DECOMOBIL Delivrable 4.2 Identification of and contribution to iMobility WGs linked to user centred design of ICT for clean mobility
Annie Pauzie, Alan Stevens, Stella Nikolaou

To cite this version:
Annie Pauzie, Alan Stevens, Stella Nikolaou. DECOMOBIL Delivrable 4.2 Identification of and contribution to iMobility WGs linked to user centred design of ICT for clean mobility. [Research Report] IFSTTAR - Institut Français des Sciences et Technologies des Transports, de l’Aménagement et des Réseaux. 2014, 55 p. hal-01810261

HAL Id: hal-01810261
https://hal.archives-ouvertes.fr/hal-01810261
Submitted on 7 Jun 2018

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Deliverable 4.2
Identification of and contribution to iMobility WGs linked to user centred design of ICT for clean mobility

The research leading to these results has received funding from the European Community’s Seventh Framework Programme (FP7/2007-2013) under grant agreement n°288 298

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<tr>
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<th>Annie Pauzié, IFSTTAR, Alan Stevens, TRL, Stella Nikolaou, CERTH-HIT</th>
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<tr>
<td>Due Date</td>
<td>30/09/2014</td>
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<tr>
<td>Delivery Date</td>
<td>03/10/2014</td>
</tr>
<tr>
<td>Work Package</td>
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<tr>
<td>Dissemination level</td>
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Abbreviations

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Appendix A: Background to ESoP

Appendix B: Definition of SafeAPP
Executive summary

Through the organization of road mapping activities, scientific seminars and European conferences, the DECOMOBIL activity allowed to identify, to discuss and to debate upon research priorities in the area of “User centred design of ICT for clean mobility” involving partners of the consortium in addition to the main relevant stakeholders from industrials, associations, forums and public authorities.

The objective of the WP4 “Contribution of the iMobility WGs linked to user centred design of clean mobility” is to take advantage of the outcomes of these activities in addition to the TRL, BAST and HUMANIST VCE partners expertise in order to structure and to disseminate DECOMOBIL contributions to relevant iMobility working groups.

This Deliverable 4.2 “Identification of and contribution to iMobility WGs linked to user centred design of ICT for clean mobility” summarizes how scientific bottlenecks, research priorities and important issues identified by the DECOMOBIL project can be articulated with the on-going activity and objectives of the relevant iMobility WGs such as WG-HMI, WGVRU, WG-SafeAPP and WG-R&I.
1 Introduction

The DECOMOBIL consortium worked to define research priorities on the area of ICT design for clean and safe mobility in coherence with the iMobility recommendations and integrating the roadmaps defines by the main European organizations such as EUCAR, ERTRAC, Green Car/Vehicle Initiative, in addition to European projects such as PROS (Deliverables Del 2.1 “Roadmap of Information & Communication Technology design for clean and efficient multimodal mobility” & Del2.2 “Roadmap for research on Human Centred Design of ICT for clean and safe mobility”).

The objective of the WP4 “Contribution of the iMobility WGs linked to user centred design of clean mobility” is to take advantage of the outcomes of these activities on Road mapping in addition to the TRL, BAST and HUMANIST VCE partners expertise in order to structure and to disseminate DECOMOBIL contributions to relevant iMobility working groups such as WG-HMI, WGVRU, WG-SafeAPP and WG-R&I.

Activities in iMobility Forum cover vision of the transport in the coming decades, with ambitious goals defined as setting up a “safe, smart and clean mobility with zero accidents, zero delays, no negative impact on the environment and connected and informed citizens, where products and services are affordable and seamless, privacy is respected and security is provided” (http://www.imobilitysupport.eu/imobility-forum/objectives).

In the time period 2011-2020, the iMobility Forum estimates for ITS the following potential contributions:

- 30% reduction in the number of fatalities across Europe
- 30% reduction in the number of seriously injured persons across Europe
- 15% reduction of road traffic related congestion
- 20% improvements in energy-efficiency
- 50% increase in availability of real time traffic and travel information

The mission of the iMobility Forum is to work towards this vision by providing a platform for all ITS stakeholders in Europe to develop, implement and monitor work programs linked to roadmaps, international cooperation for the successful development and deployment of ITS. The strategic focus is defining research and innovation priorities, in addition to speeding up overall development/ deployment processes.
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Among the 20 Recommendations made by the iMobility Forum regarding vision of priorities for mobility in Europe, (http://www.imobilitysupport.eu/library/imobility-forum/recommendations/1123-20-imf-recommendations-list/file), 12 are directly linked to DECOMOBIL scope:

| Accident Causation Data | 1 | a) Identify the most prominent clusters of contributing factors of accident in the EU (Nordic, Mediterranean, Central)  
b) Identify the minimum requirements for an EU database by comparing common features from national databases  
c) Identify which organizations are responsible for monitoring traffic crashes |
|------------------------|---|---|
| Impact Assessment      | 3 | a) Consolidate and refine methodologies for an integrated approach to assess the potential impact of ICT for safe, smart and clean mobility.  
b) Consolidate and refine a coordinated validation framework for operational tests in the Member States addressing ICT for safe, smart and clean mobility  
c) Promote and carry out large scale evaluation and validation of priority safe, smart and clean mobility systems through Fields Operations Tests FOT, in order to define future deployment actions. |
| Human-Machine Interaction | 4 | a) The 2008 ESoP should now be updated according to the consensus recommendations published in Oct. 2009  
b) Development should be monitored such that the ESoP can be re-visited periodically (at least every 3 years) providing a balance between current relevance and stability  
c) Develop robust assessment procedures and safety-relevant criteria where practicable staring with safe fixing (including field of view) for Nomadic Devices |
| Implementation Road Maps | 5 | a) Update regularly Road Maps (including the monitoring of implementation of intelligent integrated systems) with technical steps and economic implications for the introduction of safe, smart and clean systems in Europe. |
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<th>Cooperative Mobility systems and services</th>
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<td><strong>a)</strong> Identify requirements for specifications and implementation guidelines, for standards-based interfaces and communications protocols needed to ensure pan-European compatibility and interoperability for vehicle-to-vehicle and vehicle-infrastructure communications supporting interactive, co-operative mobility systems and services.</td>
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<td><strong>b)</strong> Move forward international co-operation in the development and deployment of cooperative mobility systems and services.</td>
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<td><strong>c)</strong> Establish mechanism and processes to agree on pathway towards deployment of cooperative systems to achieve minimum level of market penetration to start the services as well as to achieve maximum sustainable interoperability and ease the provision of new services in line with market demand.</td>
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<th>Legal issues for testing and deployment</th>
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<td><strong>a)</strong> Assess the need of adapting the relevant legal frameworks (e.g. Vienna convention) to deal with the road mobility improvements obtainable with some safe, smart and clean systems in vehicles and infrastructure,</td>
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<td><strong>b)</strong> Develop a methodology for risk benefit assessment, achieve an industrial and societal consensus on a European Code of Practice, and establish guidelines for facilitating the market introduction of safe, smart and clean systems.</td>
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<th>Standardisation and certification</th>
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<td><strong>a)</strong> Analyse the specific needs and priorities for standardisation in European Standardisation Organisations for ICT for mobility systems and services.</td>
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<td><strong>b)</strong> Follow-up, liaise and contribute to the standardisation work in this area in CEN, ETSI and ISO, in particular regarding the activities carried out in the framework of the Mandate /453 to support the interoperability of co-operative systems for intelligent transport, and promote global harmonisation when appropriate</td>
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<tr>
<td><strong>c)</strong> Analyse the necessary framework to ensure the interoperability, compliance and conformance and performance</td>
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<tr>
<td><strong>d)</strong> Need for an organisation to deal with pan European wide security and authentication issues. Another organisation will need to recognise and validate the trusted list of authorities.</td>
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<td></td>
<td>a) Work towards ICT deployment in mobility through partnerships on European large scale actions by organizing large scale test-beds in cooperation with demand and supply stakeholders and in line with the ITS Directive, in which solutions to existing societal challenges are taken through the innovation chain in a continuous programmatic approach of a sufficient scale and duration.</td>
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<th>Nomadic/after market devices</th>
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<td>Understand and analyse the potential impact and implications of the usage of aftermarket/nomadic devices for large scale deployment of safe, smart and clean mobility applications and services</td>
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<th>Preparation and updating of the Strategic Research Agenda on ICT for Safe, Smart and Clean Mobility</th>
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<td>a) With the support of the major stakeholders, analyse the specific needs and define the priorities for RTD actions on ICT for Intelligent Mobility in particular on: Sustainable Road Transport; Sustainable Urban Mobility; Road Safety; ICT and the Decarbonisation of Transport; Deployment; and the Horizontal Issues.</td>
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<th>Vulnerable Road Users</th>
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<td>a) Investigate the most suitable safe, smart and clean mobility services and applications for the VRU.</td>
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<th>Automation</th>
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<td>a) Develop a roadmap for automation on future research needs, legal actions and identify milestones and stakeholders.</td>
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Information related to the iMobility forum recommendations have been disseminated among DECOMOBIL partners so these priorities can be taken into consideration while debating about research priorities in the area of “Human centred design for ITS”.

The iMobility WGs identified as relevant in relation to the DECOMOBIL scope are:

- iMobility WG-HMI “Human Machine Interaction”
- iMobility WG-SafeAPP “Safe applications for nomadic devices”
- iMobility WG-VRU “Vulnerable road users Safety”
- iMobility WG-R&I “research & Innovation”

The following paragraph presents scope, content and objectives of these iMobility WG, in which some of the DECOMOBIL partners participate and co-chair for some of them (TRL for iMobility WG-HMI “Human Machine Interaction” and HIT for iMobility WG-VRU “Vulnerable road users Safety”

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2 iMobility WG-HMI

2.1 Background to safety issues

Vehicle design is highly regulated and even in the relatively unregulated HMI area, the vehicle OEMs are very aware of usability and distraction issues. In designing their products they follow standards and established HMI guidelines designed to avoid distraction such as:

- The European Statement of Principles (ESoP) for Europe
- The Japanese Automobile Manufacturers Association (JAMA) guidelines for Japan
- The Alliance of Automobile Manufacturers (AAM) guidelines for the USA

The larger issues for distraction and safety arise as a result of introduction of aftermarket (so called “nomadic”) devices by drivers. These include, for example, route guidance devices and communication aids. In recent years the SmartPhone has become virtually ubiquitous which offers not only route guidance and entertainment but a host of driving and non-driving related services through inexpensive Apps. If a way could be found to significantly reduce the distraction caused by Apps, then substantial safety benefits could be realised and technology itself does offer some prospects to mitigate or remove this distraction potential.

