SAFESPOT INTEGRATED PROJECT - IST-4-026963-IP

DELIVERABLE

Report on preliminary analysis and initial deployment program

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Workpackage No. | WP2
Workpackage Title | Report on preliminary analysis and initial deployment program
Task No. | Aw
Task Title | 
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<th>Date</th>
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<th>Name and Company</th>
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List of authors

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<td>of Amsterdam</td>
<td></td>
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</table>
## Abbreviation List

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACC</td>
<td>Adaptative Cruise Control</td>
</tr>
<tr>
<td>ADAS</td>
<td>Advanced Driver Assistance Systems</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost Benefit Analysis</td>
</tr>
<tr>
<td>CEA</td>
<td>Cost Effectiveness Analysis</td>
</tr>
<tr>
<td>HGV</td>
<td>Heavy Goods Vehicles</td>
</tr>
<tr>
<td>ISA</td>
<td>Intelligent Speed Alert</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
</tr>
<tr>
<td>LCV</td>
<td>Light Commercial Vehicles</td>
</tr>
<tr>
<td>ODP</td>
<td>Open Distributed Processing</td>
</tr>
<tr>
<td>PSAP</td>
<td>Public Safety Access Point</td>
</tr>
<tr>
<td>SP</td>
<td>Service Provider</td>
</tr>
<tr>
<td>SPx</td>
<td>Sub-Project number x</td>
</tr>
<tr>
<td>WPx</td>
<td>Work Package number x</td>
</tr>
<tr>
<td>IVSS</td>
<td>Intelligent Vehicle Safety Systems</td>
</tr>
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</table>
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EXECUTIVE SUMMARY

SAFE SPOT (Cooperative Systems for Road Safety “Smart Vehicles on Smart Roads”) is an integrated research project cofunded by the European Commission Information Society Technologies among the initiatives of the 6th Framework Program. Its aim is to prevent road accidents developing a Safety Margin Assistant (an Intelligent Cooperative System based on Vehicle to Vehicle - V2V - and Vehicle to Infrastructure - V2I - communication) that detects in advance potentially dangerous situations and that extends drivers’ awareness of the surrounding environment.

BLADE (Business models, Legal Aspects and DEployment) is one of the subprojects of SAFE SPOT, aiming at proving the architecture feasibility from a business perspective. The analysis involves many aspects (organizational, legal, responsibilities, regulations, economical), evaluating risks and defining guidelines and suggestions for the different stakeholders, as well as the government.

This is the first deliverable for the BLADE Sub Project. Its main objective is to give an overview on the existing state of the art for the different aspects that have to be investigated in BLADE, in order to set a common understanding before the start of specific analyses.

The deliverable has also the aim to provide a preliminary definition of SAFE SPOT deployment programme and a first collection of quantitative data needed for the evaluation activities.

Concerning the definition of the state of the art, the report presents an overview about results of existing projects and studies and on the adopted methodologies, potentially useful for BLADE analyses. Such results and methodologies are mainly related to Advanced Driver Assistance Systems (ADAS), but can be useful as starting point for SAFE SPOT evaluations.

It has been found a good list of suitable methodologies, that will be assessed for a possible application in SAFE SPOT. In terms of results, the analysis can be summarized as follows:

- Organizational Architecture is an innovative approach for the analysis of the organisational aspects of a new business; one exemplary application is available;

- concerning Business & Service models, it has been found some interesting elements about business case approach; none of the analysed projects adopted the wider approach suggested for SAFE SPOT, in
particular for the definition and ranking of alternative business and service models;

- about risk aspects, the analysis provides an useful list of risks and potential mitigation strategies, although it needs to be updated to current ITS and technological state-of-the-art and has to be tailored to the systems functionality supported by the SAFESPOT architecture;

- about legal aspects, the analysis showed that "legal matter" of ADAS is extremely complex and today the main reference documents are the ISO recommendations; the relevant projects analysed give the most importance to liability and insurance aspects;

- many ADAS have been analysed in terms of their socio-economic impact, using consolidated methodologies; the analysis shows that the expected benefits in comparison to costs are generally interesting for the whole society;

- Market analysis results show that generally there is a positive perception about the ADAS systems and about their integration in an unique cooperative system; there are good market opportunities for ADAS and in general for all Safety Systems, even if their penetration on the market is actually low.

Concerning the SAFESPOT Preliminary Deployment Program, the deliverable presents the first framework for the deployment. It will consist of a vision and a description of the SAFESPOT systems, by means of an action plan and of a process/communication plan. The vision will be developed on the basis of the SAFESPOT applications, the action and process/communication plan will be developed on the basis of the BLADE analyses.

Furthermore, for each of the aforementioned issues this document reports first considerations on aspects specific for cooperative systems, useful to get to a robust final deployment program of SAFESPOT. In particular, in comparison to the ADAS systems, some aspects have to be taken into account: the necessity of an adequate communication plan, the increasing role of road operators and, last but not least, how cooperative systems can face legal barriers. The major risk highlighted is to develop a technology for an extremely promising market, but without a focus on the important technological / legal / social / business success factors. This will have to be tackled by further in-depth analyses and considerations in future BLADE deliverables.

A first collection of quantitative data, useful as starting point for BLADE evaluations, is presented.
1. Introduction

SAFESPOT (Cooperative Systems for Road Safety “Smart Vehicles on Smart Roads”) is an integrated research project co-funded by the European Commission Information Society Technologies among the initiatives of the 6th Framework Program. Its focus is on Intelligent Cooperative System based on Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication.

The innovation of co-operative systems involves not only technical aspects but also the solution to be adopted for their market introduction, the management of roles and responsibilities, taking into account risks, legal implications and liabilities, and finally the adoption of a sustainable business model. This is the reason why BLADE (Business models, Legal Aspects and Deployment) sub-project is really important for the success of the entire project.

The main objective of the BLADE is to develop a deployment programme for SAFESPOT results, analysing all the aspects that can affect its implementation into real life, namely:

- organisational architecture (roles, responsibilities and interrelationships);
- potential risks and barriers, with special attention to legal aspects;
- market, financial and socio-economic impact assessment;
- suitable business models identification.

Each of the mentioned aspects will be analysed in specific work packages with the aim of collecting all the information needed for the design of a complete deployment programme for SAFESPOT system.

In particular, for each of the aspects that will be investigated in Work Packages from 3 to 6, this deliverable summarizes:

- data, information and results that can be used as a basis for further specific analyses;
- methodologies successfully adopted in other projects, therefore to be taken into consideration in the start-up phase of the new tasks.

The relations among this deliverable and the other WPs activities, can be clarified in the following chart (see Figure 1-1) where all BLADE deliverables are represented according to their timing.
Figure 1-1: Overview on BLADE deliverables and relations with D6.2.1
D6.2.1 starts the discussion on the different subjects to be faced in the other work packages, giving an overview on existing results and on available quantitative data. Each work package will be then required to take into consideration these results and to perform specific analyses related to the SAFESPOT system, being in strict contact with technical SPs progress.

1.1. Innovation and Contribution to the SAFESPOT Objectives

Although this deliverable doesn’t give a specific innovative contribution to the general BLADE objectives, this is the entry point of all the next activities. It also gives the opportunity to make a first comparison between SAFESPOT and other autonomous systems. The real innovation introduced in BLADE is to combine technical research with deployment research, addressing to cooperative systems instead of autonomous ones.

1.2. Methodology

Three phases have been identified, considering the three objectives of this deliverable:

- selection and analysis of relevant existing projects and studies;
- definition of preliminary deployment programme outlook and considerations;
- initial quantitative data collection.

For each phase the specific adopted methodology is described in the following sections.

1.2.1. Selection and analysis of relevant existing projects and studies

The work has been organised considering five main clusters according to the work packages organisation of BLADE:
- Organisational architecture (WP3)
- Business and service models (WP6)
- Risk analysis and legal aspects (WP4)
- Socio-economic aspects (WP5)
- Market / costs / financial aspects (WP6).

The list of projects and studies has been defined together with all Blade WP2 participants through email exchanges, conference-calls and during the meeting held in Torino on May 3rd and 4th 2006.

This list has been defined on the basis of:
- project start date (after 2000);
- connection with road safety topics;
- the possibility to find relevant information for the BLADE sub-project (risk analysis, legal aspects, market/cost/financial assessment, socio-economic evaluation, organizational architecture, business and service models).

Subsequently, each document has been analysed in order to understand which kind of topics and issues are available and useful for the purpose of the state of the art analysis. The results of this activity have been summarized in a template (for each project) designed according to a scheme shared among all Blade WP2 participants.

In the first part, each project data sheet contains: Title and Acronym, Period (Start and End Date), Web-site address, the Objective and the relevant deliverable/document of the project. In the second part, for each relevant issue (previously indicated) the interesting parts and a brief description are reported.

The results highlighted in the templates (see Annex 3) for each of the identified clusters have been then summarized in the deliverable by partners that will have a relevant role in the related BLADE work packages.

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1 Annex 3 is located in a separate file named SF_D6.2.1_Annex3.doc
1.2.2. Definition of preliminary deployment programme outlook and considerations

Starting from the analysis of existing projects, a discussion on the deployment programme contents have been held among partners and finalised in the present document. Work package leaders of WP3 to WP6 have been asked to lead the discussion for the related issues and the SAFESPOT IP project coordinator has also been involved.

1.2.3. Quantitative data collection

A list of data to be found has been proposed to the WP2 partners, in order to set up an exhaustive framework of quantitative data needed for the evaluations to be performed in the BLADE Sub Project. During the meeting of May, the list has been discussed and completed with all the ideas of the partners.

In particular, the collection has been focused on the period from 1999 to 2004 for EU25 geographical perimeter.

It has been developed a complete framework of data that has to be collected during the project; such framework will be useful as a guideline for the project. The initial collection has been concentrated on four categories of data, the most urgent to be gathered:

- European road accidents and their consequences
- Automotive market
- European Road Infrastructures
- Mobility (country and single road level)

The main sources for data collection have been similar existing projects, regional, national or international, as well as already existing national or European data bases and internet.

A connection with SAFESPOT SP5 has been established, with the aim of avoid double working on data collection for accidents.

1.3. Deliverable structure

The deliverable is structured in two main chapters, reflecting its main objectives:

- Chapter 2: “State of the art on relevant projects and studies”;
- Chapter 3: “Preliminary definition of deployment program”;

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Furthermore, the deliverable includes four annexes:

- Annex 1 (integrated in the present document): “Framework for the first collection of quantitative data”;
- Annex 2 (integrated in the present document): “Synthesis of SAFESPOT applications and functions”;
- Annex 3 (separated file named SF_D6.2.1_Annex3.doc): “State of the art on existing Projects/Studies”, confidential, including a structured summary of each analysed document, with general information, objectives and relevant results organised according to BLADE main items;
2. State of the art on relevant project/studies

2.1. Overview of relevant projects

The Blade WP2 Project has started with the state of the art analysis concerning existing projects and studies that can provide useful information or starting points for the activities to be performed in BLADE.

The list of considered European Projects is shown in Table 2-1.

Most of the considered projects are now ended but others are in progress, so it is important that the future BLADE activities will monitor their results.
Table 2-1: List of relevant European projects considered for the state of the art analysis (*: in progress project)

<table>
<thead>
<tr>
<th>Reference Project</th>
<th>System Analysed</th>
<th>End date</th>
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<tbody>
<tr>
<td>ADASE2</td>
<td>ADAS Systems</td>
<td>2004</td>
</tr>
<tr>
<td>ADVISORS</td>
<td>ADAS Systems</td>
<td>2003</td>
</tr>
<tr>
<td>AIDE*</td>
<td>ISA, ACC, Nomadic Systems</td>
<td>2008</td>
</tr>
<tr>
<td>AIDER</td>
<td>AIDER Systems</td>
<td>2005</td>
</tr>
<tr>
<td>ARTIST</td>
<td>ITS Systems</td>
<td>2003</td>
</tr>
<tr>
<td>AWAKE</td>
<td>System able to monitor the driver and the environment and to detect in real time hypo-vigilance, operating in all highway scenarios</td>
<td>2004</td>
</tr>
<tr>
<td>CARTALK</td>
<td>Driver Assistance Systems which are based upon inter-vehicle communication</td>
<td>2004</td>
</tr>
<tr>
<td>CVIS*</td>
<td>Cooperative Systems for Road transport</td>
<td>2009</td>
</tr>
<tr>
<td>elimpact*</td>
<td>Intelligent Vehicle Safety Systems</td>
<td>2008</td>
</tr>
<tr>
<td>E-MERGE</td>
<td>Emergency Call Systems</td>
<td>2004</td>
</tr>
<tr>
<td>ESAFETY</td>
<td>Safety Application</td>
<td>2008</td>
</tr>
<tr>
<td>FRAME</td>
<td>Intelligent Transportation Systems</td>
<td>2004</td>
</tr>
<tr>
<td>GALLANT</td>
<td>ADAS Systems</td>
<td>2003</td>
</tr>
<tr>
<td>GST*</td>
<td>Enhanced Floating Car data</td>
<td>2007</td>
</tr>
<tr>
<td>INSAFETY*</td>
<td>Intelligent Application Infrastructure</td>
<td>2008</td>
</tr>
<tr>
<td>INVENT</td>
<td>ADAS Systems</td>
<td>2005</td>
</tr>
<tr>
<td>PASSIVE SAFETY NETWORK</td>
<td>Pre-crash sensing</td>
<td>2001</td>
</tr>
<tr>
<td>PREVENT (APALACI)*</td>
<td>Pre-fire applications, Pre-set applications, Collision Mitigation, Start Inhibitor, Pedestrian Recognition, Short Range radar, Day/Near Ir Vision</td>
<td>2007</td>
</tr>
<tr>
<td>PREVENT (RESPONSE3)*</td>
<td>Adas Systems and in particular “Prevent” Functions</td>
<td>2006</td>
</tr>
<tr>
<td>PROSPER</td>
<td>ISA</td>
<td>2005</td>
</tr>
<tr>
<td>RADARNET</td>
<td>Urban Collision avoidance, collision warning, pre-crash sensing and ACC, stop &amp; go</td>
<td>2003</td>
</tr>
<tr>
<td>RESPONSE1</td>
<td>ADAS Systems</td>
<td>2000</td>
</tr>
<tr>
<td>RESPONSE2</td>
<td>ADAS Systems</td>
<td>2004</td>
</tr>
<tr>
<td>SAFEMAP</td>
<td>New Navigation map or geo-localized concepts</td>
<td>2006</td>
</tr>
<tr>
<td>SAFETUNNEL</td>
<td>Safe Tunnel Applications</td>
<td>2004</td>
</tr>
<tr>
<td>SEISS</td>
<td>Ecall, ACC, Lane Departure Warning and Lane Change Assistance</td>
<td>2005</td>
</tr>
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<td>SPEEDALERT</td>
<td>Speed Alert Systems</td>
<td>2005</td>
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<tr>
<td>STARDUST</td>
<td>ADAS Systems</td>
<td>2004</td>
</tr>
<tr>
<td>TRAINER</td>
<td>Driving Simulator</td>
<td>2003</td>
</tr>
<tr>
<td>WATCH OVER*</td>
<td>Co-operative Systems for Road Transport</td>
<td>2009</td>
</tr>
</tbody>
</table>
In addition, “ITS Japan handbook 2005-2006” and several interesting documents/web sites were investigated (see Table 2-2).

Table 2-2: List of relevant documents/web sites considered for the state of the art analysis

<table>
<thead>
<tr>
<th>Geographical Area</th>
<th>Description</th>
<th>Link</th>
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<tbody>
<tr>
<td>Japan</td>
<td>Advanced Cruise Assistant Highway research Association</td>
<td><a href="http://www.ahsra.or.jp/">http://www.ahsra.or.jp/</a></td>
</tr>
<tr>
<td>USA</td>
<td>American Public Transportation Association</td>
<td><a href="http://www.apta.com/research/info/briefings/briefing_2.cfm">http://www.apta.com/research/info/briefings/briefing_2.cfm</a></td>
</tr>
<tr>
<td></td>
<td>United States Department of transportation Federal Transit Administration</td>
<td><a href="http://www.fta.dot.gov/7639_7662_ENG.HTML.htm">http://www.fta.dot.gov/7639_7662_ENG.HTML.htm</a></td>
</tr>
<tr>
<td></td>
<td>Intelligent Transportation Systems</td>
<td><a href="http://www.its.dot.gov/index.htm">http://www.its.dot.gov/index.htm</a></td>
</tr>
<tr>
<td></td>
<td>Intelligent Vehicle Technology and Trends</td>
<td><a href="http://www.ivsource.net/">http://www.ivsource.net/</a></td>
</tr>
<tr>
<td>Europe</td>
<td>Prof. Dr Dariu Gavrila’s Smart Vehicle Website</td>
<td><a href="http://gavrila.net/index.html">http://gavrila.net/index.html</a></td>
</tr>
<tr>
<td></td>
<td>Intelligent Transportation Systems and Services-Europe</td>
<td><a href="http://www.ertico.com/">http://www.ertico.com/</a></td>
</tr>
<tr>
<td></td>
<td>IEE Automotive and Road Trasport System Professional Network</td>
<td><a href="http://www.iee.org/oncomms/pn/auto/index.cfm">http://www.iee.org/oncomms/pn/auto/index.cfm</a></td>
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<td></td>
<td>The French National Institute for trasport and safety research</td>
<td><a href="http://www.inrets.fr/index.e.html">http://www.inrets.fr/index.e.html</a></td>
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<tr>
<td></td>
<td>ADASE II European Project website</td>
<td><a href="http://www.adase2.net">http://www.adase2.net</a></td>
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</table>
2.2. State of the art for the addressed issues

The aim of the state of the art is to collect and structure all the available information with respect to the deployment of cooperative systems. Experiences and outcomes of studies focusing on autonomous systems have been included in the analysis to identify all that issues and factors that might also be critical for the deployment of cooperative systems.

The issues covered in the state of the art are strictly related to the activities that will be performed in BLADE work packages from WP3 to WP6. As anticipated in the introduction, this paragraph summarize the interesting elements coming from the analysis of several projects and studies, grouped in sub-paragraphs following the afore-mentioned issues, namely:

- Organisational Architecture;
- Business & Service Models;
- Risk/Legal aspects;
- Socio-economic aspects;
- Market/Costs/Financial aspects.

A structured summary of each project or study analysed can be found in Annex 3 (Confidential document).

A synthetic vision of the projects useful for each of the aforementioned categories is shown in Table 2-3.
### Table 2-3: Synthetic vision of the projects useful for each of the issue to be analysed in BLADE

<table>
<thead>
<tr>
<th>Reference Project/Studies</th>
<th>Organisational architecture</th>
<th>Business and service models</th>
<th>Risk analysis and legal aspects</th>
<th>Socio-economic aspects</th>
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2.2.1. Organisational Architecture

This paragraph concerns the collection of useful information about the Organisational Architectures of the systems developed in previous works, with respect to the deployment of cooperative systems for road safety.

In order to understand this analysis, it is worth to have clear why it is necessary to approach the deployment of a cooperative system by defining its Organisational Architecture, and why a methodology is necessary to do that in a structured way. In the next chapters (4.2.2) these concepts will be deepened and possibly referenced to the SAFESPOT project.

The objective of the Organisational Architecture definition is to find out the organizational aspects in order to make sure that the services functionally described in the Logical and Physical Architectures are effectively feasible. In fact, the simple implementation of the processes/functions is not enough to guarantee a correct functional service; this may guarantee its effectiveness, but it has to be supported by a business analysis aimed at its efficiency.

Overview and methodology

In the latest years, several methodologies have been developed to help planning, developing, and implementing successful Architectures on Intelligent Transportation Systems (ITS); other than the Logical and Physical aspects, some of these methodologies help the designers to define the Organisational relationships among the various users (public and private institutions) involved in developing and managing ITS.

The European Reference ITS Architecture FRAME deals with the organisational structure definition of an ITS system Organisational Architecture and defines it as an output from the Physical Architecture. Nevertheless this implementation is not developed at all, because of the absence of a single structure for European organisations that are involved in the ownership and/or use of ITS.

The organizational aspect of ITS systems is dealt in a detailed way in the Italian national reference methodology, ARTIST. Here, in order to stress the organisational and business aspects of a service, a step-by-step approach is proposed, basically focused on the concepts of Value Chain, Roles, and Responsibilities of the actors involved.
A good example for the application of this methodology, which is worth to be added to the list of analysed projects, is the pilot project E-CALLS developed as a dissemination example of the ARTIST methodology. This project is aimed at defining a plan for the integrated management of the emergency calls on the national territory. First, the value chain of this service is represented in Figure 2-1.

![Figure 2-1: Value chain of the emergency call service (source: ARTIST)](image)

Then the main functions for the service are listed:

- Acquiring Mayday Call on Roadside;
- Managing Emergency Intervention;
- Managing Emergency Vehicle;
- Providing Emergency Control on the Operator;
- Providing Access and Maintain Data for Emergency;
- Providing Traffic Control;
- Managing Incidents;
- Monitoring PT Fleet;

Functions are moreover grouped on the basis of a series of attributes, such as: required professional skills, involved systems, data needed, interaction with other functions.

Three activity (function) groups are then created:
1. Service Provider (SP);
2. Public Safety Access Point (PSAP);
3. External Agencies.
Each of these three activity (function) groups corresponds to an active role in the value chain. For example the PSAP role groups the following activities:

- Acquiring Mayday Call on Roadside;
- Managing Emergency Intervention;
- Managing Emergency Vehicle;
- Providing Emergency Control on the Operator;
- Providing Access and Maintain Data for Emergency.

Each role gets some responsibilities. For example the PSAP role detects the following responsibilities:

- Emergency management;
- Data gathering for the emergency;
- Validation and filtering of the data coming from the drivers calls;
- Emergencies classification;
- Analysis of other information;
- Correct communication with the first-aid entities;
- Closure of the intervention.

For each role related to responsibilities, suitable levers are then identified, as skills, methodologies, contractual abilities, systems, etc.. For example PSAP levers, are:

- Technological devices for the integration with the operational centres of the external agencies;
- Control centre and emergency management;
- Well-timed and correct information coming from the traffic management centre, services and public authorities.

Finally, the value related to each role was detected. Precisely:

- for Service Providers:
  - Better and more detailed information about the user and his journey.

