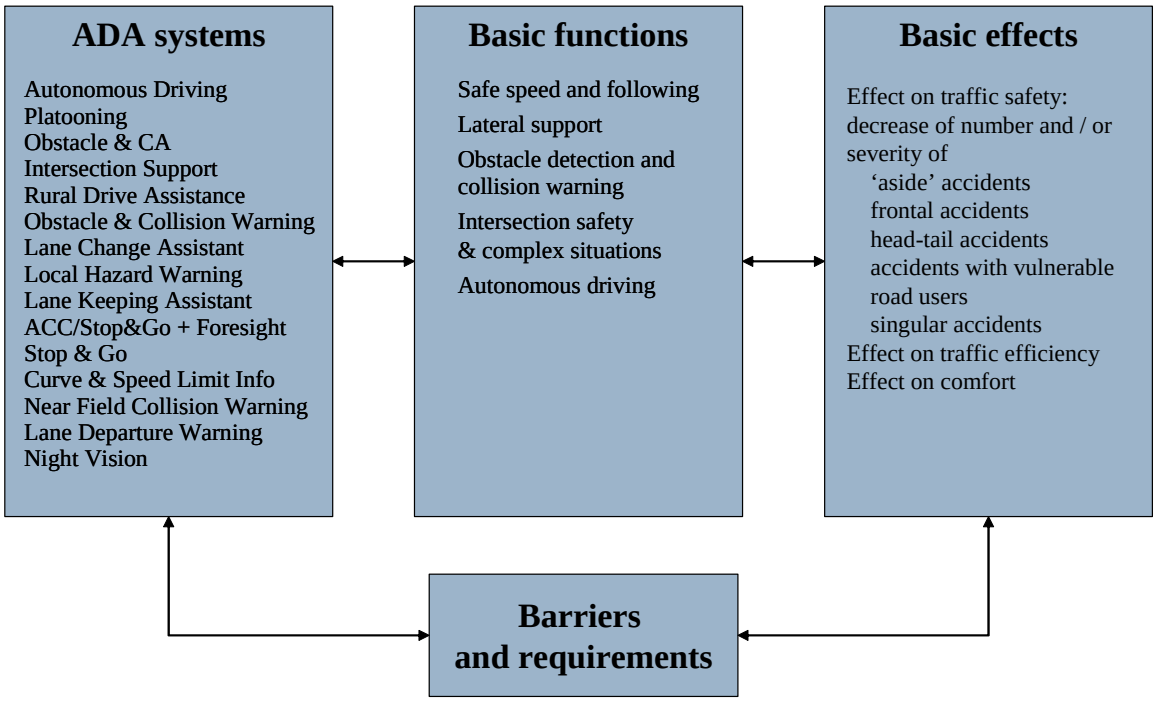

Figure 4. Impact assessment framework (Bootsma et al., 2004)

The assessment of the effects was conducted on a 5 point scale of very negative effects to very positive effects (--, -, 0, +, ++). Moreover the requirements and barriers to achieve these effects were listed. In a well attended workshop over 60 –most European- professionals from different backgrounds filled in their beliefs on the societal effects of 13 ADA systems categorized in 4 function fields using motivation for certain or uncertain opinions. It appeared that the experts from the automotive industry, suppliers, national governments, researchers and consultants overall have a fairly common opinion on the effects of the presented ADA systems. Although the automotive industry merely promotes their ADA systems as comfort improving systems, positive effects on mostly safety and also throughput are expected. Figure 5 shows the overall conclusions for the discussed impact of several functions (including typical ADA systems) on safety, throughput and comfort.

Effect	**++**	**+**	***0***	**-**	**--**
Safe speed and following	S C	T			
Lateral support		S C T			
Obstacle detection & collision warning		S C T			
Intersection safety & complex situations		C	S T		

Figure 5. Summary of impact assessment effects (S: safety; C: comfort; T: throughput); Bootsma et al. (2004)

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. 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. 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.

In summary, the input of more then 60 European experts from several professional backgrounds and the assessment of the ADASE core team ADA systems confirmed the expectation that ADA systems have potential benefits on safety, throughput and comfort.

9 Discussion and actions

In order to properly understand the potential development of ADA systems, we have developed a number of aspects that are part of the complex process of dealing with the introduction of ADA systems.

ADA systems are becoming increasingly available in the market. Although the number of ADA systems sold is still small, the variety and functionality of systems is increasing. ADA systems can not (yet?) be considered a selling hit, but car manufacturers, car dealers, car drivers and all other stakeholders involved are increasingly gaining experience. Significant negative experiences have not been reported.

Research & Development into ADA systems has been intensified and is mainly driven by claims to improve traffic safety. There is an emphasis on systems for detection, perception and interpretation of the ‘world around the car’, such as other vehicles, infrastructure and vulnerable road users. Cooperative road-vehicle systems and vehicle-vehicle systems are emerging world-wide.

Concerning public policy on ADA systems, the EC is leading in Europe by actively and heavily investing in R&D into ADA systems (EC, 2003). Within Europe, most member states monitor the progress and wait for results to become available. Several countries such as France, the Netherlands and the UK have assumed an active role by participating in research activities and promoting successful implementation. Again, the main motivation is traffic safety, but strong actions regarding ADA systems are not undertaken since uncertainty exists about the actual effects on not only traffic safety but also throughput.

The most preferable market introduction scenario of ADA systems has two key factors: a high level of usability and a low financial risk to the manufacturer. At this moment, ADA user benefits are not clear yet and financial risks are present. It can therefore be expected that car manufacturers will employ a conservative strategy: stimulate the further development of the technology, clarify the ADA user benefits and leveraging financial risks.

Concerning legal aspects, ample attention has been paid to the relation between ADA systems and product liability. Based on the current legal framework, the product liability for ADA systems will need specific additional requirements, in particular taking into account the interaction of the driver with the product. The Code of Practice that is in development by the European car manufacturers is aimed at addressing these requirements.

Finally, we reviewed the ADASE II technology roadmap for ADA systems and in particular looked at the results of a workshop on the potential effects of ADA systems. In this workshop the input of more then 60 European experts from several professional backgrounds and the assessment of the ADASE core team confirmed the expectation that ADA systems have potential benefits on safety, throughput and comfort, ranging from positive to very positive.

Returning to the issue of understanding the development of ADA systems, we observe that the development is a very early stage. To the car manufacturers, lack of clarity of usability aspects and financial risk result in a conservative market approach. Indeed the number of ADA systems that have been sold appears to be small. Some public authorities recognize the potential of ADA systems to improve traffic safety and efficiency, but are in need of stronger evidence to undertake stimulating actions. Concerning technology development, R&D is still needed to improve the performance of ADA systems to cover wider ranges of traffic scenarios and to bring down costs. In order to accelerate the introduction of ADA systems, insight is needed in the information needed and political motivations of the different decision makers to accelerate and facilitate (or regulate) the market introduction of ADA systems. In addition to very useful instrument, such as the Code of Practice, this information should consist of:

- proven results on usability or consumer demand of ADA systems (field trials),
- proven effects on traffic safety effects (using a common European accident database) and effects on traffic efficiency (in particular on travel time reliability and predictability using modelling studies).

There is a clear win-win situation for the government/road operators and car manufacturers to work, e.g., together by jointly setting up field trials and pilot project to improve the understanding of the usability of ADA systems to the road user, reduce financial risk for the car manufacturers and the contribution to improved traffic safety and travel time reliability and predictability.

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