2.2 The iMobility WG-HMI

The WG-HMI was set up under the umbrella of the iMobility Forum and is co-chaired by:
- Alan Stevens, Transport Research Laboratory (astevens@trl.co.uk)
- Christhard Gelau, German Federal Ministry of Transport, Building and Urban Development (Christhard.Gelau@bmvbs.bund.de)

The focus for the iMobility WG-HMI has been discussions concerning the need for an ESoP update, what that should consist of and how the revision process should be undertaken.

The European Statement of Principles on HMI (ESoP) was published as an EC Recommendation in 2008 and the need for its further development was identified by the WG-HMI in 2009. Since then, the EC has published the ITS Action Plan which includes HMI. Further background to the ESoP is provided in Appendix A.

The Working Group held four well-attended meetings in Brussels during 2013-14. As a result of discussions during the first and second meetings, a number of small sub-groups worked on specific areas and there were wider discussions concerning the purpose of the ESoP, its stakeholders and its application. Throughout, there was liaison and exchange with the iMobility SafeApp Working Group which is specifically concerned about drivers’ use of Apps while driving.

In summary, the WG-HMI has:
- Reviewed the state-of-the-art and the technological progress made since the adoption of the ESoP to verify whether the ESoP’s scope is still suitable or needs modification
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- Scrutinised the ESoP with respect to sufficient coverage of the different requirements induced by the variety of vehicle users
- Worked closely with the WG-SafeApp concerning aftermarket issues specifically related to nomadic devices to avoid duplicate work and inconsistency
- Discussed the need for international harmonisation, recognising the global nature of vehicle markets (e.g. UNECE activities) and include discussion of testing and Certification issues
- Identified ongoing research needs

The WG noted the new initiatives by NHTSA in the US and previous work by JAMA in Japan involving quantitative criteria for HMI design acceptability. In discussions it became clear that verification criteria for the ESoP as a whole was not considered achievable. This points to the need for further intensified research on the one hand; on the other hand this raises the issue of how the ESoP might be used beyond its initial objective of general design advice. It should be stressed that the working group recommends that solutions on the level of individual Member States or regions should be avoided and that the European approach should be to retain the unique approach of ESoP which provides guidance without quantified criteria and links to standards.

A final report consensus is currently under development. This will provide a series of detailed recommendations are made concerning the technical content for an ESoP revision, and the need for continued research and maintenance. Further recommendations will be made concerning the process through which an ESoP revision could be achieved with the aim of establishing a new EC Recommendation.

3 iMobility WG-Safe App

3.1 Background to safety of nomadic devices

The Nomadic Device Forum (NDF) concluded that most of the HMI and safety principles listed in the European Statement of Principle (ESoP) with ref. 2008/653/EC were implemented by the Personal Navigation Device industry. Remaining are those principles that require the support of other sectors to be implemented or affecting competitiveness negatively. A meeting with the Member States to discuss the deployment of these remaining principles was scheduled in 2010, but took never place.

Before becoming dormant, the NDF raised the issue of driver distraction by APPs. It concluded that most APPs were never designed to be used by the driver during executing their driving task but that Smartphones enable the APPs to hitchhike into the car environment.

Recommendations of the Nomadic Device Forum:

- To separate applications from device types in regulation
- To breakdown APPs into main functionality/driver tasks
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- Create cross device requirements for functionality/driver tasks
- Implement a mechanism to disable/enable APPs
- Add vehicle type identification

Increasingly consumers want to be connected everywhere, being always on-line. Today, many of them feel being disconnected from friends while driving. That’s why they are using their Smartphones in the car while driving and this obviously is increasing drivers distraction and the risk of traffic accidents. Politicians and industry wants to reduce driver distraction on the EU roads, not by banning Nomadic Devices or APPs in a car, but to make the use of devices and applications safer for drivers.

The use of Nomadic Apps in the vehicle is reality and consumers want to use the services by Nomadic Devices in the car. They have thereby to contribute to the overall vision of the iMobility Forum regarding safe mobility with zero accidents, without negative impact on informed citizens, where products and services are affordable and seamless, privacy is respected and security is provided.

Special User Experience designs are required to make human machine interactions safe for in-vehicle use by drivers. This means in most cases that the applications need to be designed for in-vehicle use. Today, the design guidelines for in-car application are complex and sometimes ambiguous.

The SafeAPP WG wants to analyze existing guidelines and solutions and provide recommendations how to improve the situation.

3.2 The iMobility WG-SafeAPP

The WG-SafeApp was set up under the umbrella of the iMobility Forum and is co-chaired by:
- Theo Kamalski of TomTom (theo.kamalski@tomtom.com)
- Mika Rytkonen of HERE (mika.rytkonen@here.com)

The focus for the iMobility SafeApp has been discussions about how to ensure that Apps are designed with safety in mind such that they can be used safely.

The working group provides a platform for all European ITS stakeholders and global APP developers and suppliers to develop recommendations for a successful development and deployment of safe APPs, for drivers used while driving. Guidelines for receiving safety critical messages while driving will be developed.

**Strategy**

Main points of the strategy are:

- Strategic focus on defining research activities and priorities leading to harmonized solutions for CE products in Europe and to support the international cooperation group towards global harmonization
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• Ensure there is no negative impact on competitiveness that may hamper commercial implementation during the deployment phase

• Consider existing proposals and recommendations

• Ensure that the final solution fits in the ITS Action Plan and ITS Directive and therefore have regular moments of alignment with the European Commission (DG Move and DG Connect)

• Ensure the final recommendations are complementary and non-conflicting with those of the HMI working group

Potential issues

This list of potential issues is based on experiences and lessons learned in the NDF, Car Connectivity Consortium and in the cooperation of TISA with CEN, ISO, Genivi, RDS Forum and worldDMB.

• Intellectual Properties, ownership and NDAs may hamper or delay cooperation.

• Experts availability to evaluate existing proposals, guidelines, requirements and solutions

• Guidelines, recommendations and requirements without pass/fail criteria, examined with a standard measuring method, can probably never lead to certification. Previous versions of the ESoP describe in most cases design principles without hard pass criteria. The reason for doing this is to leave enough freedom in HMI designs for innovative concepts for future applications, but this works counter- productive to certification.

• Exclusive OEM solutions can solve only a small part of the potential safety issues. Consumers decide which CE device to buy and use. Therefore the solution has to support all APPs and that are brought into the car by consumers on their portable CE devices.

• Safe individual APPs and OEM applications alone can never guarantee acceptable driver distraction. Applications running simultaneously may increase the driver’s workload to an unacceptable level and this may affect traffic road safety as well. This topic needs to be covered either in the HMI or SafeAPP working group. The relevant scope needs to cover it.

Membership

The WG-SafeAPP will be a European group open to any interested organisation that wants to actively support the Forum’s activities. The WG-HMI especially welcomes stakeholders concerned with in-vehicle devices such as:
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- APP suppliers (APP stores)
- APP developers
- Vehicle manufacturers
- Nomadic Device manufacturers
- Automotive suppliers
- Mobile telecom operators
- Service providers
- Public Authorities
- Research organisations and academic establishments
- European projects concerned with the development of APPs for drivers

3.3 Objectives

The main objective is to provide recommendations that will lead toward safe APP usage by drivers while driving. The recommendations shall not conflict with:

- The ITS Directive and ITS Action Plan
- The ESoP on HMI or its successor

Initially there was some confusion about what the group could achieve given the commercial nature of relationships being formed between car companies and App/SmartPhone providers such as through the Car Connectivity Consortium. Nevertheless, a clear remit
finally emerged that can be expressed as “accelerating the safe use of open interfaces for nomadic devices and Apps to achieve large-scale deployment...”

There are two components to this:

• Safe use – meaning that the Nomadic device and App should not be overly-distracting

• Open interface – This is related to the different commercial groups, communication protocols and certification processes

One promising approach to mitigating safety problems is to allow suitable Apps direct access to the vehicle’s carefully designed and driver-centric HMI. Thus the driver can access relevant aspects of applications in a manner that is safer than the visual and tactile distraction of interacting with a small phone screen. A number of organisations promoting connectivity in slightly different ways are emerging:

• Apple’s CarPlay

• Google’s Open Automobile alliance (OAA)

• OEM solutions such as HondaLink, R-Link and Sync

• GENEVIE’s SmartDeviceLink based on Ford’s Applink

• Car Connectivity Consortium’s MirrorLink

Mika Rytkonen, who was very involved in setting up the CCC, has been able to provide a lot of insight into the CCC processes. The approach of CCC to safety is to provide design guidelines for Apps based on 3 documents:

• The European Statement of Principles (ESoP) for Europe

• The Japanese Automobile Manufacturers Association (JAMA) guidelines for Japan

• The Alliance of Automobile Manufacturers (AAM) guidelines for the USA

CCC also offers a certification service to its members. Certified Apps are let through to the car manufacturer’s Human Machine Interface (HMI). Non-certified Apps do not appear on the car screens.

Whilst agreeing with this general approach it was unclear how the SafeApp WG can contribute or intervene in the commercial arrangements and in the context of the other commercial approaches noted above.

It now seems likely that the SafeApps group will concentrate on definition of safety-critical traffic information messages. The idea will be to use standardised icons, layouts and words such that messages can be quickly and easily appreciated by drivers.