- PSAP:
  - Social risk reduction;
  - Complete data on the incidents;
- Incidents history.
- External Agencies:
  - False calls reduction;
  - Operative costs;
  - Better management of aid vehicles.

Apart from this pilot project, the state-of-the-art analysis has showed a general lack of structured approach to the realization of an Organisational Architecture.

In fact, in all the analysed projects this aspect is generally approached with no reference to a standardised Organizational Architecture Model; the organisational/business concepts of Value Chain and Actors’ Roles and Responsibilities are dealt (sometime in deep detail, as in the GST project) in the sections related to the Logical and Functional Architecture and Business Models, but never in an organic way; other concepts typical of the Organisational Architecture, as Efficiency, Value Levers, Cost Drivers are not discussed at all.

For this reason, our analysis has been focused on the search of any information concerning the main elements belonging to the Organisational Architecture idea, even if those were dealt individually and with no mention to a structured approach.

For example, the concept of value chain is applied in the SAFE TUNNEL project, referred to the reduction of accidents inside road tunnels through PREVENTIVE safety measures. Nevertheless, the value chain concept is applied a way that is not functional to the development of an Organisational Architecture. In this case the chain mails are represented by players (truck manufacturers, tunnel operators, etc) instead of activities (or functions), as it is expected to be done at this step. In this project the scheme was developed in the Business Model context; among all the stakeholders involved, two categories are identified here: direct players (the ones directly involved during the project business operation) and indirect players (those who could take advantages from the business but that are not directly involved in the project operation). This organisational distinction may be taken into consideration when defining the SAFESPOT architecture deployment.

Some elements about actors and roles were also found in the SPEED ALERT project. Again, they are not actually structured under an Organisational Architecture point of view, but this data collection can be a good starting point to build a list of possible actors in the SAFESPOT project.
There are some tables listing all the actors forming the organizational structure of speed limit management for 7 different European countries and according to their possible different roles (consolidation of collection, maintenance and certification of speed limit information - actually recognised as one of the biggest challenges in developing an informational infrastructure speed limit management process):

- actor deciding speed limit (i.e. National or Local Government, National or Local Highway Authority, Transport Ministry, Local Office, Technical Division of Local Government);
- actor executing the decided speed limit (i.e. Regional Road Administration, National/Local Highways Authority, Traffic Control Centre, Technical Division of County Council, Road building authority at the level of the regional government, Authority that decides the speed limit, Regional Road Administration);
- actor certifying that the speed limit decision is correctly signposted (i.e. Signposting authority self quality control, Regional State Representative);
- authority on national/regional/municipality level with speed limits database;
- actor providing speed limit data.

From a deployment point of view, it is interesting the scenarios approach adopted in this project: four main scenarios are defined that correspond to the most relevant technical evolution branches and it is pointed out that, besides technical aspects, scenarios could also address organizational, political or marketing issues.

An interesting approach on the organizational aspects was made in PROSPER project, dedicated to the development of an Intelligent Speed Alert (ISA) system. Some organisational issues arose from the introduction of this system, which could also be interesting for the SAFESPOT implementation.

It was noticed that generally, informative ISA systems introduced at a voluntary basis wouldn’t cause organisational barriers, while intervening ISA systems with a mandatory introduction will face organisational constraints, at least in the short-term perspective.

The most important issue related to organisational aspects seems to be the development of well functioning management of road speed data all over the Europe: the member Countries need to establish national road databases covering the whole road network; so far, no country has a well-functioning
organisation for management of road data, which is essential in order to ensure quality-assured and up-to-date information.

The economical aspect is also important and has organisational implications; since the early phases of ISA implementation can be characterised by low demand in combination with high costs: some kind of promoting schemes will be essential in order to facilitate an introduction.

Moreover, technical systems are essential; this will not be an organisational barrier in the long run if all the member countries in the EU agree upon technical standards enabling interoperability all over Europe.

Other than these barriers, the interesting point is that the study upon possible organisational issues has been anticipated by the definition of a System Architecture, where the core functions of the system were described in order to enable an analysis. In other words, the organisation analysis needs the functions of the systems to be defined in advance (Functional Architecture).

After the functions were defined, each of them was linked to actors. This process has been depicted in a schematic overview, showing the actors’ involvement in the system (see Figure 2-2).

![Figure 2-2: Matrix describing the link between functions and actors (source: PROSPER)](source: PROSPER)
In order to make an appropriate actor analysis, the stakeholders tasks and duties has been assessed – e.g. is actor x in charge of decisions on matters regarding function x, or is the actor x only involved in maintenance issues related to the function? The following task and duty definitions has been regarded in the actor analysis for authorities:

- Propose; which actor would take an active part in the policy making process of additional issues related to ISA?
- Decide; which public actor would decide on matters related to ISA?
- Maintain; which public actor would be responsible for the maintenance and operation of the infrastructure and communication?

Another interesting approach to the organisational issues was found in the GST project. GST is an open telematic system concept for vehicles, drivers and passengers, defined for four blocks: Open Systems, Security, Payment, Certification.

The methodology adopted to establish an architecture consists firstly of the identification of the user needs; from these user needs a set of actors and entities were defined. These actors and entities are the subjects in a set of scenarios also referred to as use cases, which describe the intended behaviour of a system. Use cases help in describing the roles the different actors and entities play when interfering with the system to yield a specific result. In a next step these use cases resulted in a set of requirements the system should fulfil in order to accomplish or facilitate these scenarios. Finally the interaction links between the entities are defined as the reference points along which axes the system architecture will be developed (High Level Architecture).

These four artefacts: User Needs, Use Cases, Requirements and High Level Architecture offer the raw input materials to the architecture and design definition. The methodology adopted re-iterates on these artefacts and expands them into a detailed architectural and behavioural specification clarified by means of Unified Modelling Language (UML) symbols and diagrams. To support this development work a pragmatic and simple methodology has been defined based upon the Reference Model for Open Distributed Processing (RM-ODP) or viewpoint approach.

The ODP framework of viewpoints partitions the concerns to be addressed in the design of distributed systems. A viewpoint leads to a representation of the system with emphasis on a specific set of concerns, and the resulting representation is an abstraction of the system, that is, a description recognizing some distinctions (those relevant to the concern) and ignores others (those not
relevant to the concern). Different viewpoints address different concerns, but there is a common ground between them. The framework of viewpoints must treat this common ground consistently, in order to relate viewpoint models and to make it possible to assert correspondences between the representations of the same system in different viewpoints.

The methodology adopted by GST uses a simplified version of RM-ODP extracting from the five original viewpoints being Enterprise, Technology, Information, Computational and Engineering three essential ones tailored to the needs of GST. These viewpoints are: Enterprise, Logical, Implementation, as shown in Figure 2-3. Each viewpoint represents a different abstraction of the original distributed system, without the need to create one large model describing it and together they provide the complete description of the system.

Figure 2-3: simplified RM-ODP methodology adopted in GST project

Figure 2-4 provides a graphical overview of the overall architectural process.
Among these viewpoints, the one containing the organisational aspects is the Enterprise view. This viewpoint describes the functional requirements of the system, the manner that outside things (actors) interacts at the system boundary and the response of the system. In order to do this:

- firstly it is described the Environment of the system, including all Actors that interact with the system. This is done by building an Environment Hierarchy diagram, containing both the GST System as well as the environment that the GST System interacts with. The environment of the GST System has been divided into an Environment for the GST Operational System, an Environment for the GST Realization System and an Environment for the GST Commercial System. A table is also presented, that summarizes and describes each Actor that is part of the Environment of the GST Operational, Realization and Commercial System.

- Secondly the System itself is detailed, by building a System Hierarchy diagram, that identifies the major components within the system, defined as Entities. It is logically divided into an Operational System, a Realization System and a Commercial System. Also in this case a table is presented, containing the components of GST system.

- Finally the interactions among the major entities of the GST System and the GST System Environment are described. The interactions are displayed in a layered set of Block Diagrams, which show the interactions between the entities at different level of detail. For the most important links between the entities, "Reference Points" are identified. These reference points don't impose any implementation or design solution. Instead they merely identify the potential interfaces between the entities that are within the scope of the GST project.
This kind of analysis could be potentially applied for the SAFESPOT project.

On one hand the ODP framework of viewpoints is interesting because it states the need to develop all the SPs with different approaches coming from different positions, on the basis of a common ground. This concept can be found also in the ARTIST Architecture Model: the functions defined in the Logical Architecture are grouped under a placement point of view in the Physical Architecture and under a management point of view in the Organisational Architecture.

On the other hand, in this scenario the Enterprise view might give interesting inputs to the development of the SAFESPOT Organisational Architecture, by applying the Hierarchy diagrams, Actor tables, Block diagrams and Reference Points when developing the Artist Methodology. Also the distinction between Operational, Realization and Commercial Systems might bring a further help in the deployment process.

Conclusions

To conclude the state-of-the-art analysis for the Organisational Architecture, some general points that came up from the different projects can be highlighted.

Among all the projects that were analysed, only one (ARTIST pilot project ECALL) deals with the implementation of an Organisational Architecture following a standardised methodological approach. The organisational/business concepts of Value Chain and Actors’ Roles and Responsibilities are sometimes dealt in the sections related to the Logical and Functional Architecture and Business Models, but never in an organic way; other concepts typical of the Organisational Architecture, as Efficiency, Value Levers, Cost Drivers are not discussed at all.

The European Reference ITS Architecture FRAME does not contain a model for the implementation of the Organisational Architecture of an ITS system.

The Organisational Architecture development needs the functions of the systems to be defined in advance (Functional Architecture).

The Organisational Architecture definition starts with the detection of a value chain containing the functions of the service rather than the actors.

The development of an effective Organisational Architecture is the result of an analysis from a certain viewpoint (enterprise/organisational). Each viewpoint (Enterprise, Logical, Implementation), represents a different abstraction of the original system. The same functions are grouped in different ways to fulfil different viewpoints.
A strong relationship exists between the development of Organisational Architecture and the one of Business Model; the common objective is to find out the organizational and business aspects in order to make sure the services functionally described in the Logical Architecture are effectively achievable. The implementation of the Organisational Architecture and the definition of the best Business Model are based on the fundamental concept of the “value chain”.

2.2.2. Business & Service models

The success of a new business can’t put aside from the correct choice of its business model. The business model defines, in fact, the whole operation of the new business to be embarked on, in terms of offered product/service, served market, positioning, roles and activities of each actor involved in the business supply chain, costs, revenues and profits expected.

This paragraph deals with the aspects to be analysed in BLADE WP6 “Business Models”. This analysis aims at defining possible service and business models for the introduction of SAFESPOT architecture and at identifying the most suitable one, according to the qualitative and quantitative assessments on market, costs and socio-economic impact, made with a strong interactions with WP5 “Assessment and evaluation”.

Overview

The business model, focusing in terms of broad principles on the mechanisms for generation of revenues in the value chain, represents therefore the instrument allowing a hypothetical new business to turn into real economical outputs.

The process of business model creation consists of the following main steps:

- **business configuration**: the actors involved in the business are identified and the supply chain is structured, positioning all of them with their own roles. Activities and mechanisms for cost, revenue and profit generation are defined for each business protagonist. Moreover, the potential competitors of the new business are determined in order to define how to reach and to maintain a competitive advantage towards them.
- **product/service configuration**: product/service, mostly satisfying customer needs, and its possible alternative configurations are defined;

- **market configuration**: once the product/service has been shaped, its potential market (and so the customers to be reached) is defined without forgetting that different needs, and therefore different product/service configurations, correspond to different market segments;

The first part of the analysis will need a close relation with WP3 “Organisational Architecture” and technical SPs. In fact, the alternative models will be based on technical and functional choices made in technical SPs. Such choices are related to the type and number of the adopted applications, as well as to the positioning between the two extreme scenarios of SAFESPOT: predominance of vehicle intelligence and predominance of infrastructure intelligence. This affect the value chain definition, the actors involved and their potential roles and responsibilities. Also the service model, mainly in terms of chosen target market and pricing policies, is an important decision factor together with the role of public stakeholders.

In the analysis of existing projects and studies, it was noticed that the BLADE parts dealing with organisational architecture and business models were not explicitly separated and normally the value chain definition took to a identification of one business model. None of the reviewed projects adopted the SAFESPOT approach (definition and ranking of alternative business models).

Nevertheless, interesting elements come mainly from the analysis of three European Projects: **E-MERGE, SAFE TUNNEL** and **AIDER**. An useful methodology has been developed in E-MERGE Project. The objective is to identify the business case elements:

- the possible benefits and costs of the E-MERGE system;
- ways to reach the possible benefits;
- the needed investments;
- the stakeholders involved.

With an European survey (using the Test sites) different interesting aspects were detected:

1. the stakeholders groups, already mentioned in the previous paragraph;
2. the impacts related to business case elements for each of the stakeholders identified:
• for the vehicle manufacturers (save costs by having standardized on-board units, Common message formats and protocol used by all parties involved and all across Europe, Fully interoperable service can be offered to clients regardless of E-Call service provider);

• for the user/driver (Reduction of annual insurance costs, Faster and more reliable emergency response in case of accident, Service available anywhere in Europe);

• for the service providers/including automobile clubs (Better business opportunities and larger potential client base, Being able to offer to the clients value added ecall service, Better business opportunities and larger potential client base);

• for the PSAP’s (More effective and targeted assistance can be offered to the benefit of both the driver and the emergency agencies);

• for the Emergency agencies (more effective and quicker response, Reduction of Costs for public and private rescue operators by having correct information, Reduction of medical costs and rescue costs and decrease financial impact on public budgets);

• other (New jobs will be created in the telematics industry and SP administration, Higher efficiency for breakdown recovery companies e.g. by knowing the exact location and type of vehicle);

3. the business case elements: they are first described per stakeholders, after defining the basic hypothesis. Then each business case (on the two parameters Cost and Benefits) is ranked and judged on two parameters: estimated volume and ease of implementation.

In SAFE TUNNEL project it is demonstrated an economic advantage coming from the implementation of the system. These considerations were made only for Heavy Good Vehicles, even if benefits could also be extended to all commercial, public and private vehicles. An analysis of the players involved and their roles in the value chain has been made.

It has been analysed the impacts related to business case elements:

- for tunnel operators (an agreement with truck manufactures is necessary. In fact they are together the players who are expected to sustain the majority of related investments and operating costs, and their businesses are strongly interconnected);
- for truck manufactures (Customers are interested in telematic features that increase productivity, and also in features that generates potential savings: like insurance premium and tunnel toll reductions made for ST owners, in the same time Safety & Security features are the most desirable contents for Commercial Vehicle fleet managers).

For AIDER project, results are referred to passengers cars and Light Commercial Vehicles (main stakeholders). Indirect stakeholders are: insurance companies, automotive clubs, service providers, equipment manufactures, locations technology providers, repair industry.

In the CONVERGE project, another classification was used and it is to be considered. The classification counted four categories, those being:

- who wants the system,
- who makes the system,
- who uses the system,
- who rules the system.

This classification can be very interesting, because it permits to have a clearer view of the role of the different actors, and this way can simplify the attribution of the responsibility concerning the legal aspects.

Methodology

No specific methodologies have been found for business model analysis.

Survey method has been used in several projects (e.g. APOLLO, ADVISOR) to investigate the position of the relevant actors. After being selected and classified, the actors were interviewed on different main topics such as the severity of traffic related problems, liability, future of ADA-system. For Advisor, the actors opinion was mainly collected by telephone interviews, with a few interviewed face-to-face or by questionnaire. The survey was designed to be very short and to have only “filling in the rating” type of possible answer in order to allow a numerical analysis. The interviews were conducted in several countries and the opinions of the European Commission were also collected.

In EMERGE, in order to define the business case elements to be inserted in the E-MERGE concept, an European survey was carried out.
Then the business case elements were first ranked and then judged on 2 parameters: estimated volume and ease of implementation.

- For the estimated volume, the figures used were the ones presented by the different stakeholders;
- Ease of implementation is the answer to questions like: “Is the stakeholder able to change this for himself? Will it take considerable effort to implement? Are there only results at a full scale implementation or create partly implemented solutions already benefits for the stakeholder?”

Conclusions

The complexity of the SAFESPOT architecture requires, unlike existing projects, two different and sequential steps to be carried out in order to identify the most suitable business and services model.

In the existing projects, the definition of Organisational Architecture and business model are made at the same time with the aim to define the organizational and business aspects in terms of actions, roles and responsibilities in order to make the service achievable and sustainable.

At the end, the results of previous projects can be summarized as follows:

- among all the analysed projects, the players involved, their roles and responsibilities in the value chain have been defined and described;
- for EMERGE and Safe Tunnel projects, the impacts related to business case elements for each player have been analysed;
- only CONVERGE project used a different classification (who wants, makes, uses, rules the system) to have a clear view of each actor roles and responsibilities.

2.2.3. Risk/Legal Aspects

This paragraph deals with the issues to be faced in BLADE Work Package 4 related to the analysis of risks related to the SAFESPOT implementation and the analysis of legal aspects concerning the introduction on the market of such system.

The paragraph consists of three sections, respectively devoted to risks, liability and insurance aspects. Useful information and methodologies coming from the analysis of existing projects have been summarized in those sections.
2.2.3.1 Risk analysis

Overview

The goal of the overview of risk analysis for BLADE is to identify possible risks (in the broadest sense) for deployment of ITS. A methodology to systematically identify all possible risks has been developed in the RAID-project. The RAID methodology has been developed and applied for the KAREN framework architecture, which is only a high level architecture. This methodology is one of the few methodologies that identifies mitigation strategies. In various studies, a technical risk assessment is performed using for example Failure Mode Effect Analysis (FMEA). This methodology only focuses on the effects of a technical failure of specific system components or functionalities. This type of technical risk assessment is not within the scope of BLADE.

In general, the risk analyses performed in evaluation and deployment studies focus on a single system (e.g. AWAKE, GALLANT, PROSPER, CARTALK). Even in Advisors, that covers a wide variety of ADAS, a risk assessment is performed only for Adaptative Cruise Control (ACC). Although a risk analysis may be part of a project, the number of issues covered in the risk analysis may be limited. CARTALK focuses primarily on market introduction strategies addressing early adopter benefits. Response 2 focuses only on legal and insurance issues. The ADVISORS project is the only project coming close to identifying a complete range of risks, but this project is not finished yet. Only a few studies have developed mitigations strategies to reduce the risks of deployment failure (RESPONSE 2, CARTALK).

In this overview, we first explain the RAID methodology, especially the different categories of risks identified by RAID and the typical risks associated with those categories. We also present an overview risks that are examined in more detail in the various EU projects. This will give a general overview of the risks that have already been analysed and the risks that need more attention in the analysis of cooperative systems. This will be the concluding part of this overview.

Methodology for risk assessment - RAID overview

The RAID methodology consists of three steps:

- Identification of risks. Experts in the field of transport telematics are requested to generate a list of possible risks. RAID divides risks into 15 threat categories. These categories seem useful as they separate different
aspects of possible ITS-deployment. Using the RAID-methodology different strategies are divided into the action itself, actors needed for this action, type of action or category. These different categories cover almost all potential barriers to deployment of ITS.

- Development of deployment scenarios. A scenario is a set of circumstances in which a risk might occur and for which a mitigation strategy is recommended. Detailed reference scenarios are developed to identify context of each risk. The context is defined by geographical scope; main trends for ITS development planning (use of telematics, provision of telematic infrastructure and applications of telematics for traffic), level of public and private cooperation and the time horizon.

- Development of mitigation strategies. For each scenario/risk, one or two mitigation strategies are developed to reduce the impacts of the identified risk.

![Figure 2-5: Overview of the RAID methodology (source: RAID final deliverable)](image)

The categories distinguished by RAID are the following (few examples of possible risks will be described as well to classify different potential risks):
1. **Framework architecture**: incompatible solutions on the architecture level, different deployment speed between Countries. This indicates the overall risk of different architecture on all levels.

2. **Communication**: lack of coverage of communication methods (geographically), use of different communication technologies. Risk of different communication methods/technologies.

3. **Cost Benefit**: lack of finance support and lack of awareness of the public and therefore not enough sales with the consequence of failing market implementation. Risk is no market penetration, consequence is no deployment of specific system, reason is not enough financial back up.

4. **Deployment & Operation**: lack of high quality and comprehensive data and lack of skilled workers for development and maintenance. Operational and deployment problems because of difficult technological implementation, too much qualifications needed. Risk is choice of easier system or less complex system or no system at all.

5. **Funding Provision**: not sufficient funds to cover all services that need implementation. Risk is no deployment at all.

6. **ITS Infrastructure**: high maintenance costs of the required infrastructure may prevent the introduction of new ITS technologies, also quick evolution of technologies is a threat.

7. **Legacy**: migration to a new system, rigid regulations as barriers. Risk is current legislation which cannot handle new technologies.

8. **Organization & Institutional Issues**: unwillingness to collaborate or improper public private partnerships. Risk of different systems on different roads from different operators.

9. **Politics**: changes in political context which defer implementation of ITS. Risk of “sudden” change in plans of politicians in “bad” economical periods.

10. **Privacy**: issues raised about the use of the data that is collected. Risk is willingness to use.

11. **Safety**: use of non-safety compliant systems, driver misuse of the system.

12. **Stakeholder Acceptance**: lack of cooperation between stakeholders and poor acceptance of some ITS solutions means missing benefits. Risk of market failure of system.
13. **Standardization**: European harmonization is important for all issues (not only technical). If standardization is not achieved deployment might be at risk. It's more of a mitigation strategy and possible solution for a lot of risks.

14. **Technological Maturity**: unavailable technology, too expensive or insufficient reliability (too costly to develop). Failing of the system or too slow R&D.

15. **Traveller Acceptance**: costs of the system to the user, information availability, continuity of the service.

**Identified Risks**

This part will consider all potential risks that were identified examining the different studies. Not all potential risks formulated in the RAID-methodology have been identified and discussed by these studies. Also the mitigation of potential identified risks are not explored systematically. For each project the risks that were identified are listed in Table 2-4 to give an overall overview of the scope of the risk analyses conducted by the various studies and the kind of risks identified.

**Table 2-4: Overview of risks analysed by previous projects**

<table>
<thead>
<tr>
<th>Project acronym</th>
<th>Risk category RAID categories</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVISOR</td>
<td>3,8,12,14,15</td>
<td>Not complete</td>
</tr>
<tr>
<td>AIDE (*)</td>
<td>13,15</td>
<td>None</td>
</tr>
<tr>
<td>AIDER (*)</td>
<td>3,14</td>
<td>None</td>
</tr>
<tr>
<td>AWAKE</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>CarTalk (*)</td>
<td>14</td>
<td>Early adopter benefits</td>
</tr>
<tr>
<td>FRAME</td>
<td>All categories</td>
<td></td>
</tr>
<tr>
<td>GALLANT</td>
<td>14</td>
<td>None</td>
</tr>
<tr>
<td>GST (*)</td>
<td>3,12,13</td>
<td>Not found yet</td>
</tr>
<tr>
<td>IN-SAFETY (*)</td>
<td>3</td>
<td>Not avail. yet</td>
</tr>
<tr>
<td>INVENT</td>
<td>3,15</td>
<td>Not avail. yet</td>
</tr>
<tr>
<td>PROSPER</td>
<td>12,13</td>
<td>None</td>
</tr>
<tr>
<td>RESPONSE 1,2,3</td>
<td>4,13</td>
<td>Code of Practice</td>
</tr>
<tr>
<td>SAFEMAP</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>SeiSS</td>
<td>3</td>
<td>None</td>
</tr>
<tr>
<td>SPEEDALERT</td>
<td>8,13,14</td>
<td>None</td>
</tr>
<tr>
<td>Watchover (*)</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

(*) = cooperative systems
Only 15 studies identified risks in one way or the other. The identified risks are related to architecture, cost benefit, organizational and institutional issues, stakeholder acceptance, standardization, technological maturity or traveller acceptance category.

For the purpose of this state-of-the-art overview, the risks have been redefined into seven main categories concerning: user related risks, technology related risks, organizational and institutional risks, economic risks, political risks, deployment and operations risks and risks related to legacy.

A. User perspective: Privacy, Safety & Traveller Acceptance (10, 11, 15)

The most important risks related to privacy, safety and traveller acceptance are:

- Poor design of in vehicle-system and information can affect driver behaviour; as a result users do not use the system properly and safely. The benefits of a system are not realized and potentially dangerous situations may occur (RAID).

- Highly complex functioning of ADAS; users do not understand how the system operates and do not trust the system or do not recognize conditions under which a human interference is required quickly (RAID). This risk is recognized in the AIDE project as ‘… driver awareness of their perceptual limitations on making accurate distance estimations…’. Also the over trusting of the system is discussed in this deliverable as a risk, which is concerned with behavioural adaptation towards ITS services in vehicles.

- End user can not cope with provided facilities; end users may be put under pressure that leads them to take actions compromising their safety and the safety of others. (RAID).

- In the ADVISORS project a risk analysis is performed to identify potential implementation risks concerning driver training issues.

- Privacy of data collection is under estimated; this may lead to unacceptable and inappropriate use of personal information by third parties or consumers do not adopt the system (RAID). Privacy is not a main issue for ADAS and has not received much attention in recent studies because the systems are autonomous and there is limited exchange of information with other vehicles or road side units.
- Users have concerns about the misuse of information collected by ITS services such as actual location and origin/destination information; travellers will be reluctant to use the system. (RAID).

- Existing legislation with respect to privacy and data protection is not complete enough to cover all data (RAID).

**B. Architecture Technology Maturity and Availability (1, 2, 6, 14)**

Risks related to architecture, technological maturity and technology availability are:

- The architecture does not include or accommodate all possible or future ITS applications; as a result interoperability of ITS applications and services is not guaranteed (RAID).

- Some services are not available across Europe as required technology or ITS infrastructure is not provided throughout Europe. ITS services do not provide their full benefits uniformly across the whole of Europe. In some geographical regions there will be no benefits from ITS services and policy objectives may not be difficult to achieve (RAID).

- The infrastructure installed as part of systems providing ITS services rapidly becomes obsolete due to fast pace of technological development. Operators and service providers will not be able to recover the initial capital investment in the infrastructure before it becomes obsolete (RAID).

- Some of the existing systems that provide ITS services cannot migrate to become compatible with newer systems developed based on the SAFESPOT architecture. Some manufacturers and service providers may become excluded from the benefits of compliance to the SAFESPOT architecture (RAID).

- Reliability of systems and system components is unsatisfactory and does not reach required levels. Reliability of systems is measured in the ADVISORS project through the FMEA-methodology. This methodology of Failure Mode Effect Analysis is helpful to identify the effects of failure of parts of the system. Within this methodology assumptions are made for the failure chance of every part of the system. ADVISORS analyses the risk of ISA, driver vigilance and health monitoring systems, ACC, extended navigation and route guidance systems. For every different failure a mitigation strategy is formulated. The same methodology is used in the AWAKE risk analysis, concerning driver drowsiness. Part of AIDER is a
specific project which relates to the identification of potential failures of sensors. This again relates to reliability and is measured through the SHEL (Software, Hardware, Environment and Liveware) method. The distinction between those four dimensions of a system allows the researcher to identify not only single risks, but also related risks. Using the FAA risk Assessment method to rank the different criticalities, the ranking indicates which risks need to be solved and which can be solved during implementation.

- Required technology is not available or mature. In CarTalk, it is argued that the future development of the selected UTRA-TDD under technological and economical aspects is hardly predictable as it may be assumed that communication providers will focus on the construction of the UMTS net and its basic services first. CarTalk proposes to use an intermediate step using existing technology.

- Equipment for use by lateral collision avoidance systems will be impossible to design or locate in the highway infrastructure so that they cannot be damaged by accidents and vandalism. Lateral collision avoidance functionality that use road side equipment will be unreliable and may lead to accidents (RAID).

C. Organisational & Institutional (8, 12, 13)

The most important risk that are identified by multiple studies considering organizational and institutional issues as well as standardization are:

- Unavailability of data to other parties (because of money issues). This will degrade the performance and delivery of some ITS services (RAID). The Speedalert project is concerned with the creation of a standardized data model for speed limit information. This will allow access to data for other parties.

- Disparity between private and public sector. This lack of understanding makes it difficult to deploy some ITS services. (RAID). Speedalert mentions involvement of public and private sector in establishing a joint European roll-out plan.

- No common standard for in vehicle communication or safety readiness. It will be difficult to form a random mix of vehicles into a platoon for automatic vehicle operation, even if they are all equipped with the required in-vehicle functionality. (RAID)
- The standards which should be fulfilled by different project are listed in the AIDE project. The AIDE project delivers a complete list of guidelines, standards and regulations for the implementation of ADAS in Europe. The safety readiness of systems and standards concerning this is discussed in eSafety. Drivers may make erroneous assumptions about the safety readiness functionality in each vehicle leading to situations that may cause injury of endanger life (RAID).

- No optimal collection of data through infrastructure because private sector not allowed to install sensors on public roads. There will be a lack of good quality of services (RAID). SPEEDALERT is concerning data collection on all European roads, this is a must for full deployment of SPEEDALERT among other systems. If this data collection issue is not solved deployment of Speedalert will be delayed. Another project, SAFEMAP, is also concerned with the data collection about all roads in Europe for the introduction of a speed limit assistant, frequent accident warning spot, overtaking assistant, hazardous area identification, Intersection approach speed warning and curve speed warning safety systems. Advisors also mentions the lack of digital mapping of the road-net as an organizational risk towards deployment.

- No common policy regarding protection of vulnerable road user. Systems that support ITS services in this area will not include functionality that can accommodate all the policies of the members of the European Union. (RAID). WATCH OVER is a project which has started recently and it’s objective is solving the issues around vulnerable road users.

- Lack of general advertising devoted to ITS services. ITS services do not provide expected benefits, because users do not know of their existence. (RAID) Response 2 has regarded this issue and for a proper deployment program a marketing plan should be written in order to let people know about the benefits of certain systems. This marketing plan is part of a complete code of practice concerning deployment of a IVIS or ADAS.

- No materialization of standardization of interface of on-board systems (short term). The end user will receive different information in different countries through the vehicle on-board equipment. (RAID)

- Misunderstanding or competition about provision of ITS-services between governments. Providing ITS services becomes a hazardous area of business for the private sector. (RAID)
Manufacturers want to own systems and to protect their own market. Therefore manufacturers will hinder, delay or prevent implementation of open standards. (RAID)

Road works performed by not connected organizations hard to identify. Impossible to predict congestion and travel delays caused by these organizations. (RAID)

Subsidiarity principle stops promotion and deployment of certain systems. The implementation of systems will be held back. (RAID)

Measurement of quality of data not organized. The data provided by ITS services are of low quality and of little value to end users. (RAID)

Unable to create standard communication technology to handle all the data. Information for all won’t be available because communication with some data sources is impossible. (RAID)

D. Economics – business cases & policy cases (3, 5)

Main risks identified considering business cases & policy cases are:

- Insufficient funding provision. This jeopardizes the implementation of new ITS services (RAID). Continuity of funding provision is mentioned as important issue in the ADVISORS project, not only the availability of funding. Especially the high cost of investment, which is required for the further development of ADA systems.

- Perceived high costs of information by travellers. Under utilization of a service and high cost for travellers to obtain information (RAID). Response 2 is mentioning this issue in their Code of Practice. Mainly the promotional issues are important next to a provision of a basis for market introduction. This issue is also mentioned in Prosper and Advisor. Advisor rates this risk very high considering the implementation of ADAS.

- No payback in deploying ITS services on secondary transport axes. Commercial vehicles will be constrained to use primary roads (RAID).

- 100% reliability of sensors too costly to develop (longitudinal collision and automated vehicle control). There will always be hazards arising from the use of this functionality that drivers will find unacceptable (RAID).

- Too high costs to equip and maintain highways with sensors. Deployment of sensors and transponders will be poor and will restrict the ability of drivers use vehicle lateral collision avoidance functionality (RAID).
Some highways devoid of sensors because of costs. Some incidents will go undetected and it will be difficult to manage the effects of others (RAID).

Requirement for a minimum level of penetration and successful market introduction. In opposite to autonomously working safety systems, like airbag, ACC, ESP, vehicle-vehicle communication requires at least one communication partner within the communication range. Therefore, the introduction is more difficult as the system may not develop its benefits at once but only on a progressing penetration rate. This phenomenon is known as the benefits from network externalities. In the CarTalk project, market introduction scenarios are developed for Information and Warning Functions (IWF). These scenario aims at providing a clear benefit for the very first customer, paving the way for an increasing penetration rate. The various scenario proposed include (1) to equip police cars, ambulance vehicles and service vehicles of automobile clubs with vehicle-to-vehicle communication; (2) to equip at road works with IWF-beacons; (3) to equip set of lights with IWF-beacons, indicating actual and variable speed limits, dangers like fog, slippery road or accidents; (4) to obtain support from insurance companies, lower premiums as a result of lower risks of damages; (5) to generate value adding services, like hotspots provided free downloaded multimedia and electronic advertisement.

E. Politics (9)

The main risk considering politics is:

- There is a major risk of political instability in relations to PPP (private public partnership) constructions for deployment and development. Providing ITS services becomes a hazardous area of business for the private sector (RAID). As a result private sector is reluctant to invest in ADAS/Cooperative systems; and ADVISORS is mentioning this issue as potential risk. SPEEDALERT also mentions that the development of proper PPP constructions is necessary for deployment of Speed limitations database.

F. Deployment and operation (4)

- Different labelling and measurement of European roads. Confusion will exist with respect of the exact location of facilities on roads (RAID). This issue is recognized in SAFEMAP, which aims at creating a standardized map of whole Europe to handle the problem of differences among
European countries. PROSPER also identifies the need to harmonize standards throughout Europe through a Delphi survey. However no mitigation or anything like is proposed in the deliverable.

- Missing gaps in certification and production usage information for drivers. The introduction of ADAS might be delayed (RAID). The Code of Practice discussed in Response 2 is covering the issue about standardization of new products. Suggestions are made about how to handle new products before market introduction.

- Small number of vehicles equipped with ADAS or cooperative systems. Road travellers may not be informed in time about potential obstacles and congestions and the expected benefits of cooperative systems will be too low (RAID). PROSPER also identifies this risk through a stakeholder survey as a potential barrier to implementation. Scenarios are formulated to overcome the different barriers. Response 2 aims at providing the basis for market introduction of ADAS and therewith a significant reduction of accident rates in Europe.

- Insufficient data sources to provide good quality of service. End users will be reluctant to use the service as quality is insufficient or unreliable (RAID).

- Irregular updates make static information becoming obsolete. This will cause under utilization by the end users (RAID). Maintenance issues are mentioned in Advisors as potential threat to deployment. The specialization of workshops and higher costs related to maintenance are seen as a threat.

G. Legacy (7)

- Regulations for dealing with the consequences of failure of systems. There is a possibility that national or local governments refuse approval or licenses of ITS services. There may be also differences in approval and licensing policies across EU member states. (RAID).

- Different enforcement of regulations in different countries. This will discourage the development of uniform approach to enforcement systems, because they will have to be tailored to all individual requirements of states and countries (RAID). Prosper identifies from framework point of view the potential stakeholders and formulates different issues possibly raised for these actors. Those issues are all in the legislative sphere and all relate to the implementation of ISA.
Conclusions

Risks analyses have been considered in many EU projects although the analyses performed have not included all potential risks. In most projects specific categories of risks are considered.

Only a few projects identified potential risks with a formal risk assessment methodology and even fewer developed mitigation strategies (only 2). The Advisor project provides the most comprehensive risk assessment for ADAS. An overall view (all projects considered in this state of the art overview) of the risk analyses learns that user acceptance, liability and cost benefit are the main risk categories mentioned. Another main concern (for which specific risk analysis is done) is the consequences of failure or malfunctioning (especially to reduce liability). An area that needs more attention concerns the risks related to behavioral changes of users.

The analysis of mitigation strategies are primarily addressing systems failures and market introduction. The RAID project provides a very useful list of potential mitigation strategies. These could be helpful in SAFESPOT although the risks and mitigation strategies identified need to be updated to current ITS and technological state-of-the-art and need to be tailored to the systems and functionality of supported by the SAFESPOT architecture.

2.2.3.2 Legal aspects

Legal issues of ADAS (including insurance issues) have been surveyed in several European projects. The most important of these projects were RESPONSE 1 and RESPONSE 2. Other European research projects including legal aspects comprise ADVISORS, STARDUST, AWAKE and PROSPER. While RESPONSE 1 and 2, ADVISORS and STARDUST were looking at ADAS more generally, the AWAKE and PROSPER projects were focused on two specific ADAS concepts (driver fatigue monitoring systems and intelligent speed adaptation).

Furthermore the projects differ in the variety of legal issues that have been addressed (including traffic liability, product liability, vehicle safety standards and type approval issues, rules on driving licences, insurance aspects, and issues of legal evidence and privacy) as well as the comprehensibility in which these issues have been studied and analysed (short descriptions of these projects are included in Annex 3).
However, the performed analysis shows that the most attention has been given to liability and insurance aspects of ADAS. For this reason this paragraph is focused on this two issues.

Overview on liability aspects

As ADAS have the potential to influence the driver’s task, it immediately raises the question as to which kind of consequences this may have for liability for traffic accidents. To what extent may the use of such a system shifts liability from drivers to manufacturers, or to other parties involved (service providers, road authorities, etc.)? May the liability implications form a barrier for the introduction of ADAS?

A first important conclusion is that there are no clear-cut answers to these questions. Relevant liability regimes are often characterized by rather vague concepts such as: standards of care to be applied by drivers; the safety a person is entitled to expect from a product; or the standards that may be set for public roads. The advantage of such vagueness is that it does not restrict the ability of judges to deal with matters on a case-by-case basis, taking all relevant circumstances into account. On the other hand, such concepts fail to provide clear and objective standards to enable manufacturers, road authorities or other parties to assess acceptable levels of performance of their products, services, road designs, etc.

For example, even if it were proven that ADAS reduced the number of accidents overall, this fact alone would not shield the manufacturer from product liability claims (RESPONSE 2). This is because product liability law does not analyse the question of overall benefits of a product but rather addresses the (narrower) question as to whether a product is defective, i.e. whether it provided a level of safety that consumers were entitled to expect, taking all the circumstances into account, including circumstances wider than overall safety benefits, such as advertisement statements, warnings accompanying the product, and the availability of alternative designs.

It is for this reason that legal and insurance issues cannot be dealt with in a generic way, i.e. giving generic answers to generic questions. Useful results may only then derive if one considers specific ADAS as well as application scenarios for them (ADVISORS). In its final report the RESPONSE 2 consortium concluded, as key messages, that ADAS systems remain manageable from the legal point of view and that of the user’s viewpoint only as long as they can be controlled and/or overridden by the driver at any time. Problems regarding
licensing and (product) liability law are most likely to occur with assistance systems, which cannot be overruled by the driver or which intervene beyond human psychomotor performance limits (e.g. anti-collision systems). However, it would be over-simplifying matters to conclude that where ADAS can be overridden, liability concerns will be non-existent. This will depend upon the characteristics of the applicable liability regimes and the circumstances of each case (for example, courts will consider any inherent system limitations, taking into account whether the driver was warned about system limitations and whether he reacted appropriately to any such warnings).

Specific difficulties in this context arise if these systems are considered in respect of an urban environment. The source of these difficulties is the number and complexity of interactions between drivers, the system and the external environment. The challenge will be to introduce such a system with acceptable safety risks, given the inherent limitations of the technologies within the context of the urban environment (STARDUST).

How can a manufacturer manage his liability risks? All legal analysis carried out within RESPONSE shows the high relevance of a clearly defined technical and user-centred development and testing to reduce the risks for manufacturer and user. This is true for controllable and also for non-controllable systems.

In the context of product liability, different duties of care could be identified (AWAKE):

- a duty to investigate the potential risks of the use of driver fatigue warning systems;
- a duty to anticipate these risks through a proper design;
- a duty to warn and inform users to mitigate these risks; and
- a duty to monitor their products.

Manufacturers should be aware of the following issues.

Given the innovative nature of such a product, manufacturers cannot passively rely on the current state of knowledge (RESPONSE 2). They have a duty to investigate proactively the potential risks involved in the use of their product.

Testing such systems cannot be limited to technical safety alone, but should include human factors as well, especially including ‘vulnerable’ driver categories (RESPONSE 1).

System limitations and situational conditions that may influence system performance should be clearly communicated to the user; for example, through
warnings in the manual. Manufacturers should refrain from unrealistic claims about system performance.

Development and application of commonly agreed guidelines, performance requirements, code of practices, etc. will be an important strategy to mitigate product liability risks. These may be seen as the written expression of ‘the safety a person is entitled to expect’ or the duty of care to be applied by the manufacturer and may also have relevance in other legal contexts (RESPONSE 2). Such pre-defined standards will give some guidance in assessing liability, because such a written standard may reflect a general consensus of what acceptable levels of safety are. However, they will not be decisive because courts will take all circumstances into account.

The above-mentioned projects mainly focused on autonomous systems, i.e. systems that are not using forms of data communication between vehicles or between vehicles and the infrastructure or which require adaptation of the infrastructure (electronic beacons, etc.) for their proper functioning. In RESPONSE 2 some attention was given to legal liability in relation to cooperative driver assistance systems based upon vehicle-to-vehicle communication. That analysis is relevant to SAFESPOT but this project is, of course, aimed to take these issues much further.

Cooperative systems raise additional and fundamental questions and will complicate legal disputes. This is for several reasons:

- There are more parties involved, all with their own responsibilities for the proper functioning of elements of a cooperative system.

- Growing technical interdependencies between vehicles, and between vehicles and the infrastructure, may also lead to system failure, including scenarios that may be characterised as an unlucky combination of events (“a freak accident”) or as a failure for which the exact cause simply cannot be traced back (because of the technical complexity). As a counter-weight, greater transparency of development, technical linkages and responsibilities will undoubtedly be of great benefit in reducing the technical and legal complexity.

- Risks that cannot be influenced by the people who suffer the consequences tend to be judged less acceptable by society and, likewise, from a legal point of view.

- Furthermore, in those earlier projects there was no thorough analysis of the links between front-line compensation payment by an insurer of a vehicle/owner/driver and use of subrogated rights by that insurer to obtain
recovery from the liability insurers of manufacturers, suppliers etc. of faulty components or services.

- Apart from questions of compensation of the losses of road users or other “third parties”, which are governed by non-contractual law, there is also the question of how risks will be distributed between the actors in the chain of manufacturing, sales and operation of these systems, which is mainly governed by contract law and insurance. These issues will also include other types of damages of a more commercial nature such as recall costs and losses of sales. It should be emphasised that liability of the driver using ADAS (towards other road users) is, in principle, without prejudice to the question of other parties such as manufacturers or road authorities. It may well be that these parties could also be held liable for (part of) the damage (by joint, or joint-and-several, liability), leaving it then to be decided or agreed as to what extent they should respectively contribute through the mechanism of subrogation and right of resource. There may, of course, be constraints in this field; for example because of market power of some parties or of lack of a clear allocation of responsibilities.

Overview on insurance issues

Insurance issues have also been addressed in several projects (RESPONSE, ADVISORS, AWAKE). ADAS liability issues are strongly related to aspects of insurance. The relevance of insurance in this field flows from two different characteristics of insurance.

First of all, taking out insurance offers to people or to companies the possibility to shift certain financial risks towards insurance companies. In this way insurance does alleviate (liability) risks inherent to engage in certain activities, such as bringing ADAS to the market or driving a motor car. The absence of the possibility to take out insurance could even constitute a barrier to engage in these kinds of activities. In this way, the availability of insurance could be regarded as an important facilitating condition for the deployment of ADAS, since automobile insurance can be seen to facilitate automobile mobility.

In the RESPONSE 2 project it was recognized that established procedures of third-party recovery by subrogation would necessitate that a focus also be developed on the corporate liabilities and insurance exposures of actors in the
event of a failure of an ADAS system or of any significant component. Research was commissioned into the possible advantages of risk-sharing pools.

The Report noted “insurers may be expected to gravitate towards two fundamental questions:

- Will ADAS work?
- What will it cost to put right if it does not?