Nomadic ITS Applications

General schema and aspects to consider in the report:
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Topics to be addressed related to Nomadic Device stow:
- driver’s field of view
- crash robustness (device and fixing device)
- ND parked at a provided place out of reach of driver
- ND not parked
- wireless charging (optional)
- education of users (by assurance companies and public authorities)

Topics to be addressed related to in-vehicle connectivity:
- ND connected to vehicle
- ND not connected to vehicle
- identification of driver use, distinctive to passenger use
- enabling/disabling Apps of functionality per vehicle type
- proprietary and open solutions
- impact of proprietary solutions
- connectivity of Multi Nomadic Devices

Topics to be addressed related for Circumstantial prioritization of ITS Apps
- Timing of message appearing and cancelation
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- Apps without positioning, apps with positioning (GPS) and apps with localization (GPS and map)
- Need for integrated prioritization
- Relation with external organizations

Topics to be addressed related to message harmonisation:

- full text messages
- short text and icons
- relation with external organisations

Topics to be addressed related to message presentation:

- language independence cross EU
- requesting messaging
- pop-up messaging
- visual, textual and voice presentation
- multimedia needs (e.g. access to audio part of the unit)
- consequences of cars without Bluetooth and other multimedia means
- minimum size of icons, short text and on request full message text to be displayed on the screen and the option of picture in picture for ITS apps.
- relation with external organisations

### 3.4 Some preliminary inputs to iMobility Forum

**Nomadic Devices in a car**

The Nomadic device (like a Smartphone, a tablet or an iPad) revolution has changed people’s expectations and behavior as it relates to connectivity and enablement. Consumers now rely on Nomadic devices for almost every aspect of their daily lives and expect uninterrupted access to those apps at any time, even while they are in their cars and driving.

This behavior has had significant impacts to road safety as can be seen by statistics on accidents and deaths due to nomadic device usage in the car. The dangers associated with driver distraction have resulted in growing pressure to ban use of Nomadic devices in cars.

However, even it is deemed an illegal activity, people will continue to take a risk based on their needed to be connected. People want to be always connected personally and professionally. Additional activities include the expanded use of their applications on Nomadic devices like music, navigation and many more, also in a car and while driving.
Nomadic Apps in a car

Nomadic devices themselves do not cause distractions, but the operation of the apps on the nomadic devices while driving. Typically nomadic apps are designed for getting maximum awareness from the user via fancy fonts, moving elements, sounds, kinetic scrolling etc. It is difficult and distracting for drivers to interact with apps via small screens, especially since Smartphones tend to be placed in inconvenient locations such as the driver’s lap. The car environment is unique in its need for the driver to maintain their concentration on navigating the road. Since consumers in all likelihood continue accessing apps while driving, an alternate strategy is to design and certified those apps for in-car use.

Nomadic Apps marketplaces

Today, the mobile application business ecosystem is a duopoly, led by Apple and Google. Consumer usage spans the home, office and in cars. That said these ecosystems have the ability to block application usage from entering markets. In case they do that, an app provider can do nothing than accept the fact.

Apple and Google collect commission fees for apps sold through their marketplaces. The fee is typically 30% of an app price. This is against the common principle for open and free markets. Especially when they do not have to pay the same commission for their own apps.

Nomadic device and in-vehicle connectivity

Today, the primary alternative platform for running applications in cars is the in-vehicle infotainment system (IVI) aka head-unit. In contrast to smartphones, IVIs are specifically designed for safe use while driving. They typically have a larger display, well positioned on the dashboard, with less functions or not containing external apps. They have controls that are designed for use while driving, such as rotary knobs and steering wheel controls. A solution how a Nomadic device is connected to an IVI is in-vehicle connectivity, also known as link technology.

The link technology market is highly fragmented: each car and Nomadic device manufacturer offers their own proprietary and closed solution, typically with only a handful of preinstalled apps. There is a lack of interoperability between solutions. Besides limiting the choice of apps available to drivers, this situation has been problematic for app developers. Developers see automotive applications as the next great opportunity, but the fragmented market and closed ecosystem has hindered it.

Landscape

Nomadic device and In-Vehicle connectivity, there are five key players:

1. Apple with CarPlay. It works only with Apple products in selected cars.
2. Google with Open Automotive Alliance (OAA). It will bring Android OS into cars. It is unknown what will be the link technology solution.

3. OEM based solutions: Each carmaker does have own link technology. It means that an app developer must provide support for various link technologies before an app can be executed in a car. These are like Honda-Link and R-link.

4. GENIVI, a non-profit alliance for developing new innovations to cars, is promoting SmartDeviceLink (SDL). It is based on Ford’s AppLink and available as an open source distribution. SDL is a template-based solution and only data blocks are transferred from a Nomadic device to IVI.

5. Car Connectivity Consortium with MirrorLink solution. MirrorLink is an open standard for in-vehicle connectivity. Solution replicates whole UI from a Nomadic device to the IVI system in a non-distracting way and according to common guidelines like ESoP\(^1\).

In the table below, is a simplified analysis about link technologies.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Apple</th>
<th>OAA</th>
<th>OEM’s</th>
<th>GENIVI</th>
<th>CCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link technology</td>
<td>CarPlay</td>
<td>Unknown</td>
<td>Several</td>
<td>SDL</td>
<td>MirrorLink</td>
</tr>
<tr>
<td>Members</td>
<td>Only Apple</td>
<td>Unknown</td>
<td>1-3</td>
<td>100+</td>
<td>100+</td>
</tr>
<tr>
<td>Contribution</td>
<td>Closed</td>
<td>Unknown</td>
<td>Closed</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Governance</td>
<td>Apple</td>
<td>Unknown</td>
<td>OEM</td>
<td>Industry</td>
<td>Industry</td>
</tr>
<tr>
<td>OS</td>
<td>OSX</td>
<td>Android</td>
<td>Many</td>
<td>OS agnostic</td>
<td>OS agnostic</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>Closed</td>
<td>Open</td>
<td>Closed</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>

Table 1: In-vehicle connectivity technologies and organizations. Fields marked with green are good for app business and ecosystem, while fields with red are not. Yellow indicates unclarity.

The industry and the European Union should favor truly open standards. There are few rules which makes a standard open, like that everyone is able to contribute on work packages and specifications, there is fair, reasonable and non-discriminative immaterial rights policy (like patents and copyrights) in place, and where a standard is not fully governed by a single corporation. The best end-result is that everyone has equal rights to develop products and solutions to cars.

**Nomadic Apps should be developed for in-car use**

In order to increase safety on roads in the Europe, Nomadic apps should be designed for in-car use and be in-line with the ESoP guidelines. There must be a testing and certification practice, ensuring that only those apps, which are in line with ESoP guidelines, can be executed in a car while driving from a Nomadic device.

At the moment the Car Connectivity Consortium is the only organization providing such guidelines with testing and certification. These procedures are equivalent to those the OEMs apply to integrated or tethered devices. Guidelines are available free of charge for application developers. It is unclear how much an app testing will cost.

**Nomadic apps may have a key role for implementing the ITS Action Plan\(^2\).**

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Application developer friendly Common API and standardization cross Nomadic devices and cars will accelerate new innovations which will support implementing the ITS Action Plan.

In Nomadic apps market and ecosystem, key players are listed in table below.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Apple</th>
<th>Google</th>
<th>Microsoft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store</td>
<td>AppStore</td>
<td>GooglePlay</td>
<td>Marketplace</td>
</tr>
<tr>
<td>Apps marketshare</td>
<td>18%</td>
<td>76%</td>
<td>3%</td>
</tr>
<tr>
<td>Nomadic OS</td>
<td>OSX</td>
<td>Android</td>
<td>WindowsPhone</td>
</tr>
<tr>
<td>Commission</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Alternatives</td>
<td>No</td>
<td>Yes, like Yandex</td>
<td>No</td>
</tr>
</tbody>
</table>

In the Nomadic apps market and ecosystem, Google has more than 70% and Apple 18% market share. There is a risk for abuse of the dominant Nomadic apps market position. This might increase protectionism and dis-integration and it is not in line with a free and open market principle in the European Union. Application marketplace vendors can protect and favor their own apps from competition by blocking competitor’s apps from markets.

The most relevant matter for the European application industry is an application commission fee, which is 30% per each sale of a paid app. For an app developer this means mandatory payment to the application store vendors. This means that the Nomadic apps markets are not healthy. Just as evidence, Apple alone gained 10 BUSD revenues in 2013 via its AppStore.

3.5 Recommendations for the European Commission

The European Commission must ensure Nomadic device apps market should be open in any domain in the European Union. Duopoly will increase protectionisms and harm the app industry in the Europe. The EU should consider following regulation acts:

- **Ensure Nomadic apps development business ecosystem remains healthy**
  - The Nomadic application marketplace is today a duopoly. In order to ensure that Nomadic apps markets are fair, reasonable and non-discriminative for European based application developers, the European Commission should regulate Nomadic application marketplaces. This can be done either by decreasing commission fee, by ensuring there is an alternative choice for an app developers and by ensuring that duopoly does not increase protectionism.

- **Increase safety on roads**
  - All Nomadic applications, which can be used in a car while driving, are tested and certified and in line with the ESoP guidelines. If an app does have a CCC Application Certificate, it can

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be considered to fulfill this requirement.

- It should be mandatory to use an in-vehicle connectivity solution when using a Nomadic device in a car while driving.

**Ensure safer use of Nomadic devices in a car via open link technologies**

- Open solutions should be promoted for preferred in-vehicle connectivity solutions in the European Union.

DECOMOBIL partners (TRL, Ifsttar) participated to the setting up of “how a safe app could be defined?”. The first draft is presented below:

Apps are applications (services) that use Smartphones or other hardware platforms to interact with, and provide information to, users. Apps are increasingly found in the driving environment even if not designed specifically for that environment.

When used by drivers, Apps can support safe driving; for example, by increasing driver awareness of conditions on the road ahead and by keeping the driver more attentive.

Concerning the provision of information to drivers while driving (which is the main purpose of the Apps that we consider), the principal safety concern is distraction. If to be called “safe” an App is required to involve a complete absence of distraction risk, then safety not possible.

In practical terms “safe” has to be related to the level of distraction involved in the use of the App so “minimum distraction with maximum information” can be stated as the goal of a safe App. Nevertheless, this goal needs to operationalize in a clear way.