The answer to the first question must lie in ensuring the highest-quality engineering, testing, monitoring, recording and technical integration. Such factors will form the basis of effective risk recognition, evaluation and minimization. The second question depends on how far the parties who introduce, finance and regulate ADAS will require it to be made to work efficiently despite any early setbacks. Insurers of the owners, keepers and drivers of vehicles will seek subrogated recovery for claims payments from the insurers of vehicle manufacturers, suppliers, integrators and operators of the systems. Professional negligence insurances of consultants will not alone sustain such exposures. A strategy to establish from inception ring-fenced risk-sharing pools and/or special claims settlement funds could emerge as a good way to protect the brands and reputations and funds/resources of parties associated with ADAS while building up public confidence and responding to political and public-sector expectations. Objective, though confidential, resolution/adjudication of responsibilities between potential co-defendants could save substantial legal and technical costs and enable money set aside for insurance purchase to be utilized for procuring higher-level and aggregate liability and economic loss insurance and setting up funding mechanisms, including alternative risk transfer (ART)”.

The Report continued: “If the approach to good risk management outlined above is presented in a carefully-integrated way meanwhile, there is every likelihood of achieving effective and sustainable risk transfer to support ADAS. One indicator of such a realization would be possible reductions of insurance premiums for individual owners, keepers and drivers of vehicles equipped with Advanced Driver Assistance Systems. Dialogue should be initiated as soon as possible with leading insurers and brokers with a view to thereby possibly consolidating marketing advantage even ahead of such time as ADAS can be shown to make a substantial contribution to reduction of traffic accidents on European roads”.

This touches upon important categories of insurance, namely more particularly motor vehicle insurance. Motor insurers may play a key role in actively promoting the use of safety-enhancing technologies such as ADAS through insurance policies. If these systems contribute to reduce traffic accidents, this will
commercially benefit motor vehicle insurers. Furthermore, promoting safety-enhancing technology is a way to show their commitment with the traffic safety problem and to show that they are a ‘responsible and caring’ entity.

From this point of view insurers will be interested in safety enhancing technologies, if they are convinced that the technologies have the promised effect. However, to promote safety, insurers first of all generally prefer ‘soft’ instruments (i.e. educational campaigns, driver training, etc.) with respect to ‘hard’ instruments (i.e. premium reduction, for example if you drive a vehicle equipped with ADAS); or bonus-malus arrangements (no damage recovered if a warning was ignored). Hard measures however, are generally considered more effective. The followings can be identified as factors hindering an ‘optimal role’ of the insurance industry in promoting new safety-systems through there insurance policies (AWAKE):

- Premium setting is based on statistical principles (time lag problem);
- The need for market appeal of an insurance product;
- Competition/sensitive relations with client;
- Investment costs (in case of after-market installation);
- Administrative costs;
- Market regulation.

Therefore, actual practice and recognition appear “less then optimal” for innovations such as ADAS. Nevertheless, differences between Countries and insurers show the potential for a more active role of insurance companies in terms of establishing active premium policies to support and reflect a safety culture. Insurance products for fleet owners seem to offer the best potential because of a more optimal cost/benefit ratio and a more businesslike relationship with the client.

In the ADVISORS project (Final Report) it was stated that insurance companies, before taking the decision to support or promote a certain type of ADAS, would most likely want to:

- have some guarantees as far as liability is concerned. For instance, if the ADAS malfunctioning and this malfunctioning may become the primary cause of a car accident for which the insured driver may be held liable according to legislation, the insurance company would want to be able to refer the injured party to the ADAS manufacturer;
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- have data on high user acceptance of the specific ADAS; thus know that the clients want it;
- have scientific and, even better, statistical evidence of the potential safety benefits, as motor vehicle insurance premium setting is based on statistical systems; and
- be able to easily integrate the new policy into their administrative system.

Conclusions

In summary, among all the projects analysed the most interesting ones are RESPONSE 1 and 2, ADVISORS, STARDUST and AWAKE. Within the analysed documents the most attention has been given to liability and insurance aspects of ADAS. Although all the afore-mentioned projects are focused on autonomous systems, RESPONSE 2 gives attention also to co-operative systems.

For liability aspects, the analysis highlights that problems are most likely to occur for assistance ADAS, where the user cannot override the system, with respect to warning ADAS. Due to its complexity, urban environment is the most critical context in terms of liability issues management. An important role is played by ADAS manufacturers: they need to give great attention to the users (human factors to be included in testing phase) and to the communication of system performances. The development and application of common guidelines, performance requirements and code of practice, will be an important strategy to mitigate product liability risk.

Concerning insurance issues, the role of insurers is recognised to be a facilitating factor for the deployment of ADAS. At this purpose, hard measures (such as premium reduction) are considered to be more effective than soft instruments (e.g. driver training), even if the last ones are preferred by insurers themselves. Before deciding to support a certain type of ADAS, insurance companies declared the following needs: to have data certifying high user acceptance, potential safety benefits and guarantees on the allocation of responsibility among the actors.

Furthermore the performed analysis allows to raise some interesting considerations for cooperative systems, potentially useful for SAFESPOT, in particular:

- more parties involved, all with their own responsibilities;
- need of greater transparency of development, technical linkages and responsibilities in order to have reduce the technical and legal complexity;
- need of careful examination of the demarcation between producers and intermediaries, both as a matter of European law and also at national level;
- need to address issues relating to the allocation of responsibilities among Actors;
- new need for pre-agreed investigative processes to be deployed in the event of any significant system failure (probably a prerequisite for a well-structured insurance response);
- need to look at restoration of services;
- need for pre-agreed dispute resolution forms.
2.2.4. Socio-economic

The impact of intelligent vehicle safety systems (IVSS) goes beyond the effects on road safety. Other effects, e.g. reliability of arrival times, environmental aspects or driver convenience, may also occur and they are relevant when deciding on the implementation of IVSS. But both government and industry often have to decide on new IVSS technologies before reliable data of the effects exist. This makes it important to evaluate the socio-economic effects of new technologies before they are marketed (SEISS final report).

This paragraph aims at providing information on socio-economic evaluation addressed in former projects. Regarding the future structure of the SAFESPOT system (autonomous, cooperative) to be evaluated in BLADE, the following questions are of special interest:

- which socio-economic evaluation methods have been regarded as the promising ones and have been hence used in the past for the assessment of autonomous and cooperative systems?
- which development on socio-economic evaluation methods has been performed in order to adapt for the requirements of IVSS, especially for the evaluation of cooperative systems?

Thus, the focus is directed on projects where socio-economic evaluation was applied or development of socio-economic evaluation method was included. Table 2-5 shows an overview on relevant projects regarding the above-mentioned issues. A more detailed description of these studies is given below.

Table 2-5 - Overview of the projects with relevance to socio-economic aspects

<table>
<thead>
<tr>
<th>Project acronym</th>
<th>Type of systems to which socio-economic evaluation was applied</th>
<th>Development of socio-economic evaluation methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autonomous</td>
<td>Cooperative</td>
</tr>
<tr>
<td>ADVISORS</td>
<td>x</td>
<td>x</td>
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<tr>
<td>AIDER</td>
<td>x</td>
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</tr>
<tr>
<td>CarTALK</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>E-MERGE</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>INVENT</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>PROSPER</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>RESPONSE 2</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>SAFEMAP</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SAFE TUNNEL</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>SEISS</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SpeedAlert</td>
<td>x</td>
<td>x</td>
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<tr>
<td>STARDUST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Another type of the reviewed projects dealt with technological research and IVSS development, but did not work on methodological aspects of socio-economic evaluation nor did apply such an evaluation. These projects are not touched in this description. Nevertheless, these studies provide data which may be useful for the assessment of specific IVSS (AIDE, APALACI, APSN, AWAKE, GALLANT, GST, PROSPER, RADARNET, SPEEDALERT, TRAINER).

Some other projects may be also of interest but could not be included in this review, as the project started only recently or relevant deliverables were not yet available (COOPERS, CVIS, eIMPACT, IN-SAFETY).

Overview

The ADVISORS project dealt with both methodology and application of socio-economic evaluation. The main goal was to develop implementation scenarios in order to help market introduction of appropriate ADAS.

Two existing methods of multi-criteria analysis (MCA) for socio-economic evaluation were discussed, the PROMETHEE method (Preference Ranking organization method for enrichment evaluations) and the AHP method (Analytic Hierarchy Process). MCA builds upon the stakeholders’ own objectives as a basis for establishing criteria against which the performance of each system should be measured. After giving weights to the various criteria, the analysis permits to measure each system overall level of goal-achievement. The AHP method was selected and adjusted to the purpose of the study.

A multi-criteria analysis was carried out using AHP. The most important criteria were driver safety, third-party safety, environmental impact and travel time reduction. The method has been applied to a number of ADAS that could be commercialized on a large scale within the next decade, e.g. Stop and Go systems, Advanced Cruise Control (ACC), Lateral Support systems. The results were used to find out the most promising ADAS. However, the various systems are interesting for different reasons: for example, mandatory ISA provided high societal benefits whereas the ACC system resulted in lower safety or traffic benefits but was associated with a higher user desirability.

An extensive sensitivity analysis of these evaluations was performed in order to investigate whether the ranking of the ADAS (scenarios) would change when other sets of policy weights would be used. The rankings of the ADAS, which showed most promising results in the MCA, showed very stable results in the sensitivity analysis.
The general assumptions of *cost-benefit analyses* (CBA) methodology were described and an exemplary CBA calculation on ACC was performed. CBA results were estimated according to the penetration rate of ACC and took into account 4 discount rates (3%, 4%, 6% and 8%). It was assumed that the innovation costs borne by the equipment and/or vehicle producers are, in the long run, precisely compensated by the sales income of the ACC systems paid by the consumers. The main reason for this approach was the assumption that the consumers are not willing to pay a high price for ACC systems. It could be demonstrated that CBA was able to show clearly the scope of benefits resulting from ACC adoption.

The *stakeholder analysis* revealed different stakeholders’ preferences for the different ADAS, considering three relevant stakeholder groups (see Table 2-6).

<table>
<thead>
<tr>
<th>Stakeholder groups</th>
<th>Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>- driver comfort</td>
</tr>
<tr>
<td></td>
<td>- full user cost</td>
</tr>
<tr>
<td></td>
<td>- driver safety</td>
</tr>
<tr>
<td></td>
<td>- travel time</td>
</tr>
<tr>
<td>Society</td>
<td>- network efficiency</td>
</tr>
<tr>
<td></td>
<td>- public expenditure</td>
</tr>
<tr>
<td></td>
<td>- third party safety effects</td>
</tr>
<tr>
<td></td>
<td>- environment</td>
</tr>
<tr>
<td></td>
<td>- socio-political acceptance</td>
</tr>
<tr>
<td>Manufacturers</td>
<td>- acceptance risk</td>
</tr>
<tr>
<td></td>
<td>- technical feasibility</td>
</tr>
</tbody>
</table>

In the **AIDER** project a socio-economic evaluation of a rescue management system was carried out. The system covered the rescue chain from the emergency call generated by the vehicle up to the data reception by the Rescue Control Centre.

A short overview on socio-economic analysis is given with some definitions on the *cost-benefit analysis* (CBA) approach. The CBA started from the definition of the reference case and included statistics and costs of various accident scenarios, modelling and evaluating the costs and the benefits of the AIDER system.

A *sensitivity analysis* was performed to take into account the main uncertainty factors of the benefit-cost-ratio. Benefits covered are coming from the estimated crashworthiness (avoidance of fatalities, mitigation of injury severity) and rescue process efficiency. Both investments and operating costs were compared with the benefits. As an indicator for the system worthiness, the Benefit-Cost-
Difference was calculated. The Benefit-Cost-Difference was positive for all considered scenarios (680 M€ to 6869 M€) and remained positive during the sensitivity analysis.

In the German study CarTALK a socio-economic assessment was performed, but only some rough results can be described due to confidential deliverables. It is reported by Seiss final report, that CarTalk was one of the first studies investigating systematically the macro-economic impacts of different IVSS. The estimation of employment effects were used as an indicator for the macro-economic impact. In the worst case (Basic Warning Function, market penetration 10 %) 1,800 additional jobs have been calculated for the EU 15. The best case (Early Braking Function, market penetration 100 %) resulted in 28,000 additional jobs. The authors emphasized that the results do not allow for a general transfer to other types of ADAS. It was recommended to intensify the empirical research concerning macro-economic impacts of IVSS.

Possible accident cost savings were calculated for the CarTALK 2000 system. The savings came up from following impacts: avoided accidents, reduced severity of accidents, traffic flow impacts due to increased throughput on motorways, reduced number of congestions due to avoided accidents.

Within the stakeholder analysis the total benefits were re-allocated to the different stakeholder groups (obligatory public insurances, private insurance companies, government, road users), thus giving an insight to the overall economic importance of the benefits. However, the effect of ADAS on the insurances premiums is not quite clear. Arguments for both an insurance premium decrease and an insurance premium increase, due to introduction of ADAS, are given.

E-MERGE (Pan-European harmonisation of vehicle emergency call service chain) investigated business case elements of automatic in-vehicle emergency call systems.

A cost-benefit analysis was performed which aimed at identifying benefits, necessary investments and involved stakeholders, but not to do in-depth calculations on the size of the benefits and investments. Identifying which stakeholder is benefiting from the system and which stakeholder has to take the burden was regarded to be essential for the creation of a roadmap for a successful market deployment.

The methodology had been used with automotive telematic companies several times before. One of the relevant aspects of the methodology is the size of the benefit that is plotted against the ease of implementations. In this way a roadmap
can be worked out on the order and the timing of the activities which have to be
done during the implementation phase.

The results of the studies range from 2 - 7% reduction in the fatality numbers
and 10 - 15% on the severe injuries. In the case of installing the E-MERGE system in
all vehicles at a pan-European scale, savings of 3 - 5 B€ are estimated.

One of the issues which the subproject “Traffic Management” of the German
INVENT project (Intelligent traffic and user-oriented technology) dealt with, were
traffic jams caused by small flow irregularities. Solutions were developed using
driver assistance systems which coordinated and organized their actions
intelligently by cooperating via vehicle-to-vehicle communication based on the
Extended Floating Car Data (XFCD) technology.

Cost-benefit analyses (CBA) for a stop-and-go-assistance and a lane change-/ lane-keeping assistance system were performed. The evaluation was based both
on a macro-economic and a commercial view. But so far, no public deliverables
are available. The CBA of the stop-and-go-assistance system included impacts
on time and fuel consumption, emissions and safety. It resulted in a macro-
economic benefit-cost ratio of 3.3 – 4.5. This result was found when assuming a
market penetration of 5 % for 2010. The CBA results of the lane change-/ lane-
keeping assistance system showed a benefit-cost ratio of higher than 1 only in
case the system costs were lower than € 1,000.

An empirical survey about the willingness-to-pay for a stop-and-go-assistance
and lane change-/ lane-keeping assistance system was reported and market
penetration rates of the systems until 2020 were forecasted.

The PROSPER project (still ongoing) deals with questions around the
implementation and use of road speed management systems (ISA). The main
project output will be the assessment of cost benefit and cost effectiveness of
ISA in relation to traditional methods, and a thorough analysis of possible and
suitable implementation strategies for different road speed management
methods. The results are designed for each group of stakeholders in road speed
management, taking into account the specific information needs of each group.
The UK EVSC project analysed the potential accident reductions based upon UK
accident statistics and speed reduction benefits currently seen. The results were
given for dynamic speed limits.

In RESPONSE 2 the work package on socio-economic issues focused on
methodological aspects and aimed at an understanding of individual risks for
driver-system interaction (risk-benefits) and their consequences for the society
(cost-benefits).
Besides an overview on the complementary preventive and active safety functions and systems, existing risk-benefit methodologies in other industries were reviewed to analyse the applicability of such methodologies for ADAS. General risk concepts that can be used for setting up new technologies are introduced. These concepts were converted to the current risk status in transport. Risk-benefit methodologies from a microscopic perspective are discussed for future use in the automotive industry. A detailed analysis of the current driving risk is provided using accident statistics. The benefits of driving with ADAS are determined on a qualitative level as well as through a detailed discussion of all known risks specific to ADAS functionalities.

A framework for economic evaluation of ADAS was developed. It includes an extensive review of the methods and procedures for cost-benefit analysis (CBA) of ADAS. As the market success of ADAS will depend on cost-effectiveness for the stakeholders, the break-even analysis (BEA) is introduced as the methodological approach for cost-effectiveness issues regarding the ADAS user and the OEM.

SafeMap is a still ongoing project which is carried out within the French–German transport research program. It aims at the development of a new navigation map and a geo-localised database concept (including road safety-related data). The evaluation includes socio-economic impact and suitability to drivers. The paper presents midterm results of the state-of-the-art analysis on assessment studies and focuses on the preliminary safety benefit assessment done in the first project year. A raw estimation of costs for data collection by specific measurement equipment are given resulting in a ranking of six specific Safemap functions. Main result of the preliminary safety benefit analysis shows, that the Safemap system would have addressed 46% of accidents outside built-up areas in Germany under optimum conditions (equivalent to ca. 7 Billion Euro of accident cost savings).

A methodology, how to derive network-dependent safety benefits in terms of avoided accident costs, is described for some specific functions (e.g. for the assessment of ISA). During the ongoing tasks of the project, an in-depth study to estimate safety benefits and costs, examination of cost issues on creation and maintenance of the database, and an user based assessment of some in-vehicle system prototypes will be performed [Aguilera, Gelau].

In the SAFE TUNNEL project a socio-economic evaluation on the effects of the safe tunnel system was performed.

It contained a cost-benefit analysis of the system, i.e. the evaluation of all benefits coming from incidents reduction and accidents severity mitigation,
compared with costs related to system development, engineering, industrialization and production. Alternative scenarios for market penetration were defined and used in connection with the detailing of the incident reduction impact. The benefit-cost ratio was estimated for three market scenarios at an European level.

A sensitivity analysis was carried out on key parameters, which had shown a wide range of uncertainty during the benefit-cost rate estimation.

The objectives of the SEiSS study were to provide an overview on existing knowledge about socio-economic impact assessment related to IVSS (Intelligent Vehicle Safety Systems), to develop a generic methodological framework for socio-economic impact assessment, and to demonstrate workability of the proposed approach and verify it by exemplary case studies.

The state-of-the-art analysis on relevant former projects showed, that a number of indicators for the assessment of the socio-economic impact of IVSS had been developed in the past referred to safety, mobility, efficiency, energy and environment, productivity of fleet operation, customer satisfaction. But no systematic assessment and coherent analysis of the socio-economic impact of IVSS could be found in preceding projects.

The main outcome of the SEiSS project is a generic approach for assessing the socio-economic impact of IVSS, combining several methods. A key element of the approach is the benefit-cost analysis (BCA), which allows to determine to which extent a society would profit from the introduction of an IVSS to the market. The multi-criteria analysis (MCA) is regarded as another important element. Contrary to the benefit-cost analysis, the MCA offers a number of ways how to aggregate the data on individual criteria, in order to provide indicators of the overall performance of options. Additional elements mentioned are the stakeholder analysis, the analysis of impacts on production, income and employment, the income distribution analysis, and finally, the sensitivity analysis. Thus the methodological framework is designed to take not only the perspective of different stakeholders (e.g. system user, OEM) but also that of the society as a whole.

According to the proposed steps of the methodology, data are needed for the description of the technology, functions and costs of the IVSS under consideration, the market deployment scenarios (which influence the socio-economic impact), statistics and costs regarding accidents, congestions, vehicle operating and environmental effects.
As evaluating individual functions does not provide a reliable assessment of the overall system, the methodology recommends to take into account the interaction between different safety functions. It is proposed to use time as a basic value in calculating system interaction, collision probability and accident severity. The proposed methodology also allows for the impact calculation of three different speed scenarios covering urban, rural and highway traffic.

The main results of SpeedAlert were a common classification of speed limits in Europe relevant to speed alert applications, the system and service requirements of in-vehicle speed alert systems based on the viewpoints of different stakeholders (end-user, industry, public), the functional architecture, and a deployment roadmap.

No systematic analysis of societal benefits and overall cost-effectiveness was executed, but a pragmatic approach relying on analogies and simple models was chosen to discuss the system requirements, business aspects and benefits for the various stakeholders. From public point of view, benefits were expected by reduced numbers of fatalities and injured persons and by reduction of societal costs of road accidents.

The objective of STARDUST was to assess the extent, to which ADAS can contribute to a sustainable urban development in terms of road safety, transport efficiency and environmental impact. The systems investigated were ACC, Stop&Go, Lane Keeping, ISA and Cyber cars.

The project applied a wide range of methodologies by combining questionnaires on user acceptance and impact assessment, field trials on floating vehicles, driving simulator experiments, microscopic simulation on time-flow relations, queues and delays and macroscopic simulation on city level. Final recommendations could be based on the actual driver behaviour, rather than on theoretical views. It was expected that there would be substantial gain from the public point of view when adopting the ADAS considered.

But STARDUST did not focus on the socio-economic benefits. However, an overview of a general evaluation concept was given, which showed that socio-economic assessment is one of the important assessment categories. In this context, STARDUST used the expression in the sense of cost-benefit analysis. Different assessment categories may be inter-related, e.g. to perform a socio-economic evaluation requires the results of an impact assessment, which on its part depends on data from system performance assessment and user acceptance assessment. Thus socio-economic assessment was believed to be an important issue for future research following this project.
Conclusions

The reviewed projects report on several methods which are available for socio-economic evaluation and enable the evaluator to assess IVSS from different perspectives and under various criteria. Relevant conclusions can be drawn regarding (1) criteria, (2) single methods and (3) generic methodologies for an overall approach of socio-economic evaluation.

(1) The socio-economic evaluations performed in the studies reviewed were based on sets of criteria, which were different in the combination of single criteria. Criteria of the following categories can be found:

- road safety, e.g. accident avoidance, crash mitigation;
- efficiency of road transport, including mobility and throughput, e.g. journey times;
- environmental aspects, e.g. consumption of energy;
- satisfaction of end users and acceptance of other stakeholders.

At this purpose, experts stated that the determination of the effects on traffic efficiency, traffic safety and air quality is essential for a reliable socio-economic evaluation; these aspects must be considered in BLADE.

There were only few evaluations which include criteria considering the impact on production, income and employment, which are regarded to be important for political decisions (CarTALK, SEiSS). It is understandable, with regard to the economical requirements of performing a socio-economic evaluation, that most of the studies used narrowly limited sets of criteria. On the other hand, it is generally known that such limitations lead to a restricted validity of the estimated results, i.e. the conclusions and recommendations on the implementation of a system may be only valid within the narrow scope of the criteria used. Therefore, if the economical demands of the evaluation study admit only few criteria, it will be important to start with a comprehensive set of criteria including inter-relations between them, to assign preferences in a second step, and finally to select criteria with regard to their importance for the objectives of the study. Thorough and comprehensive sets of criteria are recommended by RESPONSE 2 and SEiSS.
(2) The methods which have been mentioned in the reviewed projects either for application on specific IVSS or in terms of method development are shown in Table 2-7:

- Cost-benefit analysis (CBA) is a key element of socio-economic assessment and is the most commonly used method. It can be used to estimate the potential benefits and costs across various impacts and compare them in monetary terms. Indicators are benefit-cost ratio (used in ADVISORS, INVENT, SAFE TUNNEL, SEiSS) or benefit-cost difference (used in AIDER). Some modifications of CBA aim on a rough calculation of benefits and investments rather than on in-depth calculations (e.g. E-MERGE, SafeMap, SpeedAlert).

- Multi-criteria analysis (MCA) aims at getting a preference between optional systems/functions with respect to a set of socially based criteria. Options with higher preference will show a higher score than options with lower preference. Systematic multi-criteria analyses have been used in ADVISORS and SEiSS.

- In several projects CBA or MCA is followed by a sensitivity analysis SA (ADVISORS, AIDER, SAFE TUNNEL, SEiSS). The purpose of the SA is to select the "critical" variables and parameters of the assessment model, as assumptions and simplifications lead to a range of uncertainty.

- Stakeholder analysis was used to meet different objectives and was proved to be a collective term for several analysis tools, e.g. financial analysis (CarTALK, SEiSS), analysis of stakeholder preferences (ADVISORS), break-even analysis (RESPONSE 2, SEiSS), or in terms of distributional effects (E-MERGE). But all references stress the importance of taking the stakeholder perspective into account, as the stakeholders acceptance affect the success of market introduction.

- Macro-economic effects in terms of production, income or employment have been only analysed by CarTALK and SEiSS. They may be important for the political acceptance of IVSS and their introduction. These impacts are not included in a CBA, and therefore need to be analysed in additional calculations.
Table 2-7: Relevant methods used for socio-economic evaluation in the reviewed projects

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<tbody>
<tr>
<td>ADVISOR</td>
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<td>A,D</td>
<td>A</td>
<td>A</td>
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<td>A, D</td>
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</tbody>
</table>

Legend: A = Application of method; D = Development of method

Besides the methods known from the other projects reviewed, the SEISS study provides further methods to be included in a comprehensive socio-economic and business evaluation:

- Business case calculations enables the analysis of costs, benefits and risks associated with a proposed investment and would be used by specific stakeholders, normally by OEMs, to make a decision on an investment.

- Income distribution analysis focuses on the question of who is burdened with the costs of implementing the system and who benefits from them. The political acceptance of the deployment of IVSS increases, if the systems contribute to a social balance. The traditional CBA abstains explicitly from the consideration of distributional effects. Therefore income distribution analysis is required as an additional tool.

According to SEISS, the methods mentioned above can be brought together to a battery of methods. Thus, a framework for a comprehensive socio-economic evaluation methodology which includes both stakeholder perspective and society perspective can be recommended.

(3) Most of the studies which worked on the development of socio-economic evaluation dealt with the development of specific methods, but did not provide an
overall systematic approach, e.g. ADVISORS focused on adaptation of multi-criteria analysis, CarTALK introduced analysis of employment effects to be included in the approach.

A comprehensive, systematic approach for a generic methodology, i.e. how to perform a socio-economic evaluation step-by-step connecting the above-mentioned methods, was introduced by SEISS. This approach is recommended to be used as a basis for the evaluation of the SAFESPOT system (see Figure 2-6).

![Diagram of IVSS assessment](image)

**Figure 2-6: Relevant steps for a generic IVSS assessment (source: Seiss)**
2.2.5. Market/Costs/Financial

This paragraph aims at providing information on how market, costs and financial aspects were dealt in the projects examined. Table 2-8 gives an overview on which projects contain relevant information.

Table 2-8: Overview of the reviewed projects with relevance to market, costs and financial aspects

<table>
<thead>
<tr>
<th>Relevant Projects</th>
<th>Market</th>
<th>Costs</th>
<th>Financial</th>
</tr>
</thead>
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<td>ARTIST</td>
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<tr>
<td>AWAKE</td>
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<tr>
<td>GALLANT</td>
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<tr>
<td>INVENT</td>
<td>x</td>
<td>x</td>
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<td>PROSPER</td>
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<td>STARDUST</td>
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<td>ADVISOR</td>
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<td>CAR TALK</td>
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</tr>
<tr>
<td>Frame</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response2</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

Furthermore, interesting information has been derived from the documents/web sites mentioned in Table 2-2.

In the following, such information are organised according to typical key questions, to which it is necessary to give an answer to perform complete
market, cost and financial analyses of new products and in particular for SAFESPOT (see Table 2-9).

Table 2-9: Typical questions to be answered for an effective market, cost and financial analysis of new products

<table>
<thead>
<tr>
<th>ID</th>
<th>Key Question description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>What will be the reference market? In what markets the product would have to be?</td>
</tr>
<tr>
<td>B.</td>
<td>What will be product configurations and the positions occupied in the reference markets?</td>
</tr>
<tr>
<td>C.</td>
<td>What kind of appeal will have the product and what kind of opportunities and threats? What will be the trends concerning: tendencies of market, consumer behaviour, macro environmental evolutions (social, political, technological and economical context)?</td>
</tr>
<tr>
<td>D.</td>
<td>What will be the distinctive characteristics of the product, its forces and weaknesses and the type of competitive advantages?</td>
</tr>
<tr>
<td>E.</td>
<td>What type of strategies will have to be used for the product?</td>
</tr>
<tr>
<td>F.</td>
<td>How to go from the strategies to product configuration, distribution, price and communication?</td>
</tr>
<tr>
<td>G.</td>
<td>What will be the investment and operating costs of the system?</td>
</tr>
<tr>
<td>H.</td>
<td>Will the initiative related to the product be sustainable from a financial point of view?</td>
</tr>
</tbody>
</table>

The state of the art coming from the analysis of existing projects gives interesting indications on answers to those questions. The presented results refer to the systems and applications addressed in each project or study (ADAS), but they can be useful as starting point for the specific analysis that will be performed for SAFESPOT applications/system in Work Package 5.

In addition, this paragraph present a synthesis of the adopted methodologies, with the indication of which key question they can help to answer.

Overview

A. What will be reference market? In which markets would have to be?

Indications on what is the reference market of ADAS systems have been extracted from the analysed project.

Generally, according to ADASE2 project, ADAS are installed on high segment car market (luxury cars) or on trucks, the introduction is expanding gradually to medium level cars. Market penetration is low at the moment but it is increasing.

Concerning the target market, the information coming from the analysis of the relevant projects, are not uniform. For PROSPER participants, almost all the Countries involved in the project indicate ‘all drivers’ and ‘all vehicle types’ as the most important target group for Intelligent Speed Alert system (ISA)
In SAFETUNNEL, Heavy Good Vehicles are indicated as the first market to be attacked for SAFETUNNEL system followed by coaches, all commercial vehicles and finally automotive market.

Specific driver categories for which ADA systems could be more useful or more accepted or could be more easily implemented are interesting to consider when thinking at SAFESPOT market. The relevant groups, that have been selected basing on the analysed projects, are:
- Professional drivers,
- Shift workers,
- Young people (especially young men),
- Elderly people,
- People suffering from sleep disorders,
- Users of sedating medications,
- Handicapped persons.

B. What will be product configurations and the positions occupied in the reference markets?

The analysis of what the reference market needs is an important basis for an effective configuration of a new product. Also, the analysis of the existing competitors of a product is essential to make the right choices during the configuration process. The analysed projects give interesting cues for SAFESPOT configuration, to be deepened in the BLADE-WP5 task devoted to market analysis.

According to ADVISOR project, ACC is the most common system, however safety systems (in particular lane departure warning) are increasing their role on the market.

AWAKE project identifies the following main application scenarios for its system: motorways, highways and rural roads. The focus of the application is on the speed range of 50-120 km/h and with good weather and visibility. Application at night is of primary importance, followed by dawn and afternoon. These indications are useful for AWAKE product configuration.

Concerning warning modalities, users and experts agreed that a modular, progressive, warning strategy is necessary, employing a combination of modalities. Tones and/or speech, combined with visual messages (for further details) might be appropriate. Rumble strips effect has been reported and accepted as the most adequate warning type, and it seems that it might be effectively simulated by a sound. (AWAKE)
ADVISOR project gives importance to the human machine interface of ADAS: as the driver receives more information in the car than before, the human machine interface is of fundamental importance, to prevent misunderstandings between human and machine and vice-versa (Advisor Project).

In relation to the attractiveness of ADAS for the market, in general the navigation function was found as the most important factor; price was also considered a significant element (the consumer willingness to pay for the ADAS is low). (AWAKE, ADVISOR AND ADASE2).

According to the accident research performed in APALACI Project, 90-95% of all road accidents are caused, to some extent, by human error. It might be due to driver fatigue, inattention, misjudgements or inappropriate manoeuvres for example. In these situations applications that support the driver, giving information or even intervening, could lower the number of accidents.

Concerning commercial vehicles, Gomezano & Partner’s study\(^2\) pointed out that Active Safety systems are currently offered by the truck manufacturers as an optional extras. The same consideration can be found in ADASE2 for car market.

C. What kind of appeal will have the product and what kind of opportunities and threats? What will be the trends concerning: tendencies of market, consumer behaviour, macro environment evolutions (social, political, technological and economical contest)?

Interesting elements come from the analysed projects, mainly concerning user acceptance/appeal and market tendencies.

In PROSPER, a survey was conducted on different stakeholders from eight countries; all the interviewed agree that generally all ADAS contribute to the reduction of people killed and injured in traffic accidents. Furtheremore the same project indicate that user acceptance seems to be very high for ISA (and generally for all ADAS Systems) for both experts and users (in the range of 80%-90% of interviewed).

In ADASE 2 it is underlined that there is an expectation concerning the integration between different safety systems\(^3\). The presented trend is coherent


\(^3\) “In the near future integration is expected with sharing of sensors for multiple functions. This approach has already been initiated by Mitsubishi Motor Company with the introduction of “Driver Support System” in 2000 including ACC, Lane Keeping Assistance and Blind Spot Monitoring…” Source:ADASE Project, Deliveravle D2B “State of Practice on Adase”, pag.9.
with SAFESPOT objective, showing that in the future ADAS will be integrated into one overall system.

Several roadmaps for ADAS are presented, among which the most important references (basing on the opinion of experts inside SAFESPOT consortium) are:

- RESPONSE2 road map (Figure 2-7);
- ADASE2 roadmap on future advanced driver assistance. (Figure 2-8);

![Advanced Driver Assistance Systems](image)

**Figure 2-7: Adas Road Map1 (source: RESPONSE 2)**
PREVENT\textsuperscript{5} reports technological roadmaps with the state of the art and trends for different sensor technologies (LIDAR, RADAR, Infrared sensors) and vision devices.

STARDUST gives an interesting ranking of systems: from the public authorities point of view, ISA is the most likely system to receive support for implementation in the coming years. It is viewed as technologically more mature than ACC and Stop&Go, and bringing the most benefits. Lane keeping, though perceived as mature technology too, generates less interest.

An important consideration for SAFESPOT, is related to the influence of ADAS penetration rate on the effect of the systems themselves. At the beginning, the effect on safety might even be negative. It may be expected that the effects will improve in the course of time (ADVISOR).

According to ADVISOR participants, it seems that some achievements can be learned from both the US and Japanese experience, but these must be tailored to the specific requirements of the European market.

\textsuperscript{4} ADASE2 Project, Deliverable D2D “Roadmap Development”, pag.3, “the complexities of the systems concerning different aspects are shown by the size of the dots. … complex systems with a high need for further research activities can be identified by an accumulation of big dots”

\textsuperscript{5} PREVENT, deliverable “Compendium of sensors– state of the art of sensors and sensors data fusion for automotive preventive Applications”, 2004
SEISS reports data on market introduction and diffusion of safety systems (see Table 2-11). For each considered system it is indicated the year of introduction (past or forecasted) and the typology of introduction (i.e. standard or optional). Also, indications concerning future market share for two ADAS applications are given:

- ACC, from 3% (2010) to 8% (2020);
- Lane Change Assistant/Lane Departure Warning, from 0.6% (2010) to 7% (2020).

**Figure 2-9: Information on market introduction of Safety system (source: SEISS\(^6\))**

<table>
<thead>
<tr>
<th>Safety system</th>
<th>Market introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS – Anti-Lock Braking System</td>
<td>1978 Standard equipment in Europe, All new European vehicles</td>
</tr>
<tr>
<td>ACC – Adaptive Cruise Control</td>
<td>2000 Optional as comfort function</td>
</tr>
<tr>
<td>Adaptive Light – Curve Illumination, Automatic Light</td>
<td>2003 Optional as comfort function</td>
</tr>
<tr>
<td>Airbag</td>
<td>na for all new vehicle</td>
</tr>
<tr>
<td>Braking Assistance</td>
<td>2003 Standard function for selected models</td>
</tr>
<tr>
<td>Crash Avoidance</td>
<td>after 2015 Optional as safety function with potential to become mandatory</td>
</tr>
<tr>
<td>Crash Detection/Warning</td>
<td>2008 Optional as safety function</td>
</tr>
<tr>
<td>Driver Monitoring – Driver Drowsiness</td>
<td>2009 Optional or standard for selected models</td>
</tr>
<tr>
<td>EBS – Emergency Braking System</td>
<td>2009 Optional, may become mandatory</td>
</tr>
<tr>
<td>eCall – In-Vehicle Emergency Call System</td>
<td>2003 for premium cars for some OEM, Optional equipment, but may become mandatory</td>
</tr>
<tr>
<td>ESP – Electronic Stability Programme</td>
<td>1999 wide penetration in Europe, Standard function for (yet) selected models</td>
</tr>
<tr>
<td>Lane Change Assistant</td>
<td>2005 Optional equipment sold as comfort function</td>
</tr>
<tr>
<td>Lane Departure Warning</td>
<td>2005 cars, Optional equipment sold as safety function</td>
</tr>
<tr>
<td>Night Vision</td>
<td>2006 Optional equipment sold as safety function</td>
</tr>
<tr>
<td>Pedestrian Protection</td>
<td>Passive 2005 Active 2010 Mandatory equipment</td>
</tr>
<tr>
<td>Pre-Crash Systems – preparation of the car for an unavoidable crash</td>
<td>2006 Becomes standard equipment</td>
</tr>
<tr>
<td>Safe Following Systems – Adaptive Cruise Control / automatic stop and go</td>
<td>2005 Optional equipment, sold as comfort function</td>
</tr>
<tr>
<td>Safe Speed – adaptive maximum speed of the car</td>
<td>As warning function 2006, after 2015 as an May become mandatory</td>
</tr>
</tbody>
</table>

---

\(^6\) Seiss Project, D., “Exploratory study on the potential socio-economic impact of the introduction of intelligent safety systems in road vehicles”
Finally, interesting considerations on opportunities and threats for ADAS introduction on the market came from several specific web sites (see Table 2-10).

Table 2-10: Opportunities and threats for ADAS introduction on the market (source: www.ivsource.net)

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Necessity to reduce road accidents (objective for</td>
<td>Low willingness to pay for the systems by customers</td>
</tr>
<tr>
<td>the EU)</td>
<td></td>
</tr>
<tr>
<td>Utility, understood by the market, of ADAS in</td>
<td>Consumer privacy</td>
</tr>
<tr>
<td>order to increase the road safety</td>
<td></td>
</tr>
<tr>
<td>“Road safety” is an important driver in the</td>
<td>Applicability often limited only on new vehicles</td>
</tr>
<tr>
<td>purchase of the car</td>
<td></td>
</tr>
<tr>
<td>Increasing of the average age of the population</td>
<td>Complex legal aspects and still incomplete</td>
</tr>
<tr>
<td>Maturity of the technology</td>
<td>Critical role of insurance companies</td>
</tr>
<tr>
<td>No other existing technologies can supply similar</td>
<td>No public incentives (at the moment)</td>
</tr>
<tr>
<td>functions</td>
<td></td>
</tr>
<tr>
<td>Existing optimistic scenarios about the diffusion</td>
<td></td>
</tr>
<tr>
<td>of those systems on the market</td>
<td></td>
</tr>
</tbody>
</table>

D. What will be the distinctive characteristics of the product, its forces and weaknesses and the type of competitive advantages?

Concerning the safety systems available on the market at this moment, the analysis shows the following results:

- APALACI makes an overview of safety systems available on the market today like: belt pretension, airbag, parking/back-up aid and ACC;
- APSN gives an overview on the state-of-the-art and future trends; for pre-crash sensing, technical & economical restrictions are there detailed;
- RADARNET analysed pre-crash systems (ACC and Collision Mitigation System) on the market (Japan and Usa). About systems on the market, there is a real emphasis on radar systems.
- ADVISOR presents a brief overview of ADA systems under development or in some cases already available.
- RESPONSE2 reports a worldwide car maker benchmarking for ACC.
- ADASE2 gives two an interesting benchmarking of ADAS Products on the market\(^7\) and a state of the art of R&D projects on the ADAS\(^8\).
- Concerning commercial vehicles, interesting information on the presence on the market of Active Safety Systems are pointed out in the Gomezano & Partner’s study\(^9\).

**E. What type of strategies will have to be used?**

In ADASE 2, it is highlighted that the market introduction of ADAS is not following a common linear flow; in fact, ADAS are being introduced by OEMs in different market areas with different strategies testing customer reactions. Market introduction “is” and “will be” different in Europe, Japan and North America, and tangible differences are due to different cultural and legislative approaches.

The recommendations proposed to European member states in ADASE2 Project\(^10\), like a sort of “mitigation strategies”, are very interesting. The results are recommendations proposed to the member states who wish to adopt a global policy with respect to ADAS, in particular: “…Develop a national policy framework for ADA systems that supports and influences national goals, provide a legal and regulatory framework, provide fiscal and financial support, provide suitable infrastructures,…”

Concerning commercial vehicles, interesting indications on worldwide market for active safety systems are pointed out in the Gomezano & Partner’s study\(^11\): “Approaches to the introduction of Active Systems differ across the three many regions of automotive development, Europe, North America and Japan. … Europe leads the rest of the world in the development and application of truck Active Safety Systems…this is due to a number of reasons:

- traffic and road conditions are very different in the three regions;

\(^7\) Adase2 Project, Annex Table of Deliverable D2B “State of Practice”, pages 1-3;  
\(^8\) Adase2 Project, Deliverable D2A, “Advanced driver assistance systems -Results of the State of the art of ADASE2.
\(^10\) “… the member 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. On the other hand, ADAS developers, in particular car and in-car equipment manufacturers, need to solicit the public authorities with respect to many aspects, and also to better understand the positions of the member states. …” Source: Adase2 Project, Deliverable D2C, “State of policy”.  
- Japanese market does not traditionally use such large numbers of articulated trucks as in Western Europe and North America.

...In comparison to Western European manufactures, the North American and Japanese manufactures appear to rely more on driver assistance in the form of Active Cruise Control and Collision Warning System... Germany is the most active country with government funding involved in numerous projects, linking together vehicle manufacturers, system supplier, academic institutions and insurance companies. The Netherlands and Sweden are the next most active, followed by other northern European countries: the Southern European countries have very little involvement.”

F. How to go from the strategies to product configuration, distribution, price and communication?

ADAS are usually available as optional devices, but safety features are becoming “standard equipment” on several model version. In ADASE 2, the Benchmarking of ADAS Products\(^\text{12}\) is very interesting. For each Adas System on the market there are several interesting specifications: functions, technology, vehicle segment, vehicle model, availability, market area and price.

Another aspect that could be useful for SAFESPOT comes from STARDUST project, concerning marketing & communication aspects: people would like new technologies in their cars only when they understand the system and see a personal benefit.

Experience in STARDUST shows that, when correctly informed (for example after a trial in a driving simulator), perceptions and opinions of respondents were more favourable to Intelligent Telematic Systems than without being informed. Information campaigns would thus be useful before launching systems on a wide scale.

G. What will be the investment and operating costs?

The information available in SEISS\(^\text{13}\) about the Safety System are very interesting; in fact, for each of the considered ADAS (eCall, ACC, Lane Departure Warning and Lane Change Assistance) investments and operating costs are indicated.

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\(^{12}\) Adase2 Project, Annex Table of Deliverable D2B ”State of Practice”, pages 1-3;

\(^{13}\) Institute for transport Economics at the University of Cologne, “Exploratory study on the potential socio-economic impact of the introduction of intelligent safety systems in road vehicles”, 01/15/2005
In RADARNET there is a Cost Comparison about different sensing technologies for ADAS.

In SPEEDALERT there are some considerations, useful for SAFESPOT, concerning the limiting factors for cellular media and for vehicle-infrastructure communication, mainly consisting of deployment cost, cost per data volume during operation and cost estimations about communication between infrastructure and in-vehicle systems.

AIDER and SAFE TUNNEL reported estimations on investments and operating costs for the development of the related systems.

**H. Will the initiative be sustainable from a financial point of view?**

In SEISS and SAFE TUNNEL projects there is useful information for the financial assessment for ADAS considered in those projects.

SEISS underlines the importance to accompany socio-economic analysis with a specific analysis of costs and benefits for each stakeholder. In this context financial analysis are needed to verify the sustainability of the initiative. Several methodologies are described, mainly break even analysis seems to be interesting for SAFESPOT purpose (see methodology section of this paragraph).

SAFE TUNNEL reports an interesting application of Break Even Analysis for truck manufacturers. The methodology was applied with the aim of evaluating a sustainable pricing policy for SAFE TUNNEL system, resulting in the range 30-110 € according to the considered market scenario.

The financial sustainability of SAFESPOT will be specifically analysed in business models work package (WP6), with the support of the evaluations performed in WP5 (assessment & evaluations).

**Methodologies**

In order to answer the above mentioned key questions (see Table 2-9), different methodologies were used in the analysed projects. Such methodologies are listed and described in the following. Table 2-11 shows which methodologies can be useful to answer the key questions presented in the overview section of this paragraph.

*Qualitative / Quantitative Analysis / Survey / Questionnaires* (e.g. Delphi in Prosper, Brainstorming in AWAKE, Questionnaires in ADASE2) are methods used in order to understand/identify some relevant aspects and to obtain the
consensus opinion of a group of experts about likely future developments. Surveys are also used to investigate potential market of a new product (see its application in ADVISOR).