The risk of unsafe consequences when interacting with an App (such as distraction leading to a momentary loss of situation awareness resulting in a crash) depends on:

- Frequency of use
- Length of use
- Intensity of interaction

The risk will also depend on external factors in the driving environment which will affect a driver’s workload at any one time. Some of these factors can be assessed by the driver, such as traffic density, but there will also be less predictable elements such as the behaviour of other road users. The driver has a responsibility to “drive safely” and this includes managing their own workload such that they are able to properly interact with the external driving environment. It is ultimately their choice about how they distribute their attention between tasks both within and outside their vehicle.

The design of an App will depend on many factors including its intended function. Some general characteristics of a well-designed App are likely to involve information which is:

- *Presented at the right time* …
- …*in a clear way, which can be quickly gathered by the user* …
- …*and likely to be easily understood*
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A safe App is one that assists the driver to make good choices and continue to drive in an appropriate manner but actually verifying that an App is “safe” is problematic. However, it could be approached in a number of ways:

Measuring the consequences of driver behaviour during and after interacting with an App would require very extensive field trials.

Simulator and bench tests would be possible but rather artificial and the resulting measures are controversial.

The third and most practical approach is to define a SafeApp as one whose design meets certain agreed principles or guidelines. These would need to be described in sufficient detail and in a technology-neutral way such that the App producer has sufficient flexibility for design innovation whilst staying within the human factors principles/guidelines. The ESoP could be used as a basis for this.

4 iMobility WG-VRU

The WG-VRU was set up under the umbrella of the iMobility Forum and is co-chaired by:

- Chairwoman: Stella Nikolaou, CERTH/HIT (snikol@certh.gr)
- Co-chairman: Jean Michel Henchoz, Denso, (jm.henchoz@denso.be)

The objectives of the iMobility WG-VRU is to identify ITS technologies to improve VRU safety. The VRU Working Group targets the improvement of the safety of vulnerable road users (pedestrians, cyclists, motorcyclists), along with recommendations and guidelines to achieve this target.

VRU WG activities are implemented in four phases:

- Phase I focuses on the analysis of know-how, background data and current market & near-market solutions/trends.
- Phase II aims at analysing the most significant studies, researches, projects and field studies involving new concepts on VRU safety.
- Phase III will analyse user needs and their requirements stemming from the identification of research gaps and priorities for future research initiatives.
- Phase IV will promote the identified solutions, and contribute to the objectives and targets related to VRU safety in the “Horizon 2020” work-programmes.

In this framework, DECOMOBIL partners participated or received information and documents related to the various actions conducted by VRU WG.

4.1 Workshop VRU safety, VRUITS project, iMobility Forum

The objective of this workshop was:

- To select and prioritize VRU ITS scenarios and applications for further assessment for pedestrians, Cyclists and PTWs
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- To identify available databases which contain relevant in-depth details of VRU accidents.
- To identify (as precisely as possible) the exact circumstances of accidents involving VRUs including common causal factors.
- To determine the most critical scenarios for different types of VRUs.

Some examples of critical scenarios for VRU:

Pedestrian crossing the road (occulted or not from a parked car)

Support pedestrians at intersections to increase comfort and remove obstacle barriers

Vehicle on a crossroad, pedal cyclist crossing the road from the right/left
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Urban single motocycle accident on straight road

Urban junction accidents with car

Most promising ITS applications for pedestrians
- Speed cameras and ISA
  - Speed cameras: measuring the speed between 2 points
- Tags for kids
  - Bus stop with flashing lights
- Mobile phone tracking for transport planners
- In-vehicle pedestrian detection tools
  - For evaluating drivers
- Countdown signals
- Automatic detection of pedestrians - change sequence
- Special users
  - Communication between controllers and blind people
Most promising ITS applications for cyclists
- Intersection safety
- Blind spot detection
- Its bicycle green wave & pre-green for bikes
- Safe route planner & black spots
- Bike sharing (including navigation)
- Bikes in all PTW systems
- Automatic bicycle identification

Most promising ITS applications for cyclists
- Intelligent speed warning
- Rider monitoring
- Enhance visibility and conspicuity of PTW
  - Combination of intersection safety and flashing lights in the PTW
- Intersection safety
- Cooperative systems
  - V2I, V2V
- Detection system for cars

Challenges for ITS VRU implementation
- Distraction
  - Infotainment applications
    - How to make them safe and not distracting
    - Depends on how you integrate them
  - Navigation systems
- Overliance of systems
- HMI for VRU: need safety guidelines directed to vrus
- Autonomous vehicle
- VRU can not identify which is the autonomous and non autonomous vehicle
- Maintenance (local authority)
- Less costs: changing signs, messages, times
- Further costs: equipment and human capital
- Who will in the end have to pay

4.2 Inputs from experts related to scenarios

Next step of the activity conducted by the WG VRU has been to collect inputs from experts regarding key selected scenarios per target group (two scenarios for each group; pedestrians, cyclists and riders) and relevant ITS that can contribute to the prevention of such type of accidents. Innovative ITS systems that haven’t been considered or could be interesting for future research and development are open for proposition.
4.3 Key research and innovation priorities

The following topics have been identified by the WG-VRU as key research and innovation priorities:

1 In-depth accident analysis for VRU’s

Content and scope
Looking at the data related to fatalities reduction in EU 18 between 2001 and 2010 the overall reduction of fatalities was of 43%, while pedestrian and cyclists fatalities decreased by 39% and 37% respectively. On the other hand, PTW rider fatalities decreased by only 18% compared with 39% of car drivers, whereas motorcycle is the only transport mode for which the percentage of fatalities was increased in the relevant decade. The above data show that, in order to reduce road fatalities by 50% by 2020 and to reach zero fatalities by 2050, a further effort on VRU safety enhancement is needed. This is also highlighted through the Policy orientations on road safety 2011-2020 and the Action 3.4 “Safety and comfort of the Vulnerable Road User” of the ITS Action Plan of the European Commission. Moreover, new ITS for VRU safety are currently entering the market, whereas new methods and tools to achieve a better understanding of causation of road accidents involving VRU are needed. Dedicated in-depth studies on accidents involving VRU can help to understand the impacts of new ITS entering now the market, as well as identify the technology gaps towards the future ITS design and implementation for VRU safety.

Target outcome
The analysis of in-depth accident data involving VRU’s is a key activity in order to improve VRU’s safety and to understand accidents’ causation factors. On the other hand, potential road safety impacts due to the implementation of innovative ITS safety solutions on the vehicle side, user side and infrastructure side need to be evaluated. More specifically, the quantitative evaluations of new casualty reduction systems are needed. Results should allow the specification of functionality of future countermeasures for maximum casualty reduction.

For these reasons, existing in-depth databases from national and European projects should be further analyzed in order to understand the causes of road accidents involving VRUs. The analysis methodology, starting from what has been developed in previous research projects, such as DaCoTA and TRACE, should allow interrogation of the combined in-depth data sets to consider the range of possible causation factors. This work should be strengthened by the application of innovative analytical methodologies for in-depth data.

New in-depth data on VRU accidents needs to be collected in order to understand the impacts and potential impacts of innovative ITS solutions now entering the market. Sufficient data must be gathered from several European locations to allow statistical
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analyses that will provide results that are valid and representative of the European situation. A common in-depth protocol should be used by trained in-depth investigators to gather and store harmonized in-depth data. This protocol should be based on existing resources already developed at European level in other projects such as DaCoTA and SafetyNET.

**Expected impact**

- Provision of base-line, in-depth data for VRU safety for Europe;
- Definition of new in-depth statistical methodologies to analyze aggregate data;
- Better understanding of VRU’s accidents causation;
- Quantification of positive and negative impacts of innovative ITS for VRU safety, addressing both ITS on board vehicles and from the users’ side;
- A strengthening of the European Road Safety Observatory (ERSO) with new data, methods and findings to assist with improved safety of the VRU’s;
- Significant improvements in safety of VRU’s, including contributions towards the H2020 objectives of 50% road fatalities by 2020 and zero fatalities by 2050.

2 Large-Scale Field Operational Tests on Vulnerable Road Users

**Content and scope**

Automotive FOTs have shown the huge value and potential of pre-deployment of ITS functions for end-user exposure, attitude and behavior analysis. However, the equipment, systems and methodology developed in automotive FOTs are not directly transferable for VRUs. Also the maturity of ARAS/OBIS for VRUs is not as far developed as for cars. The scope of this topic is to adapt the successful FOT instrument to PTW’s, bicycles, in order to collect essential accident/ incident data that are currently lacking, as well as to study riders and cyclists behaviour. Such data will support the analysis of the human factors complexity (especially of the demanding riding task), as well as the availability of accident/ incident characteristics for optimum design of safety ITS functions and appropriate HMI elements.

**Target outcome**

FOT methodologies, equipment and systems used in the automotive FOTs are to be investigated, refocused and further developed to be suitable and applicable for PTW and bicycle environments due to significant differences in vehicle design, riding dynamics and rider protection compared to cars. The on-bike equipment for powered (i.e. various PTW categories) and non-powered two-wheelers (i.e. bicycles) is needed to expose riders to ARAS/OBIS and to organise the data acquisition and data upload/ communication/ transfer to be organised off-bike for data storage, data management and data analysis. The proper data handling procedures and data analysis need to be re-organised, re-designed and further developed for VRUs. Naturalistic riding conditions cast an additional requirement on ARAS/OBIS development and availability due to minimal space and power availability during riding. Priorities include the collection of data on
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various PTW and bicycle cultural and traffic environments in urban, inter-urban and rural environment, as well as the involvement of a critical mass of user and vehicles, as well as a wide variety of ITS functions on PTWs and bicycles, targeting the creation of a pan-European database on VRU data characteristics.

Expected impact

- Enhanced FOT methodology, data handling and analysis procedures and means to cover all road transport modes, updates on FESTA Model and Handbook.
- Sufficient understanding of PTW and bicycle rider behavior and response to ARAS/OBIS services in naturalistic riding environments.
- Storage of aggregated data for advanced research, analysis and market entry
- Identification of the key areas for technology development and deployment
- Enhanced understanding of penetration and business potential of ARAS/OBIS services for vulnerable two-wheeler road user communities.