**Scenario analysis** is a method used in order to analyse possible future events by considering alternative possible outcomes (application in RESPONSE 2).

**Conjoint Analysis** is used in order to achieve the optimal product/service configuration. Its strength is the ability to place the "importance" and "preferred value" on the different attributes, a particular product or service is composed of. Conjoint Analysis guides the end user into extrapolating his or her preference to a quantitative measurement. All products or services can be modelled as an entity with a set of attributes (one of this, generally is the price/willingness to pay) (see application in ADVISOR, AWAKE, INVENT).

**Impact/Uncertainty Analysis** is a methodology used in order to construct scenarios. The approach first identifies the important factors that in the future will be able to condition the development of a product, and then show the impact and the uncertainty degree about these factors are defined (see application in RESPONSE2).

**Constraint Analysis** is used in order to make an inventory of potential risks and threats, and quantify them in terms of criticality. Each risk or threat is then judged to be substantial, a mitigation strategy is identified (see its application in FRAME).

**SWOT Analysis** (Strengths, Weaknesses, Opportunities and Threats) is an important method to audit the overall strategic position of a business and its environment (see application in GST).

**Break Even Analysis** is used to calculate the approximate sales volume required to just cover costs, below which production would be unprofitable and above which it would be profitable. Break-even analysis focuses on the relationship between fixed cost, variable cost and profit (see its application in SEISS and Safe Tunnel).

Regarding cost analysis no specific methodologies were mentioned in the analysed project: experts estimations are often used as source while a pragmatic approach based on analogies is mentioned in SPEEDALERT.
Table 2-11: Methodology useful for market/cost/financial analysis and relation with key question that can help to answer

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Key question for Market/cost/financial analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative/Quantitative Analysis/Survey/Questionnaires</td>
<td>$A, B, G$</td>
</tr>
<tr>
<td>Scenario analysis</td>
<td>$A, C$</td>
</tr>
<tr>
<td>Conjoint analysis</td>
<td>$B$</td>
</tr>
<tr>
<td>Constraint analysis</td>
<td>$E$</td>
</tr>
<tr>
<td>Impact/Uncertainty Analysis</td>
<td>$F$</td>
</tr>
<tr>
<td>SWOT analysis</td>
<td>$C, D$</td>
</tr>
<tr>
<td>Break even analysis</td>
<td>$H$</td>
</tr>
</tbody>
</table>

The methodologies listed above for each research questions, could represent a good starting point for SAFESPOT. Literature shows other possible useful methodologies (e.g. Discounted Cash Flow for financial evaluation) that will be carefully considered before starting each specific analysis in BLADE and in particular in Work Package 6.5 (Assessment & Evaluation) and 6.6 (Business Models).

Conclusions
The analysed documents report useful information on the market of ADAS and safety systems in general and on adopted methodologies. The collected information has been analysed according to eight key questions to be answered when approaching the market analysis of a new product.

The results potentially useful for SAFESPOT can be summarized as follows:

- **reference market (question A)**: the penetration of ADAS is low today, even if it is increasing in terms of number of equipped vehicles and functionalities; luxury cars and trucks are normally the first target of ADAS; ‘all drivers’ are often indicated as potential users, even if specific categories seem to be more receptive (e.g. professional drivers, young men, elderly people,…).

- **product configuration and appeal (question B, C)**: human machine interface is really important for ADAS and for cooperative systems in particular; warning modalities to the user seem to be well accepted when a good warning strategy is in place, employing a combination of modalities; systems giving support to the drivers reducing human error causes could be very effective in reducing accident number; user acceptance is good, even if the willingness to pay of users for safety systems is low;
- **tendencies and trends (question C, D):** forecast about year of introduction on the market of many safety systems have been found in several project, most before 2015; the integration among different safety systems and technologies into one system is expected in the near future, some initiative in this sense is already has been already initiated;

- **strategies for the introduction (question E, F):** strategy should be different according to the market area that is considered; traffic and road conditions have to be considered as well as most common type of vehicles; the introduction of ADAS should be accompanied by an adequate national policy framework and a strong communication strategy;

- **cost and financial aspects (question G, H):** estimations of investments and operating costs are given for several systems; the analysis of financial sustainability for each stakeholder involved is presented in some case, also with the aim of evaluating sustainable pricing policy towards final users.

Concerning methodological aspects, several methods adopted in the analysed projects are presented, mainly to investigate market needs, user acceptance and to help product configuration. Also interesting approaches for the evaluation of financial sustainability have been found. Regarding costs, estimations are made basing mainly on analogy with similar products.
3. Preliminary definition of Deployment Program

3.1. Introduction

The objective of the deployment program is to provide a comprehensive overview of all functions and aspects (business models, organisational architecture, legislative environment) required for the deployment of SAFESPOT systems. The deployment describes the various issues that need to be resolved to make deployment possible and provides a coherent set of actions, action holders and time path to overcome barriers.

The target group of the deployment program consists of all stakeholders and decision makers within the European Commission, the automotive industry, national governments and road administrators, component suppliers, traffic data providers, etc. The deployment program describes for each stakeholder objectives, role and responsibilities, resources, business/policy case and actions for both the realisation/deployment process of SAFESPOT systems as well as during the actual use of these systems.

In our view the SAFESPOT deployment program could consist of three parts:

**Part 1:** Vision and description on implementation of SAFESPOT systems

Including a description of organisational architecture, business models, risk analysis, legal issues, traffic and socio-economic impacts. In fact, this is a summary and overview of the various work packages of BLADE.

**Part 2:** Action Plan & Recommendations

Including a description of the major issues to be solved and recommendations for actions and action holders. The deployment program suggests implementation strategies for both industry and public actors.

**Part 3:** Process plan/communication plan

Including a description of a process how the various actions can be coordinated by the EU, Ertico or other major organisations and how the SAFESPOT deployment program plan should be coordinated with actions plans provided by other large initiatives like Galileo, CVIS, Coopers, etc.
Hereunder for each of the sections a short description is given.

**Part 1: explanation/vision/background**

This first part of the deployment program should make visible

- for what functionalities we are trying to accomplish deployment;
- which actors are going to use the deployment program and why (what questions/issues they have to deal with);
- state of the art knowledge of deployment of ADA safety systems
- additional issues which rise specially for the cooperative SAFESPOT Safety Margin Assistant.

Besides dealing with the deployment issues, the deployment program could also give instructions on who will make, test, use, install (components of) the Safety Margin Assistant (SMA).

A clear way of presenting the functionalities will be through a roadmap figure like for example the one presented below.

![Figure 3-1 Evolutionary roadmap of ADA systems with corresponding technical challenges based upon Bonnet and Ulmer and ADASE](image)

**Figure 3-1 Evolutionary roadmap of ADA systems with corresponding technical challenges based upon Bonnet and Ulmer and ADASE**
An additional way of describing the SAFESPOT SMA evolution is telling the Loredana story for different moments in time between now and 2020.

It is important to make clear that SAFESPOT is going beyond the work already done within various ADA projects. So therefore the state of the art knowledge in ADA deployment issues has to be presented and subsequently it has to be made clear where the cooperative approach of SAFESPOT raises additional questions.

As starting point, Annex 1 reports a synthesis of SAFESPOT applications and functionalities. Vehicle to vehicles (V2V) applications will be the focus of SP4 – SCOVA, while SP5 – COSSIB will concentrate on vehicle to infrastructure applications. A selection of these applications is in progress in order to guide the work in BLADE.

*Part 2: action plan/ recommendations*

Based on the technology/functionality roadmap presented in part 1 of the deployment program, in this part of the program there are the actions for different actors to solve the identified issues.

This could for example be done by using a standard format (table) for each action in which aspects like step description, key actor, other actors, timeframe, expected risks, expected impact are being clarified. An example of this approach can be found in Deliverable 7.1 of the ADVISOR project (see figure 3-2).
Figure 3-2: standard format (table) for each action in which aspects like step description, another way of presenting the actions is just by compiling a list of actions & recommendations as it has been done in the final report of the eSafety Working Group on Road Safety.

An important aspect to be included in this section is related to the standardisation actions for the whole system and in particular for the communication system. At this purpose it is important to work strictly with SCORE sub project (SP7), that has the main objective of defining a System Core Architecture to be used as a reference across Europe for both the development of new ITS safety services and the development of applications increasing the ITS traffic efficiency.

Part 3: process plan/communication plan

In order to realize deployment of the SMA it is has to be made clear who has to take the lead/responsibility (and how) in managing the execution of the action
plan. This is not something that can be done after SAFESPOT/BLADE. It is an action that should be already started during the course of this project.

### 3.2. Preliminary considerations for Deployment Program

This paragraph presents first considerations/guidelines for SAFESPOT deployment programme. According to the state of the art analysis presented in chapter 2, it has been dedicated one paragraph to each of the issues to be analysed during BLADE.

A concluding section summarizes the preliminary guidelines coming from the analysis.

#### 3.2.1. Risk/Legal Aspects

This paragraph presents preliminary considerations on deployment of cooperative systems, regarding risk/legal aspects. Such considerations are structured in the following five categories:

- A. New and enhanced risks to the public (including vehicle owners/drivers)
- B. Allocation of responsibilities among actors has a new significance
- C. New need for pre-agreed investigative processes to be deployed in the event of any significant system failure
- D. Restoration of services
- E. Resolution of disputes within the community of actors

A. **New and enhanced risks to the public (including vehicle owners/drivers)**

- The risks of erroneous telematic signals (including Floating Car Data) coming from the vehicle, and likewise those coming from the infrastructure, can now affect other road users at large, as well as infrastructure “managers” such as PSAPs and data fusion centres.

- Whereas ADAS mainly involve contractual exposures and product liability risks, the new cooperative systems, such as SAFESPOT, involve tortuous liabilities which are fault-based and cannot be reduced by contract or managed by contractual terms.

- The public sector involvement in providing sensors etc., to emit or confirm data, engages the public authorities and their franchised operators in new legal exposures; they might also face liability if they licensed or continued to approve actors who were not complying with the agreed standards,
particularly as to safety, as well as ensuring a reasonable program of maintenance and checking that the sensors were actually working.

B. *Allocation of responsibilities among actors has a new significance*

- Actors can combine by contract to crystallise their liability exposures to each other.
- Actors can define the “offering” they make by their components/composite assemblies and/or by their services.
- Such definition includes functionalities, performance criteria, degradation parameters etc., which are a major feature of any offering.
- Interface compatibility criteria are standardised, tested, certificated, validated, updated, and monitored in operation, to a far greater extent than hitherto because there are more dependencies to more actors.
- Allocation of responsibilities inside the system should follow predetermined criteria as to the basis of liability (e.g. fault-based or strict). In principle, every actor should be prepared to say “I am responsible for what I can control”.
- Modularity would greatly assist clearer and more normative definition of offerings and compatibility between actors, and will simplify responsibility allocation.

C. *New need for pre-agreed investigative processes to be deployed in the event of any significant system failure*

- These processes should be defined as well as the roles in the assessment of causes, extent and reactions to the system failure

D. *Restoration of services*

- Restoration cannot be left to even the best-motivated actors acting individually.
- The collective response may well have an urgency which requires system restoration and the rebuilding of confidence much sooner than the completion of the forensic investigation, let alone the allocation of responsibilities.
- Restoration needs money and it needs a widely-mandated, qualified and trusted control entity.
- Restoration must be on a basis which is “without prejudice” to ultimate liability allocation. However, after a system failure, all involved will need to be confident that lessons are learned and that the reliability of the parts of the system that had to be investigated is improved.

- Restoration funding must, when established, be sufficient and fair.

- Restoration funding must be replenished after use, also by agreed means.

E. Resolution of disputes within the community of actors

There must be agreement embodying the most effective way of resolving disputes at an acceptable level of justice (which will also be greatly assisted by modularity as that itself will reduce disputes).

Dispute resolution should always be confidential.

Hence, instead of litigation, actors should pre-agree the alternatives, and agree to be bound by the outcome of arbitration and/or mediation or other forms of alternative dispute resolution (ADR).

3.2.2. Organisational Architecture & Business Models

Organisational Architecture (WP3) and Business Models activities (WP6) are strongly related, as they have the common objective to investigate business & organizational aspects enabling the development of SAFESPOT system.

For this reason, some common considerations about the future deployment program are here presented.

Business and service model analysis performed in WP6 has the main objective to build and evaluate alternative models to be addressed in the SAFESPOT deployment program. On the other hand, Organisational Architecture aims at investigating which are the actors playing in SAFESPOT business, their roles and responsibilities for the success of the initiative. Then, Organisational Architecture will give input to Business Models definition.

In other words, the common objective is to find out the organizational and business aspects in order to make sure the services functionally described in the Logical Architecture are effectively feasible. In fact, it may happen that some services that are well designed under a functional point of view, cannot be applied in the business world because the adopted organizational models do not correspond to the real needs. The correct functional service supply is not guaranteed by the simple implementation of the processes/functions (these may
guarantee its effectiveness), but has to be supported by a business analysis aimed at its efficiency. Because of that, a value analysis is performed along the service supply process; for each step of the value generation path, it is important to detect the levers that allow to create value by increasing the efficiency of the service and reducing the process costs (business vision of the service).

As a first consideration, it is important to highlight that the definition of alternative technical and functional configurations is the essential input for both these analyses. On the other hand, the analysis of business and service models can give important inputs to the technical and functional configuration of a new system.

For these reasons it is very important that technical SPs activities (mainly SP4, SP5) will be integrated with BLADE-SP6 ones. A good Deployment Program should be the result of a process of continuous interface between:

- the SAFESPOT developers involved in SP6, responsible for determining how the solution can be realistically deployed, and

- the activities of the subprojects focused on the application aspects, where the logical functions are defined, both for the infrastructure, the vehicle and the overall communication system.

Business and service models definition can be influenced by different drivers, mainly grouped in three categories: technology roadmaps, stakeholder strategies and market needs.

Important considerations can come just right now from the analysis of the stakeholders involved in SAFESPOT system deployment.

It is interesting at this level to try to adopt the classification suggested in CONVERGE project, in order to identify all the stakeholders and their role, answering the four questions: who wants SAFESPOT system, who makes it, who use it and who rule it.

<table>
<thead>
<tr>
<th>Who wants it</th>
<th>Who makes it</th>
<th>Who use it</th>
<th>Who rules it</th>
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</thead>
<tbody>
<tr>
<td>Public Authorities for reducing social costs</td>
<td>SW &amp; HW suppliers</td>
<td>Final users</td>
<td>Public Authorities (EU, governments)</td>
</tr>
<tr>
<td>Final users for their safety</td>
<td>OEM (car, trucks, …)</td>
<td>Public services (emergency services, traffic managers / patrol)</td>
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<tr>
<td></td>
<td>Road Operators</td>
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<td></td>
<td>Telecommunication operators</td>
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<td></td>
<td>Service providers</td>
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</table>
It seems clear that public authorities can play a crucial role in SAFESPOT business model, being positioned between 2 edges:

- governments are active subjects with policies that force suppliers and finals users to adopt SAFESPOT system;
- governments do not have an active role in the process and the system deployment is completely market driven.

Alternative business & service models have to be defined between these two extremes, influencing the main characteristics of the related deployment program, namely:

- actors involved;
- target market;
- service policies.

Road operators role has to be precisely analysed: they are the main actor for infrastructure based applications. These applications need big investments and the returns are not immediate. It is important to analyse possible strategies in order to overtake this obstacle, for example thinking at their possible role in the business of services enabled by SAFESPOT architecture.

At this purpose it is also important to highlight that the SAFESPOT system can be the basis for the development not only of safety related services; other services can also be enabled by SAFESPOT architecture, potentially influencing the Return on Investments of the whole initiative, and this aspect should be deeply analysed in Business & Service Model analysis. Concerning this aspect the collaboration with other project dealing with traffic efficiency issues (fist of all CVIS project) is essential, in order to identify possible infrastructure synergies.

Coming back to investments for road operators, it is also true that not only the entity of SAFESPOT investments has to be analysed but also the incidence on the total costs needed for traditional safety infrastructure and road maintenance. This can also be an important decision parameter for deciding the about undertaking investments. This consideration is also valid for OEM, when it seems clear just by now that such incidence related to vehicle cost will be really high.

Thinking at the SAFESPOT infrastructure based architecture, it is important to say that OEM and Road Operators need to work together from the beginning of SAFESPOT deployment. Their roles are essential for the deployment of such architecture and a way to find an agreement among them has to be deepened.
Another aspect that should be taken into account is the geographical coverage of the SAFESPOT initiative. Considering that the deployment should cover at least the European area, it is clear that the same model cannot be adopted in all the European countries: an analysis of the differences that can influence the success of SAFESPOT initiative is necessary. Furthermore, the situation in countries such as Japan and USA should be monitored.

In order to give an idea on how the analysis will be performed, in the following the main steps of the work are presented, first of all for the Organisational Architecture part that will start soon in the project.

The steps of the implementation of the Organisational Architecture and the definition of the best Business & Service Model will be based on the fundamental concept of “value chain”. This tool is aimed at having a general vision on how the telematic services are supplied in order to detect the path of the value generation, thus evaluating feasible options for the service supply. Its application involves specific benefits:

- to supply a structure to perform competitive analysis by separating the steps that generate some value;
- to help along the identification of the cost drivers, of the needed levers and of the activities adding no value;
- to identify the areas that can be improved or the potential competitive advantages, by the comparison of the cost drivers and levers;
- to integrate opportunities by including final customers and suppliers in the value chain.

The methodology is based on the detection of the sequence (chain) of processes/functions, tools (methodology, technical solutions) and activities oriented to the production of a result, in this case the service (functional vision of the service).

Finally, the approach to the definition of the Organisational Architecture can be translated in a step-by-step procedure, leading to the following elements:

- **Definition of a macro-process or value chain for the service.** In this step, it is very useful to detect different typologies of service inside the field, to which the same value chain is applicable, aiming at making easier, later on, the detection of the skills that the different roles along the value chain are requested to have;

- **Evaluation of the sub-processes of each chain mail.** Each macro activity of the macro processes value chain, or process, can then be divided into
sub-processes/activities, corresponding to what is set by the Logical Architecture. This partition is needed for the correct assignment of the activities to a certain chain mail and thus to a certain role. The detected sub-processes are then positioned on the value chain (first level of analysis), to build what it is called “sub-processes diagram”;

- indication of the possible roles inside the sub-process / Indication of the responsibilities / Detection of the management levers for each role. In this step the roles needed for the implementation of the activities inside the chain mails and the sub-processes are defined, the responsibilities that each role shall have to implement his own activities, and the levers to make operationally effective his job. Once the roles have been defined, the basic part of the task is to define a process view applied to the roles, that is a flow of activities assigned to the detected roles, defining the service supply.

The activities that contribute to the service supply are grouped into homogeneous categories depending on:

- required professional skills;
- systems involved;
- data needed;
- interaction with other functions and consequently the responsibilities linked to those sets of activities are defined;
- definition of the logic/time flow of the activities mapped on the roles.

Once the services to be supplied to the users and the involved roles are defined, the flow of activities needed for the service supply can be designed, grouping them by roles, hence putting in evidence the pertinences.

This vision is a deepening of the concept of value chain. In fact, in order to make the relationship between Roles and Value Activities immediately usable, a dedicated diagram is built, where for each role the corresponding Value Activities are assigned, as a basis for the definition of the levers and responsibilities.

The Diagram, that will be called “Flow Chart of the service”, contains the activities flows with the exchange of the macro-data that are related to the corresponding macro-function (only as a guide for the correct sequence of the activities); in particular the functions that were detected in the decomposition of the macro-process are linked to the roles detected at the previous step, by assigning to each role the functionalities under his pertinence.
3.2.3. Socio-economic

The development of cooperative safety systems that ensure the communication and the exchange of information between vehicles and between vehicles and road infrastructure is a milestone in road safety work. By combining information from “intelligent” vehicles and from “intelligent” infrastructure it can be expected that the cooperative approach will ensure a further reduction of number of accidents and fatalities.

In competitive markets the development, commercialisation and marketing of new technologies is in the producing industry field of activity as well as financial responsibility. The vehicle manufacturers and automotive suppliers compete for customers with the quality of their products and technical solutions. Therefore competition can be labelled as an incentive for innovation and diffusion of new technologies. But due to special characteristics, there is a tendency towards weaknesses of the market mechanism or even market failures:

- in general, communication networks generate network effects. In the case of cooperative safety systems, every additional vehicle equipped with “intelligent” technology and participating in the communication network between vehicles and infrastructure increases the benefits of all network users. The higher the number of participants, the higher the benefits for each user;

- with the increasing number of cooperative safety system users, the costs for provision and operation of the safety system decrease. These economies of scale are low when new technologies are introduced into the market, so that users have to face high costs of purchase and operation. The cost reductions become highly effective when the market is broadly penetrated;

- even road users which are not participating in the cooperative safety system’s communication network benefit from the safety effects resulting from the cooperative system. This issue of external benefits is related to that of public goods, which are goods where it is difficult or impossible to exclude people from benefits. The production of a public good has beneficial externalities for all, or almost all, of the public.

As a consequence of the market weaknesses/ failures, the development, commercialisation and marketing of cooperative safety systems by the automobile manufacturers and automotive suppliers decelerate or are performed insufficiently. In the worst case the introduction is even omitted.
Hence, the question for public authorities arises, whether it is justified to step
in with a collective solution of intervening measures at its disposal in order to
compensate the obstacles regarding market diffusion. This issue is addressed
within a comprehensive deployment program, which should comprise legal as
well as financial measures that may seem appropriate to stimulate market
deployment of safety systems. These measures could additionally be flanked
with a variety of policy measures for promoting market penetration (e.g.
setting standards and rules, general-awareness raising, supporting actions,
highlighting best-practices).

Moreover, sometimes government could contribute to the deployment of
cooperative safety systems by acting as commercial partner. Public
authorities could implement appropriate instruments to solve the following
tasks with the aim of strengthening market penetration of “intelligent” safety
systems:

1. As owner and administrator of information which are essential for the
   operability of communication networks, the necessary data and information
   (e.g. transmission of temporary speed limits) could be made available if
   feasible.

2. Since communication networks require area-wide, substantial investments in
   infrastructure, road authorities could participate in the provision of
   infrastructural elements by providing appropriate basic conditions for the
   industry.

3. In the special case of communication networks for a cooperative safety
   system the development of technical standards is an important issue to
   guarantee the compatibility of technologies developed.