3 Cooperative Systems for PTWs safety enhancement

Content and scope

The safety of Powered-Two-Wheelers is of high importance in the strategic agendas of European road safety, considering the fact that although a considerable reduction of moped riders fatalities has been achieved between 2001-2010, motorcycle rider fatalities for the same decade was decreased only by 2%6.

For the moment, research into PTW safety is targeted mainly through “research on ABS and airbags, alongside protective clothing and helmets, visibility, road infrastructure and road construction measures, driver training and safety training, as well as periodic technical inspection of motorcycles”7.

The potential benefits of ITS-based active safety systems on PTWs have been so far largely neglected. With over 20 years of research and developments in ITS for cars and trucks (even buses), only in the last years efforts have been devoted to ITS for PTWs and those were limited and focused on standalone functions.

The advanced expertise created by ADAS/IVIS research in four-wheel vehicles may help to promote the ARAS/OBIS research, by transferring knowledge, sensors and even entire systems from four-wheel to two-wheel vehicles. Nevertheless, there are additional requirements in PTWs that call for extensive research on how to adapt or even redesign such systems, for example8:

- There are specific constraints and requirements for motorcycles (power and space limitations that are unique to those types of vehicle) and also the fact that the vehicle tilts.
- Sensor fusion also needs to be reassessed in many aspects.

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7 “Motorcycle Road Safety Report 2010”, DEKRA
There are very different requirements for HMI in motorcycles. Typically, a car driver is inattentive and needs his/her attention to be alerted. A rider needs a sort of “augmented perception”, due to the fact that it may happen that he/she is attentive but fails to evaluate the real situation (improper evaluation of curvature, missing objects, etc.).

A motorcycle rider moves close to other VRUs, thus motion in crowded areas and in proximity with other vehicles should receive much more attention than in the automotive domain.

**Target outcome**

a) ICT research in **Cooperative Systems** for enhancing motorcycle safety via vehicle-to-vehicle and vehicle-to-infrastructure communication for critical scenarios such as intersections, rural roads, hazardous situations and/or black spots, etc. Through the design and development of motorcycle-based Advanced Rider Assistance Systems (ARAS) and On-Bike Information Systems (OBIS) functionalities and their combination with deployed accurate positioning systems, smart infrastructures and automotive active safety systems, it is expected to minimize the increasing number of motorcycle accidents, with special emphasis to novice and elderly riders. Special focus should be given to the further research and integration of the eCall system in motorcycles, focusing on the complexity of motorcycle accidents, where the vehicle and the rider are separated. Research should include the design and/or adaptation of rider-friendly Human-Machine Interaction and decision support systems that will communicate prioritised information from all ARAS/OBIS and other services to the rider, through advanced safety warning strategies, considering the complex and weighed riders’ workload.

b) **Coordination and Support Actions** through the framework of the iMobility Forum, for promotion and training activities of ICT technologies for riders and ICT tools for rider training and instructors, clustered per category of motorcycle type (L1, L2, L3) and user group (novice, elderly, advanced).

**Expected impact**

- Common pan-European architecture, standards and deployment model for ARAS/OBIS and co-operative systems for motorcycles.
- World leadership of Europe’s motorcycle industry in the emerging area of Co-operative Systems.
- Significant improvements in safety, comfort and sustainability of motorcycles. This includes contribution towards the H2020 objectives of 50% road fatalities by 2020 and zero fatalities by 2050, and a contribution to a significant reduction in the energy consumption and congestion in road transport through the introduction of safer motorcycles and more sustainable and fluent riding opportunities in the road network.
4 Methodologies for assessment of Intelligent Transport Systems on Vulnerable Road Users safety

Content and scope

During the last years there has been a strong interest in new technologies, innovative and intelligent transport solutions and in their opportunities for improving safety, increasing efficiency, protecting the environment and offering new customer-oriented services to citizens. The impact assessment accompanying the European White Paper on Transport Policy shows that the large-scale deployment of Intelligent Transport Systems (ITS) is expected to have positive effects on safety.

Several EU co-funded projects dealt with ITS as a mean to improve traffic safety conditions or to prevent accidents. However, “available solutions as well as on-going R&D has been focusing on cars and trucks and has been more limited for motorcycles, light PTWs, cycles and pedestrians”.

While vehicle-based applications and infrastructure-based ITS are already available, cooperative systems are still in a development phase even if some applications have a high potential to improve VRU safety. Besides these, nomadic devices (e.g. Personal Navigation Devices, Smartphone, handhelds with navigation function) must be taken into account as it is expected that these systems will strongly grow in the next future (+150% from 2008 to 2013) and may positively or negatively impact directly or indirectly VRUs safety.

There is still a lack of information on the effectiveness for many ITS improvements, especially when taking into account VRU safety. As stated in the European Road Safety Observatory (ERSO), “Although some aspects of this are being addressed within the research domain there is no accepted, systematic approach to predict the impact on safety of a new system. This is an essential component of any benefits analysis. An accepted, routine approach is now required. A clear framework is needed urgently to identify, evaluate, deliver and monitor technologies which improve safety and to identify and discontinue work on those which cost lives. Measures need to be demonstrably effective safety aids before they are introduced widely.” (SafetyNet, 2009).

While VRUs accident causations are not fully known nor understood (e.g. as regards to PTWs use as their specific characteristics, including limitations, capabilities, profiles and vulnerabilities), the current state-of-the art in ITS has undergone few impact assessments with regard to positive or negative consequences for other road users.

To allow the great safety potential of new cooperative and informative applications for accident avoidance and mitigation, there is a need for a methodology for ITS impact assessment on VRUs safety, allowing the evaluation of technologies (that will come in
the next years or that, to some extent, are already used), to identify positive and negative effects and areas for improvement, in order to point research and development in the right direction.

Furthermore, for assessing the benefit of active safety systems for VRU protection, various accident scenarios should be considered including different daylight and precipitation conditions, urban and rural streets, driver and pedestrian or cyclist reactions as well as longitudinal and vertical maneuvers. Within such scenarios the performance of the active safety system shall be evaluated, especially with regard to the detection speed of critical cases and the characterization of non-critical, so called false positive, tests.

Active systems may inform the driver about a possible critical scenario, send a warning to assist the decision of the driver or support or initiate a possible maneuver. Future assessment methodologies should evaluate the driver’s capability of reacting on the system information or warning and should evaluate the benefit of such interactions, e.g. based on training courses for drivers. Since future systems will increasingly consider the pedestrian’s and cyclist’s motion in order to predict intended actions, more human-like dummies with respect to body shape, reaction and motion should be included.

Target Outcomes

Based on the knowledge acquired in previous national and European projects (e.g. PReVAL, FESTA, TELEFOT) and experiences, a concrete and comprehensive methodology for the qualitative and quantitative assessment of impacts related with safety of ITS should be developed for different VRUs groups (i.e. PTWs, cyclists, pedestrians).

The methodology should merge together several tools and data. Emphasis should be given to the analysis of behavioural studies and data (e.g. naturalistic driving data) in order to identify car-VRU conflicts that are addressed by specific ITTs (e.g. vehicle-based technologies) and to understand why certain types of accidents happen.

The assessment context should answer the basic research questions being asked, which need to be understood before any assessment can take place. What is being assessed; and why is it being assessed? What are the relevant assessment criteria? What are the timescales to be considered?

A specific activity should also be dedicated to understanding why most of the existing ITS are still little used at the European and international level. The project should identify the barriers to the use of ITSs having positive impacts on safety of VRUs and consequently the actions that should be undertaken to overcome these barriers.

Expected Impact

- To define an assessment framework of ITS for all the VRUs groups (i.e. PTWs, cyclists, pedestrians), based on a careful identification of the existing differences with car use and enabling to capture, repeat and analyse VRUs behaviours that are linked to ITS technologies:
  - usability and willingness-to-have aspects (“how new functions and systems suit the user”);
  - impacts on behaviour,
  - impacts on safety;
  - impacts on efficiency;
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- impacts on environment (economic / “green” driving);
- socio-economic impacts.

- To provide long-lasting tools for the assessment and use of ITS for VRUs safety.
- To identify promising applications for enhancing VRUs safety.
- Producing recommendations to foster the deployment of ITS having positive impacts on the VRUs safety.

5 Advanced ITS technologies for the enhancement of children safety in road transport

Content and scope
Several EU and national projects have been working on the prevention of accidents with vulnerable road users through new or improved intelligent transport systems (ITS). One of the areas where further improvement is still to be done is the application of ITS for children, as vulnerable road users.
Advanced vehicle safety systems, infrastructure based ITS and cooperative systems based on communication from vehicle-to-x or infrastructure-to-vehicle/user have to be implemented to enhance safety among children as passengers, pedestrians, bicyclists and PT users. Integrated and co-operative systems need to be developed to cover the children and enhance their safety throughout their whole route with multimodal transport modes. Additionally, the safety and comfort of children as passengers in private vehicles, as well as the minimization of their parents distraction while driving, need to be taken under consideration, using innovative technologies within the vehicle.

Target Outcomes
- Enhancement of safety and comfort of children as pedestrians, bicyclists, PT users, as well as passengers in cars and co-riders in PTWs, throughout their whole route from the origin to destination.
- Development of cooperative ITS-based communication from vehicle-to-x or infrastructure-to-vehicle/user that will be used by children, parents, car drivers, infrastructure planners and authority.
- Focus on children as vulnerable road users, particularly in urban and sub-urban environments and during embarkation/disembarkation from various vehicles (cars, motorcycles, etc.).
- Specific attention to the development and operational use of Human-Machine-Interface (HMI) responding to the needs of children, while within a transportation mode, at a transportation hub or at their way to/from it.
- Design of innovative HMI for the infotainment of children as car passengers, to minimize driver distraction.
- Development of a concept that contributes to an improved safety for the novice young PTW drivers especially when it comes to communication between other road users and the young inexperienced risk taking children, but also here an innovate HMI to make them more easily seen is of importance.
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- Develop ITS based tool for inventory of safe routes for example to/from school or safe bus stops.
- Develop ITS based tools in order to involve the children to identify point or events that is not experienced as safe or secure and that needs to be improved.