Having in mind the policy concepts to support the development,
commercialisation and deployment of cooperative safety systems, the public
interventions must not have any negative impacts such as distortions in
competition, windfall gains or predestination of the industry’s R&D-efforts. In
total, a strategic deployment concept for cooperative safety systems is crucial.
This deployment program has to take into account what kind of developments the
industry could achieve by its own efforts on the one hand and what kind of
measures could be taken to support the industry in case of excessive financial or
legal requirements.

When deciding upon a deployment program for cooperative safety systems
decision makers and politicians face many difficulties. In general, they have to
decide on:
- the necessity of a public deployment program (if) taking into account the possible market performance and penetration of a safety system without governmental interventions;

- the priorities of research and deployment activities regarding the selection of safety systems (which systems) since there can be large differences in costs and benefits between the systems;

- the prioritization of measures to be taken by public authorities to support the deployment of safety systems (which measures), since there is a wide range of policy interventions.

Within these three steps the public authorities in charge are obliged to choose those cooperative safety systems and deployment measures from a variety of possibilities that demonstrate „optimality“. In times of scarce financial resources and strict financial budgets for the implementation it has to be ensured that money available will be spent on those safety systems and measures to deploy the systems that follow the principle of efficiency. The principle of allocative efficiency is underpinned by an assumption that social welfare may be enhanced by the redistribution of resources used within society (e.g. time, energy (fuel), accidents, environment), even where this entails redistribution from the poor to the rich. The consideration of consequences of the decision on the safety systems as well as on deployment measures with the aim of providing ex-ante-information on efficiency for rational decisions, is a challenging task. Within the deployment program the issue of efficiency has to be addressed with a socio-economic assessment.

Considering the methodological framework, a widespread approach for assessing the potential socio-economic impact has to be used. Economic science provides several methodologies for assessing and quantifying the specific values of socio-economic impacts. Two broadly-accepted techniques are the cost-effectiveness analysis (CEA) and the cost-benefit analysis (CBA). Both represent economic evaluations of alternative resource use and compare the socio-economic benefits in terms of resource savings with the system costs (investment, operating and maintenance costs) in the same way. They differ in the analytical questions that can be answered:

- within the CEA the costs of safety systems are measured in monetary terms. On the other hand, benefits are expressed in non-monetary terms, e.g. number of saved lives. Therefore the CEA can only be used to ascertain the effectiveness of a measure in accomplishing a particular objective (e.g. reduce the number of road accidents);
the welfare-economics-based CBA measures all relevant costs and benefits in monetary terms. Hence, the CBA can be used to assess the absolute efficiency of a measure (by monetarizing all costs and all benefits) which aims at finding whether a proposed objective is economically efficient and how efficient it is. As a result of the analysis a benefit-cost ratio is calculated. Benefit-cost-ratios of more than “1” indicate that the deployment of the safety systems would be in the public's interests.

Comparing the results of cost-benefit analyses for different safety systems will lead to a prioritization of systems to be deployed from the public point of view. In addition, the CBA is the appropriate approach to safeguard the optimality requirements for policy measures to support the market penetration of cooperative safety systems. For each measure which can be chosen by the public authorities to deploy the safety systems a cost-benefit-ratio can be calculated. Therefore the public authority in charge for the deployment program gains greater control over resource allocation within the deployment process.

The broadly-accepted CBA evaluates the economic benefits and costs of safety systems respectively measures that serve to deploy those systems in monetary terms of resources saved within an economy. A wider and recently discussed socio-economic assessment approach to support decisions regarding the deployment of safety systems is an enlargement of the traditional CBA by tools to analyse economic impacts for different stakeholder groups (e.g. automotive industry, end users, public organizations, insurance companies), macroeconomic impacts as well as distributional and financial effects. This integrated evaluation framework enables an overall judgments on the socio-economic impacts of safety systems and measures to deploy the systems.

In the development of a deployment program for cooperative safety systems from a socio-economic perspective the authorities in charge have to take into account that these safety systems could lead to benefits which – to a considerable extent – depend on the deployment process itself, meaning that benefits (besides costs) could be largely influenced through differences in the degree of market penetration of the system. Therefore, assuming a certain degree of market penetration for determining allocative effects which could occur after the implementation of the system is not sufficient. In terms of assessment, the effects of possible deployment measures and the various stages of the deployment process as well as the possible overall results of a deployment program have to be taken into consideration. Hence, different paths selectable by decision makers and politicians to support the deployment of cooperative safety systems have to
be compared and included in the socio-economic assessment which aims at providing guidance to policy decisions on the design of a deployment program for cooperative safety systems.

3.2.4. Market/Costs/Financial

In addition to the aspects raised in the previous paragraph, more market related considerations are here presented, with the objective of addressing specific analyses later in the project.

The deployment program should concentrate on market related issues coming from the exploitation of SAFESPOT applications. In particular, the innovations brought by SAFESPOT architecture with respect to ADA/ADAS systems (considered in existing studies/projects, described in chapter 2) introduce new elements to be identified and analysed during BLADE project.

Most of the issues here presented are also valid for ADA/ADAS systems but probably the complexity of SAFESPOT system introduce new elements to be deeply analysed.

As already remarked in business related considerations, road operators are expected to be key subjects for the deployment of SAFESPOT architecture, whereas they have a minor role for ADA/ADAS systems considered individually. For this reason their actual market strategies should be deeply analysed in order to verify the coherence with SAFESPOT objectives. In particular, future road related services and the way of supplying them should be analysed.

Final users position is another key point for SAFESPOT deployment. In particular:

- user acceptance is an important aspect to be considered, as SAFESPOT architecture include several applications installed on the vehicles, communicating with other vehicles and with the road infrastructure; privacy aspects should also be taken into account. This aspect is more important for applications that act on the driving than for applications which simply warn the drivers;

- willingness to pay is another important aspect to take into account, as numerous applications will contribute to form SAFESPOT system. Therefore, it seems mandatory to have a precise idea of if the end user is willing to pay for the system as whole, but also considering the individual role of each of them. The willingness to pay for these two aspects, system as a whole, and each application taken individually, is to be examined together with the related services;
- the risk of drivers lower attention due to an overestimation system performances can have an indirect impact on the market perception about SAFESPOT system. In fact, in case of accident (even if the system worked well), a worsening of image can occur, having catastrophic consequences on the market diffusion of the system.

An important consideration for deployment program is the necessity of an adequate communication plan towards final users having two main goals:
- to stimulate the appeal of the system for the market;
- to avoid the misunderstanding about the functionalities of the system.

At this purpose a clear competitive positioning of SAFESPOT compared to other road safety systems, should be defined.

As all the above mentioned market aspects can influence the best product configuration, it is important that a link between market analysis (conducted in WP5) and technical SPs analysis (COSSIB and SCOVA) will be maintained during all the project. This will assure that the deployment program will take into account both technical and market views on the system. In particular a strong collaboration is needed in the definition of user acceptance analysis that will be carried out on the test sites.

### 3.3. Conclusions

The Preliminary Deployment Program for SAFESPOT presents the first framework for the deployment of the project. It will consist of a vision and a description of the SAFESPOT systems, by means of an action plan and of a process/communication plan. The vision will be developed on the basis of the SAFESPOT applications, the action and the process/communication plan will be developed on the basis of the BLADE analyses.

According to the research performed in BLADE, the deployment program will take into account all the aspects required for the exploitation of SAFESPOT systems in terms of risk/legal issues, organizational architecture and business model, socio-economic impact, market, cost and financial considerations.

First considerations have been presented in this chapter. The development of cooperative safety systems, that ensure the communication and the exchange of information between vehicles and between vehicles and road infrastructure, involves tricky liabilities that can’t be managed by contractual terms. Therefore, the responsibility allocation for the new system should follow predetermined criteria as to the basis of liability.
The definition of the organisational architecture and the activities related to the business model development are strongly linked, since both aim at investigating business and organizational aspects enabling and making feasible the SAFESPOT systems. The whole SAFESPOT system perimeter will be represented by the fundamental concept of “value chain” that describes all the mechanisms involved in the new business in terms of alternative service configurations, actors, roles and responsibilities involved in order to identify the way of the value generation.

The value of socio-economic impacts related to the SAFESPOT system cooperative approach will be evaluated by the cost-benefit analysis (CBA) technique, in terms of economic benefits, coming from the reduction of accident and fatalities number, and system costs. Since the socio-economic benefits are widely influenced by the degree of the system market penetration, different paths (selected by decision makers and politicians to support the deployment of cooperative safety systems) have to be compared and included in the socio-economic assessment.

The innovative architecture of SAFESPOT system and its complexity with respect to ADAS systems, introduce new elements to be minutely analysed, not forgetting to take into account both technical and market aspects. First of all, the coherence between the market strategies of road operators, the key actor for the deployment of SAFESPOT architecture and SAFESPOT objectives will be considered; then, the position of final users in terms of user acceptance, willingness to pay and market perception of the SAFESPOT system will be analysed. Finally, an adequate communication plan will be carried out in order to stimulate the appeal of the system and to avoid possible misunderstanding about the system functionalities.
4. Conclusions

This deliverable provides the first elements to be taken into account for the activities of the BLADE sub project, in particular:

1. the actual state of the art regarding the different issues dealt in BLADE: organisational architecture, risk analysis, legal aspects, market/costs/financial assessment, socio-economic evaluation and business models;
2. preliminary guidelines for the deployment program;
3. a first collection of quantitative data needed for the evaluations to be performed in the Sub Project.

For each of the issues mentioned at point 1, the State of the art analysis has been focused on results and adopted methodologies potentially useful for SAFESPOT, even if mainly referred to ADAS systems.

ARTIST project is the reference for a standardized methodological approach for the Organizational Architecture of a new product/system, together with the pilot project ECAL. This analysis looks at the system for the Enterprise/organisational point of view; the definition of system functions is a required input. A strong relationship exists between the development of Organisational Architecture and the one of Business Model; both are based on the fundamental concept of the “value chain”. Several projects identified the stakeholders composing the value chain for safety systems. E-MERGE describes through an interesting methodology the main elements of a business case: possible benefits and costs, ways to reach the possible benefits, the needed investments and the stakeholders involved. No project adopted the approach suggested for SAFESPOT business models analysis, including the integrated definition and ranking of alternative service & business models.

About risk aspects, only a few projects identified potential risks with a formal risk assessment methodology and even fewer developed mitigation strategies (only 2). An overall view of the risk analyses learns that user acceptance, liability and cost benefit are the main risk categories mentioned. Another main concern (for which specific risk analysis is done) is the consequences of failure or malfunctioning (especially to reduce liability). An area that needs attention concerns the risks related to behavioural changes of users. The RAID project provides a very useful list of potential mitigation strategies.

Concerning legal aspects, among all the projects analysed the most interesting ones are RESPONSE 1 and 2, ADVISORS, STARDUST and AWAKE. The most
attention has been given to liability and insurance aspects of ADAS. Although all the afore-mentioned projects are focused on autonomous systems, RESPONSE 2 gives attention also to co-operative systems.

Some interesting considerations are given for cooperative systems, potentially useful for SAFESPOT, in particular: more parties involved, all with their own responsibilities, need of greater transparency of development, need to address issues relating to the allocation of responsibilities among Actors; new need for pre-agreed investigative processes to be deployed in the event of any significant system failure (probably a prerequisite for a well-structured insurance response), need to look at restoration of services, need for pre-agreed dispute resolution forms.

Concerning socio-economic aspects, several safety systems have been analysed in terms of their impact on the whole society. Many of the reviewed projects report on several methods that enable the evaluator to assess intelligent safety systems from different perspectives and under various criteria; Cost Benefit Analysis and Multi Criteria Analysis are the most used, often accompanied with a Sensitivity Analyses and Stakeholder Analysis. Main criteria on which socio-economic evaluations are based are: road safety, efficiency of road transport, environmental aspects and satisfaction of end users and acceptance of other stakeholders. A comprehensive, systematic approach for socio-economic evaluation was introduced by SEiSS.

Market aspects analysis collected useful information on the market of ADAS and safety systems in general and on adopted methodologies to investigate it. In particular, the results have been analysed according to key questions to be answered when approaching the market analysis of a new product. Aspects that have to be investigated are: reference market, product configuration and appeal, market tendencies and trends, introduction strategies. Several methods adopted in the analysed projects are presented, mainly to investigate market needs, user acceptance and to help product configuration.

Cost and financial aspects were also investigated. Also interesting approaches for the evaluation of financial sustainability have been found while it can be concluded that estimations on costs are made basing mainly on analogy with similar products.

The state of the art analysis has been the starting point for the definition of first guidelines for the SAFESPOT Deployment Program. The expected contents of a complete deployment program are detailed. It will consist of a vision and a
description of the SAFESPOT systems, by means of an action plan and of a process/communication plan. The vision will be developed on the basis of the SAFESPOT applications, the action and the process/communication plan will be developed on the basis of the BLADE analyses.

The deployment program will take into account all the aspects required for the exploitation of SAFESPOT systems in terms of risk/legal issues, organizational architecture and business model, socio-economic impact, market, cost and financial considerations.

This deliverable presents first guidelines that have to be deepened in the next steps of BLADE. For the development of cooperative safety systems the responsibility allocation for the new system should follow predetermined criteria as to the basis of liability. The definition of the organisational architecture and the activities related to the business model development are strongly linked together, since both aim at investigating business and organizational aspects enabling and making feasible the SAFESPOT systems. The whole SAFESPOT system perimeter will be represented by the fundamental concept of “value chain” that describes all the mechanisms involved in the new business in terms of alternative service configurations, actors, roles and responsibilities involved in order to identify the way of the value generation.

The socio-economic impacts of the SAFESPOT system will be evaluated by means of the cost-benefit analysis (CBA) technique, in terms of benefits for the whole society and related costs. Since the socio-economic benefits are widely influenced by the degree of the system market penetration, different paths (selected by decision makers and politicians to support the deployment of cooperative safety systems) have to be compared and included in the socio-economic assessment.

The coherence between the market strategies of road operators, the key actor for the deployment of SAFESPOT architecture and SAFESPOT objectives will be considered; then, the position of final users in terms of user acceptance, willingness to pay and market perception of the SAFESPOT system needs to be analysed. An adequate communication plan is a crucial point in order to stimulate the appeal of the system and to avoid possible misunderstanding about the system functionalities.

Finally, the deliverable presents a first collection of quantitative data, useful as starting point for BLADE evaluations. In particular available data on European
road accidents and infrastructures, automotive market and mobility have been collected for the period 1999-2004.

Next steps of BLADE SP will be specific analyses of the aforementioned aspects, starting from organisational architecture (WP3) and risk/legal aspects (WP4).
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- D4.1 Driving simulator scenarios and requirements

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- D3.2 V2 Framework for Insurance and related Liability issues, gaps and barriers for the implementation and expected organizational changes
- D 6.1 Integrated Multicriteria analysis for Advanced Driver Assistance Systems
- D7.1 v6 Priority Implementation Scenarios and schemes regarding equity, insurance policies, legislation incentives and organizational consequences for ADAS deployment. Type approval and standardization recommendations.
AIDE
- D1_2_1 Literature review of behavioural
- D2.1.1 Review of existing Tools and Methods
- D2.2.1 Review of existing techniques and metrics for IVIS and ADAS assessment D3.1.1, v2.0 Final Workshop on Nomadic Devices Minutes
- D4.2.1 Report on results of First User Forum
- D4.3.1 (draft) Report on the review of the available guidelines and standards

AIDER
- D. 06.1 Analysis of the cost/benefit of the Aider System
- D.06.2 Legal and ethical implication of the Aider system
- D.06.3 Common standard recommendation

APOLLO
- D.5 Dissemination and Use Plan (DUP);
- D.6 Needs of various user groups the interview method and results;
- D.14Scenario description: safe traffic, safe vehicle and safe tyre;
- D.22/23 Final Report;

ARTIST
- Vol. V1.1--“ARTIST – L'attuale sviluppo dei sistemi ITS”
- Vol. V1.2--“ARTIST – I Requisiti Utente”
- Vol. V1.3--“ARTIST – L'Architettura LOGICA” and related annexes
- Vol. V1.4--“ARTIST – L'Architettura FISICA”
- “Sistemi telematici per il traffico ed il trasporto” – Quaderno - Riferimenti normativi basati sulla suddivisione delle aree secondo la Norma Quadro UNI CEI 70031:1999.
- Vol. V1.5--“ARTIST – L'Architettura ORGANIZZATIVA”

CarTALK
- D12 Socio-economic Assessement
- D15 Final report
- D:L&L, Deliverable on Legal and liability


Dr. Dariu Gavrila’s Smart Vehicle Website

[http://www.dgt.es](http://www.dgt.es)

E-MERGE
- Final Report
- D21&D22_Part201 – accident statistics
- D3.0 - Specifications of the European in-vehicle emergency call
- D6.2 - E-MERGE Validation plan
- D6.3 - E-MERGE Compiled evaluation results

ESAFETY
- Estimating global road fatalities, Report by the Transport Research Laboratory.pdf
• Transport Policy Challenges after Joining the EU. Improvement of Transport Safety Presentation.pdf
• Technology impact assessment in Germany.pdf
• Status of ITS deployment on European roads.xls
• Socio Economic Impact in Safety Systems.pdf

ERTICO : http://www.ertico.com

EUROSTAT http://epp.eurostat.ec.europa.eu

FRAME
• D 2.02 List of European User Needs
• D 3.1 Functional Architecture – Main Document
• D 3.4 Cost Benefit Study Report
• D 3.7 Models of Intelligent Transport Systems
• D 4.1 European ITS FA: Proposed Framework of Required Standards
• D 4.2 Deployment approach and scenarios
• D 03 Version 4 (RAID Project) FINAL REPORT (including Annexes): Constraint analysis, mitigation strategies and recommendations

GALLANT
• WP 2 - Use Cases and System Requirements
• WP 3 - Architecture
• WP 7 – Dissemination and Exploitation

http://www.ibsr.be

IEE Automotive and Road Trasport System Professional Network : http://www.iee.org/oncomms/pn/auto/index.cfm

INVENT(Prevent)
• Final Report of subproject “Traffic impact, legal issues and acceptance”, Work package 5000
• Documentation of a workshop concerning the market introduction of driver assistance systems on 02/12/2004 in Cologne,

Invest in France Agency http://www.investinfrance.org

INRETS : http://www.inrets.fr/index.e.html

INTELLIGENT TRANSPORT SYSTEMS
• ITS Japan Handbook 2005-2006, Intelligent Transport Systems

APALACI (PREVENT)
• D50.30 User Needs State of the Art and Relevance for Accidents
INTERAUTO NEWS http://www.interautonews.it/
IVSOURCE.NET : http://www.ivsource.net/
OICA http://www.oica.net

PROSPER
- D2.4 Final report on stakeholder analysis
- D2.5 Report on user perception and acceptance
- D5.2 Final recommendation definition of European ISA deployment
- D6.1 Legal and policy aspects on road speed management in Europe
- D4.2 Global effects from ISA speed management methods
- D4.3 Assessment of road speed management methods

RESPONSE 1
- The RESPONSE I Final Report on Recommendations for Testing and Market Introduction of ADAS (Deliverable D2.2)

RESPONSE 2
- D.2 Methods for Risk-Benefit-Analysis of ADAS: Micro Perspective and Macroscopic Socio - Economic Evaluation
- D.1 ADAS: Market Introduction Scenarios and Proper Realization
- Welcome to Final Workshop, Cologne, 29 & 30 April 2004
- Adas Systems and Market Introduction Issues Cologne, 29 April 2004
- Risk-Benefit Considerations for ADAS and Active Safety Systems – Socio Economic Issues (Macro Perspectives)
- The Japanese Studies: Market Introduction and Liability Issues of ADAS in Japan

RESPONSE 3
- (annual) workshops on 25th November 2005

SAFE TUNNEL
- D2.0 Tunnel Control and Enforcement Strategy
- D02.01 Innovative systems and frameworks for enhancing of traffic safety in road tunnels
- D2.2 User needs analysis
- D2.03 Innovative systems and frameworks for enhancing of traffic safety in road tunnels
- D6.04 Tunnel safety impact and user acceptance analysis
- D6.05 Socio-Economic and Cost-Benefit Analysis

SAFEMAP
- Project description, final version, July 2003,

SEiSS
- Final Report

SPEEDALERT
• D2.1 Common Definition of Speed Limits and Classifications, v1.5,
• D2.2 System and Service Requirements, v1.0,
• D4.1 Evolution of SpeedAlert concepts, deployment recommendations and requirements for standardisation, v2.0,
• Final Report, v1.0,

STARDUST
• D2 and 3 Scenarios and evaluation framework for city studies
• D9 Legal and institutional aspects
• D10 Evaluation of Scenarios to Deployment of ADAS/AVG Systems in Urban Contexts

UNRAE http://www.unrae.it

USDOT ITS http://www.its.dot.gov/index.htm

6. Annexes

6.1. Annex 1: First collection of quantitative data

This paragraph deals with the first collection of quantitative data, necessary for the evaluations to be performed in BLADE, mainly in Work packages WP5 and WP6, the first one devoted to Socio-economic, Market and Financial assessment and the second one to the definition and selection of suitable service and business models.

In particular the following aspects are presented:

- the general framework of data to be collected during BLADE SP;
- the data collected.

For the last point, not all data are included in this document but reference to some other documents have been made.

6.1.1. Framework for data collection

Starting from the idea to create an exhaustive framework of quantitative data needed for BLADE evaluations, the following categories have been identified:

- European road accidents and their consequences
- Accident costs
- Automotive market
- Vehicles safety devices on the market (country level)
- Mobility (country and single road level)
- Meteorological statistics affecting road safety (country and single road level)
- European Road Infrastructures
- Socio-demographic statistics affecting mobility choices (country level)

Not all the data have been collected at this moment of the project. A selection of four out of the eight categories was made to determine which are the crucial data to be found at the moment, and which should be found later, inside specific work
packages, in order to make more efficient the data collection itself. In particular, data that have been collected during this activity are here listed:

- European road accidents and their consequences
- Automotive market
- European Road Infrastructures
- Mobility (country and single road level)

In the following an explanation of each data category is reported. Table 7.1 reports an initial list of data that should be collected for BLADE evaluations.

The data concerning European road accidents and their consequences will allow ratio calculation as well as other types of calculations in order to identify for example where the accidents occur most often, what are the conditions that make this figure increase (weather, external cause). This information can be useful in order to choose efficient systems to reduce the number of fatalities and injuries on the European roads.