Expected impact

- Increase safe walking, cycling and use of public transport by children.
- Enhance the safety and comfort of multimodal mobility (pedestrian, bicyclist, and public transport) of children of all ages.
- Make the road infrastructure more user-friendly and intuitive for children as vulnerable road users, while at the same time maintaining flow.

6 ICT-based advanced in-vehicle and infrastructure-based technologies and smart applications to protect VRU’s

Content and scope

Current systems (recently commercialized or still under development) for VRU’s protection are quasi exclusively based on in-vehicle technologies that concern both passive and active safety. They should be fitted with Brake Assist Systems (BAS).

Within passive and active safety the sensor system is an essential part of the environmental perception systems. The sensor must be capable of distinguishing pedestrian or other vulnerable users from other objects within complex environments and also assessing the relative velocity of the pedestrian they should also have to provide a risk evaluation.

Passive technologies depend on radiation emitted naturally by the human body: in visible spectrum (350nm to 750nm up to 850 for NIR), or infrared (heat). Passive safety technologies also involve impact sensors in the front section of the vehicles. Main issues related with those technologies are that radiation may be affected by time of day, weather conditions and location, human infrared emission is shielded to some extent by clothing. Active technologies encompass technologies when a signal is emitted into the surroundings and reflected off a target, for example laser, radar, active Infrared. Such technologies provide accurate range information. Main issues related with those technologies are for example highly cluttered backgrounds or wide range of appearances, due to body size (for example children) and pose, clothing and outdoor environmental conditions.

Both active and passive technologies are currently only able to work in limited environment and restricted and simple scenarios.

Target outcome:

Improving VRUs vs car safety would need to address new developments within the next 10 years, such as:

- Improvement of functionalities of the current technologies: Advanced image processing techniques, data processing and data fusion for example between camera and radar information to rebuild a precise and reliable mapping of the vehicle environment. These new development will be strongly supported by the increase of on-board processing capabilities.
Far Infrared sensors remind one of the most promising technologies for the vehicle environmental obstacle detection. Nevertheless the ratio between costs and performances remains still high. Further research activities have to be foreseen to achieve low cost and affordable technologies compatible with automotive market constraints. Furthermore some specific effort has to be provided to provide new generation of processing algorithms to guarantee a good and reliable classification of the targets.

Addressing Car to infrastructure, Car to VRUs, Infrastructure to VRU’s communications based on cheap embedded processing and communication capabilities. is obviously another very promising domain of research. These technologies should allow providing a good and reliable dynamic localization of VRU’s and Vehicle and provide in, real time a mapping of potential critical issues. This approach would also enhance VRU’s awareness of the situation (with standalone on-board systems, only the car driver is informed about critical situations through dedicated HMI). The use of these technologies would lead for example to the development of specific research activities related with distributed system architecture, communication between distributed dynamic objects, management of complex and large data flows etc.

In a second step, combining both on-board VRU’s detections capabilities with car to X in order to provide a global and very reliable map of the surrounding situation.

A special focus should also be brought to special VRU’s categories such as children, elderly and disabled persons according to their specificities, for example: displacement speed, predictability of the displacement direction, size, physical and cognitive limitations.

**Expected impact**

- Advanced VRU protection technologies of high detection and reliability.
- World leadership of Europe’s automotive industry in VRU protection.
- Significant improvements in road safety and road user protection. This includes contribution towards the H2020 objectives of 50% road fatalities by 2020 and zero fatalities by 2050.

7 Sustainable riders' training aiming at safe and cost efficient behaviour Training & awareness campaigns for cyclists and pedestrians

**Content and scope**

This objective focuses both on the combined use of ICT, ITS and riding simulators for training of all rider categories and the training of all types of riders on optimal use of ICT tools that support riders, are used by them during riding or used by riding instructors before, during and after riding sessions. New simulation tools are expected to be developed for motorcycle riding (both for novices and emergency riders).
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Target Outcomes

a) **Training and assessment of novice motorcycle riders**' on-bike control and basic traffic participation skills, as well as on new ICT-based technologies, such as ARAS, OBIS and cooperative systems (V2V, V2I, I2V). Emphasis is expected to be given on critical riding scenarios for the young riders, combining the emerging vehicle technologies, where special care should be given to their simulated HMI elements and functionality. Dynamic changing of scenarios elements and story, taking into account the individual riding style of rider is of strong significance. Providing additional similar real traffic scenarios when a basic scenario was not successfully passed. A modular training curriculum for riders, with personalised potentials, should be developed and used. Computerized assessment methods should define in detail the level of skills of each rider and potential needs for further training exercises.

b) **Continuous training of experienced riders to new vehicle technologies.** The focus is on lifelong training of experienced riders that can benefit from training to new vehicle technologies and ICT.

c) **Use of ITS and ICT by riding instructors for planning, execution and monitoring the riding instruction sessions.** Focus is to develop interactive ICT&ITS-based Instructor Curriculum Advice for regular riding instruction sessions and ad-hoc en-route situations of various phases of curriculum. Identification and selection of typical riding scenarios and matching best practise instruction locations, live demonstrations of safe riding on difficult and/or dangerous (black) spots, follow-up and monitoring of instruction tasks to be carried out. Cooperative systems for intersection support with approaching vehicle warning enhance the instructors’ possibilities to guide and protect the trainee in safe intersection approach and maneuvers in the intersection itself. Feedback for trainee on his/her own performance and riding monitoring successes, shortcomings and improvements/additional training required.

Work should include the development of an open simulation tool for simulating the functionality and user interface of a wide range of ARAS, OBIS and cooperative systems. It should be supported by appropriate user interface allowing its users (mainly riding instructors and researchers) to easily change the functionality and user interface layers and construct alternative scenarios of use. Emphasis should be given to the simulation of the operation of clean vehicles (hybrid and electric cars PTW’s) as stand-alone and in combination to the use of various ARAS, OBIS and cooperative systems, taking into account their space and power limitations as well as particularities of use (i.e. silent operation).

Expected Impact

Improvement of elementary, experienced and continuous riding training, in order to stimulate riders towards a more responsible or, when needed, professional behaviour.

More specifically, the following benefits are expected:

- Road safety enhancement by reduction of accidents due to poor on-road training.
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- Road safety enhancement by training on the use, benefits and of ICT on-bike support technologies.
- Road safety enhancement with the possibility to train riders in dangerous simulated scenarios (risky traffic conditions, adverse weather conditions, etc.), not possible to be demonstrated in real traffic.
- Contribution to green environment through reduction of traffic volume and pollution in cities by less on-road training as well as through ecological/economical training promotion by the new training tools.
- Creation of statistical record of riders’ behaviour through key data storage by the ICT-based tools.
- Reduction of the stress levels of trainers and trainees, induced by actual on-road training of complex situations.
- New employment opportunities and competitive advantage for the European rider training schools industry.
- Reduction in training time and cost.
- Road safety enhancement by securing that all required on-road instruction tasks have been appropriately covered with success, and when needed, more suitable training locations and probable traffic scenarios can be easily located based on the actual needs identified during riding session.

5 iMobility WG-R&I

The WG-R&I was set up under the umbrella of the iMobility Forum and is co-chaired by:
- Chairman: Alessandro Coda EUCAR ac@eucar.be
- Co-Chairman: Frans Op de Beek frans.opde.beek@rws.nl

The iMobility Forum Research & Innovation (R&I) Working Group is a permanent Working Group dealing with research and innovation issues for the whole Forum, such as the update of Strategic Research and Innovation Agendas and Road Maps linked to ICT for smart, clean and efficient mobility, and to the transport of goods and people in linkage to the various implementation platforms.

The Working Group aims at identifying new medium and longer term R&I priorities, and at formulating a set of recommendations on future research in the area of ICT for mobility.

Extract of the 22 Recommendations for 2014-2015 Research Needs proposed by the WG-R&I in 2013 that are linked with the DECOMOBIL priorities; 12 of these recommendations are presented as they are strongly relevant for the DECOMOBIL scope:

5.1 Driver centred heightening of driving assistance towards autonomous driving

Well over 85 per cent of serious traffic accidents are caused by human error. Increasing the
level of automation in vehicle safety and/or driving functions means reducing situations in which misperception, excessive demands, and distraction of the driver can occur. Therefore increasing the level of automation of driving and safety functionalities in future vehicles will result in significant reduction of serious road accidents. The ability to increase to level of automation of individual vehicles is the key technology for the European automobile (and supplier) industry to remain global market leader based on technology and innovations. The objectives are included in strategic vision of the EUCAR Strategic Pillar on Safe and Integrated Mobility and in particular in the Research & Innovation roadmaps on Safety. The area of research for “Safe highly and fully automated driving functions” should include:

- Proofing the driver’s capability to take over vehicle control in an appropriate manner at take over request of partly and highly automated systems.
- Development of methods for robust driver state assessment for partly automated (driver has to be attentive) and highly automated (driver may not sleep) systems.
- Proofing the impact of different levels of automation in driving and application scenarios on safety: individual vehicle, traffic, society and socio economic level as well as costs of implementation (incl. development, production).
- Defining requirements and methods for testing, approval and real life safety impact of highly and fully automated low and high-speed driving (how to do it with a common acceptance by the society).
- Preparing social acceptance for automation risk.
- Preparing interaction of future automated vehicles with compatible vehicles and vulnerable road users.

5.2 Driver-vehicle collaborative automation & next generation driving environment

Automation of driving requires collaboration between the driver and the automated- and connected vehicle systems. Automation can provide a more comfortable, efficient, productive, and safer driving experience. Partially and highly automated vehicle systems must be engineered to act in harmony with driver expectations and be resilient to system- and driver failures. Information, warning, intervention, and automation strategies must be further developed. The design and development of solutions for automated manoeuvres and driving is at a pioneering stage, the effect of driver-vehicle interaction related aspects of automated driving is a crucial issue to be investigated from the early design phases. Automated vehicles’ manoeuvres and new intelligent-vehicle technologies will have an impact on the physical driving environment layout and ergonomics. Research and innovation shall explore vehicle interiors as a novel workspace which impacts posture and possibilities for working/operating with other tasks while operating an automated vehicle.

Focus of Research
- Estimation of the driver’s readiness to take control in autonomous driving situations:
  - Assess different concepts for driver attention monitoring and reactivation.
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- Develop criticality measures for judging the complexity and manageability of the situation (traffic, weather, road, vehicle, ...) w.r.t. the proven skills of the system.
- Design methods for early identification of upcoming situations with need of human action including statistical assessment of the effectiveness of such methods.

- Timely transitions and reactivation of human attention and action must be handled within safe driving performance limits in complex situations.
- Driver monitoring is needed to keep the driver in the control loop despite monotonies, complex decision making, or short reaction times.
- Develop methods and conduct studies for the assessment of various types of HMI and system phasing in/out for the transfer of control between the system end the driver.
- Understanding HMI to define a “reference model for the driver” for the different levels of automation strategies from highly automated (low and high speed driving) to full automated driving (performance and limits in complex situations:
  - hand-over;
  - requests to keep the driver in the control loop in the field of monotonies and complex decision making or short reaction times;
  - measures of “risks in driving situations” that drivers are willing to accept.
- HVI for driver behaviour: “automation surprises”
- Human-vehicle interaction in semi-and autonomous driving
- §HVI for automated maneuvering in specific context of use

5.3 Safe and natural interaction

Human Machine Interface technologies in the consumer market are rapidly evolving; a suitable subset of these technologies shall be selected and explored to be applied to the next generation of vehicle cockpits and driver-vehicle interaction solutions to bring human-vehicle interaction at a higher level of accessibility and usability.

Expected impact
- HMI guidelines for artificial views during driving. Provide background for safer, more efficient and more comfortable cars. Technological prototype available.
- Updated state of the art on users’ feedback about existing urban driving support and information systems, functions and services.
- Strategy for deployment including filtering of driver relevant data into priority order, understanding of the drivers’ needs through a human centred approach.
- Technical feasibility and human centred study outcomes based on the data input and user centred information output.

5.4 Attentive driving

Drivers’ inattention to forward roadway, distraction and drowsiness has been identified as the primary contributing factor to road accidents. Novel solutions shall be designed to drastically reduce this problem.

Focus of Research
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- HVI for adaptive and affective natural speech user interfaces
- HVI for automotive augmented reality systems
- HVI for driving with less stress, more comfort, less boring
- Safe interaction and connectivity
- Safe HVI design process
- Multitasking contextual HVI

Expected impact

- Evaluation protocols and cognitive “models”.
- Updated state of the art of augmented reality systems and key challenges for HVI identified.
- HVI design guidelines and proposal of a standard (ISO) regarding HVI testing for augmented reality systems.
- HVI demonstrator for augmented reality systems to verify the selected guidelines.
- Investigation results on traffic scene interpretation from a driver workload perspective.
- Integrated information on traffic scenario and driver conditions.
- Availability of driver support solutions for boring and stressful driving.
- Improved HVI design minimizing distraction caused by secondary tasks.
- Improved use of context adaptivity involving sensors and technology that are capable of monitoring all relevant aspects of the driver-vehicle-environment state.

5.5 Safe testing and assessment of intelligent vehicles with increasing level of automation

The ability to increase to level of automation of individual vehicles is the key technology for the European automobile (and supplier) industry to remain global market leader based on technology and innovations. The addressed scenarios for the next levels of automation are complex pre-crash situations driven at high speeds and sequences of them on motorways and two lane rural roads.

The requirements “near-crash” and “high speeds” as well as “complex” result in testing methods that satisfies high standards in the reproducibility and reliability in carrying out the manoeuvres and in particular in the safety for all involved humans and/or test engineers.

Accident monitoring, impact & benefits; casualty reduction benefits of as well as prediction and evaluation; low cost accidentology and NDS or FOT based of crash data recorder

5.6 Driver behavior and performance in cooperation with ADAS

Driver behaviour is a key concern in all preventive safety work. Well over 85 per cent of serious traffic accidents are caused by human errors. The scientific understanding of driver behaviour and its causal relation to road crashes is rapidly improving but is still immature compared to the science of bio- and structural mechanics, which is today routinely applied in injury and crash analysis. This is reflected in a lack of established, validated, methods and tools for analysing and modelling driver behaviour, in particular behavioural effects of primary safety functions. The development of such methods and tools would be very valuable in the development of primary safety systems (e.g., for assessing the effectiveness
of alternative warning and intervention strategies) and for obtaining more precise estimations of their benefits. The growing number of automated or semi-automated manoeuvres requires collaboration between the driver and the automated- and connected vehicle systems. Correspondingly, automation of driving manoeuvres can provide a more comfortable, efficient, productive, and safer driving experience. Moreover, existing technologies for monitoring and supporting driver behaviour in real time are generally intrusive, unreliable and/or too costly to allow for large-scale deployment. Finally, behaviour-based safety programmes (coaching, training etc.) for obtaining long-term improvements in driver behaviour have begun to emerge, especially in the US. However Europe is clearly lagging behind in this area. The consistent design of the human vehicle interaction (HVI) plays a key role in the successful market introduction of highly automated safety and driving assistance systems.

Focus of Research

Driver models that represent the behaviour and performance need to be investigated.

1. Research must answer questions on how the drivers react in critical so-called “pre-crash” situations, how quick these reactions are, and how the behaviour varies on the set of so-called “normal drivers”, the significance of distraction and a secondary task. Also normal driving behaviours are of interest. The studies should be combined with measurements of the reactions of the body of the driver, e.g. brain activity, muscle tension and eye movements. Did these parameters vary in Europe?

2. A second topic is to define a “reference model for the driver in cooperation with driving or safety assistance” for the different levels of automation strategies from highly automated (low and high speed driving) to full automated driving. (Driver vehicle interaction in highly and fully automated driving systems must be engineered in such a way that they are acting in harmony with driver expectations and be resilient to system- and driver failures. Information, warning, intervention, and automation strategies must be further developed.) Measures of “risks in driving situations” that drivers are willing to accept must be analysed as well as “ability for judging the complexity and manageability of boundary condition” like weather, road conditions, traffic and vehicle with respect to the proven skills of the system. Understanding automation strategies (handover, autonomous driving) from assisted driving manoeuvres over highly automated driving in low as well as in high speed manoeuvring to fully automated driving (autonomous driving). Measures for “the driver’s readiness” to take control in autonomous driving situations and the measures for increasing and reducing levels of stress via automation. Timely transitions and reactivation of human attention and action must be handled within safe driving performance limits in complex situations. Methods for passing / phasing in/out control from/to the system to/from the driver and back.

3. Methods for identification and handling of “automation surprises” must be established.

4. Driver monitoring is needed to keep the driver in the control loop despite monotonies, complex decision making, or short reaction times. Real-time driver behaviour/state monitoring and status adaptive support: These types of functions are foreseen to become particularly important with the advent of highly and fully automated driving functions.
However, the non-intrusiveness, sensitivity and reliability of technologies for real-time detection of distraction, drowsiness and intoxication need to be improved. In addition, costs need to be reduced in order to increase market penetration. Possible application of newly developed methods using physical symptoms of drowsiness and investigate their ability to improve the detection of impairment, like alcohol or drug intoxication or drowsiness. Inattention detection with and without eye-tracking systems should be developed. (Eyes-On detection instead of Hands-Off detection to allow freehand driving without comprising driver privacy) Methods for the control of the information flow from multiple (driver-, environment and vehicle) sensors to the driver, to obtain optimal driver support should be developed. The integration of inattention and impairment monitoring systems into a general on-board perception platform should be developed providing a wide range of functions.

5. Methods and tools for driver behaviour analysis: Methods and tools developed in existing FP7 projects (e.g., EuroFOT, interactIVe) should be further refined. The relation between different types of methods (driving simulator, test track, on-road experiments and naturalistic driving) should be better analysed and differences understood.

5.7 Road user behavior and performance in cooperation with ADAS

Driver behaviour is a key concern in all preventive safety work. Well over 85 per cent of serious traffic accidents are caused by human errors. The scientific understanding of driver behaviour and its causal relation to road crashes is rapidly improving but is still immature compared to the science of bio- and structural mechanics, which is today routinely applied in injury and crash analysis. This is reflected in a lack of established, validated, methods and tools for analysing and modeling driver behaviour, in particular behavioural effects of primary safety functions. The development of such methods and tools would be very valuable in the development of primary safety systems (e.g., for assessing the effectiveness of alternative warning and intervention strategies) and for obtaining more precise estimations of their benefits. Correspondingly, automation of driving maneuvers can provide a more comfortable, efficient, productive, and safer driving experience. The consistent design of the human vehicle interaction plays a key role in the successful market introduction of highly automated safety and driving assistance systems.

2. Automated driving will imply to detect obstacles all around the vehicle, including pedestrians and other vulnerable users wherever and whenever there is a non-null hypothesis of a presence of such a user in the automated car vicinity. Whatever the sensor used for detection, there are some use cases for which, if the pedestrian is supposed to have a fully stochastic behaviour (he/she can change direction, path, and pace at any moment) the automated car is unable to avoid the pedestrian, even at very low speed. This is for example the case when the car drives along a sidewalk with pedestrians on. Cars and pedestrians could be at least than 1 meter distance, i.e. less that 0.3 s of impact if the pedestrian suddenly decides to run. If we want to achieve a zero or a close to zero probability for an automated car to crash with a pedestrian or another vulnerable user with a high unpredictable direction/speed, we need to better specify the pedestrian behaviour on and off roads/streets.
Focus of Research

Driver models that represent the behaviour and performance need to be investigated.