Accident costs are essential to carry out the costs/benefits analysis. It gives information on the social cost of accidents and allow the calculation of expected benefits coming from potential accident number / severity reduction.

Concerning the automotive market, it is significant to know the number of new vehicles and used vehicles that are registered each year for the different countries, but also and most of all, the repartition of the registrations: type of vehicle, fully equipped or not and the repartition of the vehicle owners as well (e.g. age, income, sex). This will allow a better assessment of the market, and a better deployment program.

It would be also important to know the vehicles safety devices on the market in order to know what the competitors are doing, to adopt a marketing strategy for the introduction of the SAFESPOT system on the market. Moreover, this information will also be a criteria for choosing the applications to include in the SAFESPOT system.

Mobility cluster includes data concerning the traffic flow, the number of vehicles that use the road every day (or every month), what type of vehicle and so on. They give information about where and when the traffic is concentrated, and could be useful to determine strategic points to set up the infrastructure. An initial list of data can be found in the table below.
Meteorological statistics affecting road safety are other information that can complete the data concerning European road accidents and their consequences. That can, as well, influence the choice of application to be part of the SAFESPOT system. For example, if thanks to those data, it is noticed that rain is responsible of a significant increase in the number of accidents, it could be decided to include an application aiming at reducing the risk of aquaplaning.

European Road Infrastructures category includes data that will help choosing an implementation strategy, namely how should the safety applications be organised in order to allow the vehicles to communicate in the most efficient way with the infrastructure. That requires to be aware of the kind of infrastructure that is already in function and also the infrastructure that is under construction. For example it is important to know if the roads are private, public, what is the total length of all the types of road, etc.

Socio-demographic statistics affecting mobility choices, allow to know the segmentation of the vehicle owners, based for example on age, income, sex. This will help to better understand the potential market, and therefore this could be important to define a complete deployment program.

To summarise, there are two kinds of data: those which will permit to understand better when, where, and in what conditions the accidents occur, which will allow a more judicious choice of the different applications forming the SAFESPOT system, and those which will assure a coherent deployment program, as well as a successful introduction of SAFESPOT system on the market.
<table>
<thead>
<tr>
<th>Statistics on European road accidents</th>
<th>Statistics on Mobility</th>
<th>Statistics on European Road Infrastructures</th>
<th>Statistics on automotive market</th>
</tr>
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<tr>
<td>Total number of accidents</td>
<td>Total Average monthly traffic:</td>
<td>Existing Road typologies and lengths:</td>
<td>Vehicles in use</td>
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<tr>
<td>Total number of corporal accidents</td>
<td>Motorcycles</td>
<td>motorways</td>
<td>Motorcycles</td>
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<td>Total number of dreadful accidents</td>
<td>Light Vehicles</td>
<td>national/main roads</td>
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<td>Total number of fatalities</td>
<td>Heavy Loads</td>
<td>county roads</td>
<td>Heavy Loads</td>
</tr>
<tr>
<td>Total number of injuries</td>
<td>Total Average daily traffic:</td>
<td>Under construction road typologies and lengths:</td>
<td>New registrations</td>
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<td>Total number of severe injuries</td>
<td>Motorcycles</td>
<td>motorways</td>
<td>Motorcycles</td>
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<td>Total number of light injuries</td>
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<td>national/main roads</td>
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<td>Injury accidents</td>
<td>Heavy Loads</td>
<td>county roads</td>
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<td>per 100 000 Population</td>
<td>Total Average annual traffic:</td>
<td>Tolled Roads and toll modality</td>
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<td>per 1 mill. Veh-Km</td>
<td>Motorcycles</td>
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<td>Outside Urban Areas</td>
<td>Light Vehicles</td>
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<td>Motorways</td>
<td>Heavy Loads</td>
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<td>Fatalities per</td>
<td>Traffic Topology Distribution:</td>
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<td>All roads</td>
<td>urban</td>
<td>Travel time losses due to congestion</td>
<td>Price</td>
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<td>Outside Urban Areas</td>
<td>regional</td>
<td>Value of time (VOT) data</td>
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<td>Motorways</td>
<td>national</td>
<td>Fatalities costs</td>
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<td>inside urban area</td>
<td>Average frequency</td>
<td>Severe injuries costs</td>
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<td>outside urban area</td>
<td>daily</td>
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<td>typing</td>
<td>weekly</td>
<td>Light injuries costs</td>
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<td>1 million of inhabitants</td>
<td>monthly</td>
<td>Data on pollutants emissions (1)</td>
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<td>1 billion of km covered</td>
<td>occasional</td>
<td>Data on fuel efficiency (user costs) (1)</td>
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<td>Fatalities per 1 billion veh.km</td>
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<td>Number of days of:</td>
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<td>All roads</td>
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<td>Motorways</td>
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<td>Socio-demographic statistics</td>
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<td>Motorways</td>
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</table>
6.1.2. Presentation of collected data

As anticipated in the previous paragraph data collection was focused on four categories.

During data collection, some sources have been of a great utility. That is the case of the CARE database, the IRTAD (International Road Traffic and Accident Database) the Sécurité routière and Observatoire national interministériel de sécurité routière for France, Ministry of transport of Luxembourg, KfV &FMI for Austria, Road safety in Spain, IBSR for Belgium, Eurostat, Verband der Automobilindustrie, International Road Federation, the united nations, BundesVerband Guterkraftverkehr Logistik und Entorsung (BLG) and European Transport Report.

Thanks to those different sources, most of the required data for the mobility category have been found, even though some of the data are still missing. Although the total average traffic is available annually for all the countries for the light vehicles and heavy loads from 1999 to 2004, it is yet to be found monthly and daily for each type of vehicles and each year. The data for total average traffic for the motorcycles have been found for all 5 years for the following countries: Belgium, Germany, Austria, Switzerland, Slovenia, United Kingdom. No data have been found for: Estonia, Italia, Latvia, Luxembourg, Malta, Portugal, Hungary and Cyprus. For the other countries, which are: Denmark, Finland, France, Greece, Ireland, Lithuania, Netherlands, Poland, Sweden, Slovakia, Spain, and Czech Republic, the figures have been found for at least one year, and for some, only one year is missing.

The distribution being different according to the month, or the day, it is important to have also this information. If it comes to be impossible to find the actual figures, finding a coefficient to be applied for each month could also be a solution to answer the question. Of course the figures would be calculations and as a consequence, approximate and not actual real figures, but what is important, given the fact that we have the real figures for the average annual traffic is to have a trend.

At the moment, data about the traffic topology distribution have also been found for about 10 countries, but for some of them, only the data concerning national topology are at this point available. That is the case for Belgium, Germany, France, Czech Republic, for which the data are available for the 5 years.
The only 3 countries for which all has been found are Finland, Austria, United Kingdom. Concerning Netherlands, the data are available only for the years 1999 to 2002.

Concerning the average frequency, no data have yet been collected for neither of those 4 categories: daily, weekly, monthly and occasional.

The list of the collected data about European road accidents and their consequences will be presented and more deeply analyzed in the deliverable of the SP5 COSSIB, named SAFESPOT Accident Data Analysis that has a due date at the end of month 6th.

Concerning the Statistic on European Road Infrastructures, the existing road typology and lengths have been found for all the countries of the European Union for the whole time period. There is only a few data to found that are the ones of: the year 2004 for Lithuania, Cyprus, Estonia and Slovakia, as well as the years 1999, 2000, 2001 and 2004 for Latvia and 1999, 2000, 2003 and 2004 for Malta.

However, the typology and the length of the under construction roads are still to be found. Of course it is a small percentage of the total length, but it can become significant for some of the new countries that just joined the EU.

Concerning statistics on automotive market, all the data have been found for all the countries, as well as for other countries with which it could be interesting to make comparison. countries such as the USA or Japan. Having data on those countries working on similar projects or having already deployed such projects could allow comparisons, a better assessment of the market, and as a consequence, a better deployment program. Having some very accurate figures is truly important.

A detailed table with all the collected data can be found in Annex 4, where all the sources are also specified. Because of the confidentiality of some sources, they will be available only for SAFESPOT partners, through the collaborative.

V2V based – SUB PROJECT SP4 – SCOVA

Lateral safety applications (LATC)

Lateral safety applications (LATC) are addressing the avoidance of the risk of lateral collision through an early warning to the driver. Specific scenarios for the three component applications are:

- road intersection safety: two types of urban intersections are analysed; in the first type it is assumed both infrastructure sensors and V2I communication are available; in the second type – longer term - the scenario is more complex, assuming all of the involved vehicles having V2V capabilities implemented (with or without the support of the infrastructure);

- lane change manoeuvre: prevention, during the road merging situations and approaching to the intersections, of the risk of lateral collisions; safe lane change manoeuvre with blind spot for trucks;

- safe overtaking: prevention of collision among vehicles in an overtake situation (integration of blind spot and early notification to the preceding driver of the intention to overtake of the vehicle behind).

Intersections are probably the most complex part of road infrastructures and places where collisions result in serious injury or death. An accident at an intersection can result in other accidents as an unforeseen situation would exist. On intersections traffic-flow is very complex, then the driving behavior of other drivers could change immediately, due to such unforeseen situations.

V2V communication can improve significantly the safety at the road intersections.
Concerning the lane change manoeuvres, even if specific rear mirror help driver to have a good vision around its vehicle, some blind spot already exist in some situations. This is especially (but not only) relevant for trucks and commercial vehicles. For this type of vehicles it is relevant in some situations to improve the driver information about the presence of other vehicles all around. The relative speed information with other vehicles can be taken into account to appreciate the safety of some manoeuvers. Some lateral collision or/and rear end collision can be avoided with other vehicles.

Example scenario for a lane change manoeuvre involving a truck.

The safe overtaking is a type of situation which is critical for all road vehicles due to blinds spots and differential of speed between involved actors.

Host vehicle (1) starts to overtake vehicle (3) while a Motorbike (2) is already in overtaking manoeuvre.

The Motorbike (2) informs the host vehicle (1) about its manoeuvre.
Longitudinal collision (LONC)

Focus of the longitudinal collision cluster of applications (LONC) is the possibility to inform the driver at an early stage about potential risk of frontal or rear-end collisions due for instance to the reduced speed of the preceding vehicles or, in case of two ways roads, due to overtaking manoeuvres that the vehicles in the opposite traffic direction have started. The cooperative vehicles communicates, directly to the other vehicles or to the SAFESPOT local infrastructure, their position and dynamics or the presence of obstacles on the road. Scenarios in for the four component applications are:

- head on collision warning: early warnings for situations where vehicles, travelling on opposite directions, may face the risk of an head on collision; specific use cases are presented where the advantages of V2V communication respect to ADAS sensing are emphasised;

- rear end collision: warnings for head to tail collisions, where host vehicle is moving (static scenarios covered by the frontal collision warning function) and it risks the rear end collision due – for instance – to a slow down due to road shape (hills, curves);

- speed limitation and safety distance: early information and warning to the driver concerning the speed and the safety margin to keep in the black spot situations in front, such as road works, static obstacles, or other factors that may limit or dynamically change speed and safety distance;

- frontal collision warning: warnings for head to tail collisions, where host vehicle is moving or static, and it risks the frontal collision due – for instance – to the presence of static or reduced speed traffic.

Example scenario for the head on collision warning function. In the pictogram above, host vehicle (1) attempts an overtaking maneuver to vehicle (3) which obstructs the driver’s (1) field of view, while vehicle (2) is approaching from the opposite lane.
Example scenario for the rear end collision warning function. A vehicle (2) is driving at a sustained speed before the top of an hill, while a slower vehicle (1) – e.g. a concrete-mixer – is short ahead, but still not visible, due to the specific shape of the road. Here, due to the particular morphology of the road, sensorial system eventually available for vehicle 2 is not able to detect in time the vehicle 1.

Example scenario for the speed limitation and safety distance function. Driver of vehicle V1 gets speed recommendations before approaching and inside a tunnel from two possible specific sources: the infrastructure, with specific sensing and communication capabilities in order to recommend the proper distance to keep from the vehicle in front, or directly through V2V communication, from vehicle in front (V2).

The rationale for including frontal collision warning functions among the ones of relevance for SAFESPOT is that radar or lidar sensor performances are limited (distance around 200 meters), and in some cases, the driver can not be informed enough in advance about a risk in front. For instance, sensor performances can be limited if an accident occurs after a curve or due to bad weather conditions. Better anticipation for trucks is important to safely stop the vehicle.
Example scenario for the frontal collision warning function. Purpose of the given example is to inform or/and warn the driver in order to anticipate the vehicle deceleration caused by static obstacle on the road in front. It can be for instance due to accident or a vehicle breakdown.

Road departure applications (RODP)

RODP are related to the sharing with other vehicles of the information of a slippery road status, or a bad road condition (can be due to weather condition, ice, fog...), or other factors – especially in curve - that may lead to the risk of a road departure. Scenarios for the two component applications are:

- road condition status – slippery road: a warning is broadcasted concerning the slippery road status or bad condition of the road;

- curve warning: information is gathered and delivered with a sufficient anticipation to the driver about the road curvature and the adequate speed to keep in the specific black spot. Conditions that may dynamically change the speed and the trajectory to keep in the curve (road works, static obstacles) are also tackled.

Example scenario for the road condition status – V2V based function. The driver in V2 shall be informed about the road condition status measured by V1 so that the driver of V2 can be informed.

Concerning the curve warning, it should be evidenced as example that by means of broadcasting of information from the host-vehicle, also a vehicle approaching a sharp curve without any digital maps or other navigation systems installed on-
board, can travel inside the curve safely (with the suggestion of reference speed to keep). On the other hand, if the vehicle is already equipped with digital maps, the information of how other vehicle behold in the same situations can help to reduce the number of false and missing alarms.

Example scenario for the curve warning function. Host vehicle (1) transmits to an infrastructure transponder (3) its speed and (possibly) other vehicle dynamics information. In a second time a vehicle approaching to the rural black spot (2) receives this information, adapting its speed depending on multiple parameters, including map and navigational information, if available, and the behaviour of other vehicles.

Vulnerable Road User (VURU)

VURU is focusing on the propagation of information about a vulnerable user (detected by means of infrastructure or vehicles equipped with suitable ADAS, developed outside SAFESPOT – e.g. available by previous or on going projects, like Watch-Over) to other vehicles that do not have possibility to see or detect the vulnerable road user. Two basic scenarios are addressed in the Vulnerable Road User detection and accident avoidance application:

after the detection of a VRU the information is sent to the vehicle incoming behind (scenario related to a 2 ways road in urban situation);

avoid accident with bicycle or motorcycle on the side of the vehicle when it decide to turn (frequent type of accident referring to the blind areas of trucks and commercial vehicles).
Example scenario for the Vulnerable Road User function. Especially in urban and extra-urban roads with two or more lanes, the presence of vulnerable road user can be not detected by other vehicles (V2) which are approaching. Several reasons may originate the situation: VRU are hidden by the truck, or other vehicle; the pedestrian crossing marking is not detected by the vehicle (V2) driver (night, sun reflection).

V2I based – SUB PROJECT SP5 - COSSIB

Smart signalling for safety enhancement

Part of the accidents which occur on roads, are due to a lack of visibility or understanding of the signalisation by the drivers. By improving horizontal and vertical road signs and crossroads, and making them cooperative with vehicle sensors and able to communicate information on road ahead, the number of accidents could be reduced.

Smart Signalling enables the transmission of static or dynamic information into the vehicle regarding any hazard conditions including maximum speed according to regulation, special road infrastructure (tunnel, bridge, dangerous bend), specific traffic conditions (jam ahead), weather, road surface, or any other safety related information.

When informing or alerting the driver, especially in adverse condition, the design of the man-machine interface is critical. A particular attention will be brought to ergonomic studies.

Particular benefits will come from the ability to update and maintain the accuracy of the information, as well as manage temporary conditions like road-work or weather impact. It is also important to tackle operational considerations, such as energetic question (how to bring energy to the road signs in rural area), as well as installation and maintenance matters.
Static or dynamic information sent directly to the on-board unit allows the driver to be aware of potential danger or hazard situation and to anticipate the situation with adequate behaviour.

**Hazard and Incident Warning**

Hazard and Incident Warning is based on transmission of warning messages to vehicles arriving on a black spot. The message might be issued from infrastructure, eventually relayed by assistance vehicles.

The messages contain in particular:

- type of hazard (accident, obstacle, fog, heavy rain, road works, …)
- current location and previous positions (GPS data)
- speed, direction
- and others.

In the receiving vehicles, the information is processed, and if relevant (i.e. vehicles on the same road, same direction, etc.), it is displayed to the driver; otherwise, it is postponed or put aside.

*Black spot can be geography localised or spread on a large area. Warning messages must contain sufficient information to be addressed at the right time to relevant vehicles / drivers.*
Safe urban intersection

In general, city safety with respect to drivers and pedestrians is mainly addressed to their safety in the vicinity of (signalised) intersections that can be regarded as static black spots. This is why this application area aims to realize enhanced driver assistance for urban areas on the basis of an intensive exchange of data between the roadside traffic light controller and the approaching vehicles. For this information about vehicle's localization and speed can be brought together with intersection topology data and traffic control parameters in order to generate new valuable information for the drivers that approach the intersection.

On the infrastructure side, complex modelling of the whole scenario (accurate reconstruction and forecasting of all vehicle trajectories), is needed that might be performed on local dynamic maps. Also, on the basis of the dynamic scenario results, a second processing step in form of sophisticated decision and strategy procedures must be specified and implemented. As a final processing step an extended in-vehicle navigation or ADAS equipment can then present the new information (recommendations and warnings) to the driver in an appropriate way.

The following set of measures and driver assistance services are expected to be part of the above described application area and have to further examined and specified:

- Surveillance of intersections and their surrounding in order to detect dangerous situations at an early stage and to inform vehicles/drivers being affected;
- The safe speed and manoeuvre to approach the intersection is suggested to the driver or even applied to the vehicle cruise control;
- A warning to the driver is issued: (1) if the driver is not following the rules (by example: he is not stopping), or (2) if there is a risk of accident (by example: another vehicle is infringing the intersection rules);
- Brake and accelerate recommendations at intersection approaches in order to synchronize vehicle behaviour with traffic lights phases;
- Speed recommendations with respect to passing of signalised intersections or green waves;
- A specific infrastructure-based warning system is used to warn also the non-equipped vehicles;
- Warnings for turning vehicles with respect to permissive flows, conflicting pedestrians and cyclists;
- In-vehicle display of traffic lights, static and dynamic traffic signs and intersection topology.

In complex intersections, supporting high volume of traffic, cooperative systems (V-I) and (V-V) can improve safety for drivers and also for vulnerable users

The application “safe urban intersections” requires a very fast cooperation of the involved sub-systems. On one side a very precise computation of the vehicles trajectories has to be performed. It is necessary to have local digital maps of intersections together with a map of all vehicles around and in some cases the situation of traffic light control status to the various lanes of the intersection approaches. On the infrastructure side (mainly traffic light controllers) all these trajectories and their approximations has to take into account in order to deliver accurate recommendations to the vehicles and to recognize dangerous situations as soon as possible. One major task will be to relate these trajectories to other available data like control states, detector information and other strategic objectives. As a consequence some new requirements for the local traffic light control procedure will emerge. The most important is the need to have an accurate predictability of signalling phases, which in particular has certain consequences on the programming of traffic actuated control algorithms.

Speed alert and road departure prevention

The transmission in the vehicle of the maximum speed according to regulation is a limiting approach, because the safety margin can be affected by traffic conditions, weather, road surface and many other parameters. Starting from the idea that the driver is the main responsible and the unique decision maker on the vehicle, the strategy implemented is based on the warning and not on the intervention; for this reason the infrastructure must evaluate the safety margin taking in account the driver reaction time.
In some cases the infrastructure must be able to detect the loss of trajectory of one vehicle: to reach this target a very fast cooperation of the involved sub-systems is required. On one side a very precise computation of the vehicles trajectories has to be performed.

In some cases, for example tunnels, bridges and any other critical road segment, the infrastructure must take care that not all the vehicles are equipped and special attention must be considered for these drives investigating the right way to alert them.

Safety margins for assistance and emergency vehicles

The drives of emergency and other special assistance vehicles in urban areas are as a rule of high priority. Other road users are expected and forced to give way to them and traffic lights either may be ignored or switched in order to ensure a “green route” for them (decided as a local action or from a central UTC). In the case of emergency missions drivers could partly be in a dilemma, as they are asked to proceed as possible and at the same time must take into account the safety requirements of other vehicles along their route.

On rural roads and expressways, identified needs for assistance vehicles (patrollers, signalisation vehicles, snow-removal vehicles, …) and emergency vehicles (ambulances, fire brigades, …) are directly related to safety. It is important to protect the concerned drivers and the working staff on site, but also to protect all vehicles from any accidents. Cooperative approach is based on self-positioning of these vehicles, sending crucial information (such as position of the incident, typology of incident, …) to infrastructure and all vehicles.
Assistance vehicles on motorways will benefit from V-I communication for protecting themselves together with other drivers

As a consequence of this there is a certain shift of the safety margin concept for the emergency and other special assistance vehicles themselves and also for other vehicles along the route that might be affected by the mission. The cooperative approach is expected to support solutions to dynamically identify the safety margins of all affected vehicles in dependence of the current situation that might be defined through parameters like urgency or importance of the mission, degree of support by traffic control, current traffic states, weather and road conditions, network topology, etc. On the basis of a determined safety margin profile, online support for the vehicles in form of recommendations and warnings can be generated and transmitted. Assistance and emergency vehicles themselves can provide valuable information on incident location and characteristics to infrastructure and other vehicles.

As far as can be seen now (further examination is part of the project), this application area comprises the following analysis, specification, implementation and integration tasks:

- What are the most important use cases (according to statistic analysis and expert experiences);
- Exact definition of the safety margins and their functional dependencies with situation and environment parameters;
- Creation of strategies to provide all concerned vehicles with the according information and warnings;
- Development of the application specific components and integration into common vehicle and infrastructure platforms.
6.3. **Annex 3: State of the art on existing project/studies**

Annex 3 is in a separated file named *SF_D6.2.1_Annex3.doc*. 
6.4. Annex 4: Initial collection of quantitative data

Annex 4 is in a separated file named SF_D6.2.1_Annex4.xls