1. Research must answer questions on how the drivers react in critical so-called “pre-crash” situations, how quick these reactions are, and how the behaviour varies on the set of so-called “normal drivers”, the significance of distraction and a secondary task. Also normal driving behaviours are of interest.
2. A second topic is to define a “reference model for the driver in cooperation with driving or safety assistance” for the different levels of automation strategies from highly automated (low and high speed driving) to full automated driving. (Driver vehicle interaction in highly and fully automated driving systems must be engineered in such a way that they are acting in harmony with driver expectations and be resilient to system- and driver failures. Information, warning, intervention, and automation strategies must be further developed.) Measures of “risks in driving situations” that drivers are willing to accept must be analysed as well as “ability for judging the complexity and manageability of boundary condition” like weather, road conditions, traffic and vehicle with respect to the proven skills of the system. Understanding automation strategies (handover, autonomous driving) from assisted driving manoeuvres over highly automated driving in low as well as in high speed manoeuvring to fully automated driving (autonomous driving). On the other side, it is important to understand the behaviour of the other road users: Automated car and pedestrian behaviour detection.
3. Analysis of strategies/decisions/behaviour of pedestrians and vulnerable users to cross/walk on roads and streets
4. Quantify and determine probabilities for these strategies
5. Develop specific algorithm for detection and prediction of pedestrian movements
6. Test them and evaluate their performance
7. Methods for identification and handling of “automation surprises” must be established.
8. Driver monitoring is needed to keep the driver in the control loop despite monotonies, complex decision making, or short reaction times.
9. Real-time driver behaviour/state monitoring and status adaptive support: These types of functions are foreseen to become particularly important with the advent of highly and fully automated driving functions. However, the non-intrusiveness, sensitivity and reliability of technologies for real-time detection of distraction, drowsiness and intoxication need to be improved. In addition, costs need to be reduced in order to increase market penetration.

Methods and tools for driver behaviour analysis: Methods and tools developed in existing FP7 projects (e.g., EuroFOT, interact!Ve) should be further refined. The relation between different types of methods (driving simulator, test track, on-road experiments and naturalistic driving) should be better analysed and differences understood.

5.8 Mobility of the individual traveler in the urban environment

Urbanization in Europe increases the pressures and stresses in the urban environment. The environment and transport infrastructure are being stressed due to use in the traditional ways: vehicle traffic in the city centers, increasing the CO2 and pollutions emissions, noise, congestion problems, and reducing safety and mobility of urban citizens and users. Smart mobility cooperative services in the urban environment hold great potential to allow
mobility in a sustainable and safe way. To achieve its potential, though, better understanding of travelers motivations are required.

Focus of Research
Understanding and influencing traveler’s behavior for sustainable urban mobility Smart urban mobility can be regarded as mobility that is a result of optimised aggregated choices made by individual traveller using the transport network by a variety of transport modes, flexible in time and space. A basic assumption to achieve smart urban mobility is that individual mobility choices are made in a more flexible and dynamic way than before, (e.g. to use a privately-owned car to transport yourself in urban areas may not always be the most logical – or smart – way to move from A to B). There is evidence becoming available that points out a shift from ‘traditional’ mobility to smart mobility. People (and especially younger generations) trend to be more flexible in the way how to own and use private vehicles. It is too early to speak about a revolution in car ownership, but the trend is definitely moving towards a sharing community. Purpose-destination-mode-time-route choices are made in a much more flexible way than before (e.g. avoiding peak hour by working from home, increased popularity of multimodal travel options supported by improved ICT solutions and increased ‘value of times’ for public transport users).

Better insight in the trends sketched above and the related travellers’ behaviour will help transport planners and industries to develop smarter solutions. There is a need: (a) for common European data on traveller behavior and experience, (b) to be able to influence the traveller’s behaviour in an effective way, (c) for next generation mobility forecast models, (d) for innovative mobility services and (e) to better plan transport infrastructure and services in cities of all sizes.

To achieve this, it is important:
- To know the travellers and understand their needs (profiling)
- To know what mobility services and networks need to offer to meet the needs in the most optimal way
- To know how these services can be best developed and by whom.

1. Knowing the travellers and their needs (profiling)
   - Improve understanding of personal, social and cultural factors that affect future mobility styles and patterns: travellers demands and choices between home/remote working, videoconferencing and making commuter / business trips in relation to personal circumstances (appointments at home, daycare, leisure activities etc)
   - Investigate Car independent lifestyle (ownership vs use): differences in demographic segments show “younger” people do not have the need to own their vehicle. They are open to shared vehicles to using on-demand mobility services, such as car sharing schemes, using public transport and non-motorised transport modes.
   - Address traveller profiling (clustering) to identify effective ways / measures to influence behavioural changes. This forms the basis for the personalization of services to achieve changes in traveller behaviour.
   - Using Social media to provide more information on travellers’ profile and needs. This helps give the traveller pro-active information and tempt him to better choices. This helps on forecasting the transportation needs and anticipating by traffic management.
   - Develop understanding of the ICT impact on travel and transport (e.g., smart working, shopping on internet etc)
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- Fuse (open) data from different sources be fused to derive a more complete travel profile; to share data of travellers from different data sources (train subscriber database, carsharing database, social networks) in a secure way.
- Make use of innovative technologies to reach and procure information about traveler choices.

2. Knowing what the mobility services need to offer that meet the needs of travellers (and measure/predict their usage)
   - Develop an approach to influencing travelers’ behavior: departure time, modal choice, destination, whether or not to travel. Address transferability: many small cities do not have the possibilities and expertise to work on changing travelers’ behavior. This needs to be supported by methodologies and data acquisition tools to realize a shift.
   - Build models that describe the human behavior, interacting in the environment where interventions are taken. And integrate these models on behavioral change into next generation traffic forecast models

3. To know how the mobility services can be best developed and by whom (Business Models, PPP)
   - Develop Public-private partnerships to share data of travellers from different data sources (train subscriber database, car-sharing database, social networks) in a secure way.

4. Mobile devices for data collection and analysis on personal travel and choices: Improve mobile devices to:
   - Automatically detect the modality in use (bus/car/bike/walking) for urban transport
   - Use smart phones develop travel patterns

5.9 ICT for energy efficient driving

In the past 20 years, enormous progress in applying Information and Communication Technologies (ICT) to vehicles. Initially, the focus was on safety, resulting in stand-alone Advanced Driver Assistance Systems (ADAS). More recently, the energy efficiency domain rose in importance, due to the threats of climate change and human health. Technologically, communication has been used to achieve greater energy efficiency and safety of reducing CO2 emissions by 80% and road fatalities by 50% in 2020. ICT for energy efficient and safe driving deals with both stand-alone and cooperative systems (communication among vehicles (V2V) and between vehicles and a roadside and backend communication infrastructure system (V2I)). Looking forward to the next 20 years, the driver will remain in control of the vehicle, thus the promised effects will greatly depend on how drivers use the systems provided. To achieve the promise that ICT for energy efficient and safe driving, research on the several aspects related to the driver are necessary: driver behaviour in the automated environment, HMI design, driver support and information processing. To address sustainability and the reduction of greenhouse gas emissions, research in the short term needs to address driving behaviour in vehicles with an internal combustion engine as well as electric vehicles (EVs), as well as specific aspects of electro mobility. Green driving support systems challenge the driver to adopt a green driving style. Through green driving support systems the benefit of ‘greener’ engines can be fully achieved. A green
driving style can add up to 15% of CO2 reduction to already ‘green’ vehicles. However a single ‘one system fits all’ approach will not be sufficient to address and convince the wide variety of drivers to adopt a greener driving style. By applying knowledge about the driver the green driver support system can be adopted to increase the usage and acceptance of the system and a higher compliance with the advice provided. Drivers need to be challenged in different ways through intelligent advice and feedback on and about their performance. While fatalities of all other categories are decreasing, fatalities among VRUs are flat or even increasing, signifying that the problem of VRU safety needs to be addressed with greater urgency than displayed up till now. Tied into this is the need to also address the mobility and travel comfort of VRUs. Lack of (perceived) safety may impact mobility and comfort, and vice versa, mobility patterns may influence safety. What is needed? The VRU must become an active, integrated element in the ITS approach to vehicle – infrastructure – human studies. Similar to current developments in V2V and V2I cooperative systems, VRUs should be innovatively equipped, in a way that meets their needs. Analogous to the current V2V and V2I developments, VRU2V and VRU2I will lead to prevention or mitigation of critical accident scenarios. The VRUITS project will develop an architecture for integrating the VRUs into the cooperative ITS.

To ensure the safety of new technologies and vehicle concepts, innovative products, testing methods, tools and facilities need to be developed. Better integration of active and passive safety systems, improving sensing for increased safety, Improved internal vehicle management of electronic and communication components for Autonomous driving, Improved Testing Methods for safety systems.

Safe, reliable, efficient, accessible and secure communication depends on information and communication technology. To go beyond the early deployments of cooperative systems, supporting traffic management and safety warning applications, improvements to connectivity and security are necessary.

The human factor in (cooperative) green driving:

· Optimizing HMI and advice strategies to really convince drivers to change their behavior:
  o Develop / refine Driver state classifications with respect to green driving
  o Develop / refine Driver type classifications with respect to green driving
  o Use Work Load information when developing the HMI strategies

· Integrating new options like social media and serious gaming
· Proving real world CO2 emission reduction by green driving support
· Field Operational Tests with Green Driving Support

5.10 The driver in the automated environment

Human errors account for almost 90% of the accidents that happen. The first generation of Advanced Driver Assistance Systems (ADAS) has been developed based on quasi static environmental perception and relatively “easy to solve” driving scenarios (fixed obstacle, free corridor left or right). Future challenges in the development of ADAS lie on the anticipation of more complex road scenarios, dynamic flow of traffic, dense traffic with reduced sensor inputs (e.g. limited field of view for camera) and target classification (cars, trucks, pedestrians, cyclists).

The concept of a Safety State Estimator (SSE) which will be able to fuse all relevant
information from a Local Dynamic Map and output the actual threat level of a vehicle and its environment is a necessary module for the next generation of ADAS systems. The determination of threat level is also necessary for determining the type of intervention (advise, warn, intervene, automate).

Safety State Estimator/ Advanced driver support and automated driving: Research should address the following objectives:

- Personalization through driver behaviour classification (young / old, risky / conservative)
- Tool development for next ADAS assessment

To support the driver either in driving or in the transfer of controls there is a need to achieve a symbiosis between the vehicle and the driver. The vehicle needs to know the possibilities and limitations of its driver. This requires a deep understanding of different driver types and how they want to be supported under different conditions. Knowledge then needs to be developed on different driver types and how they change over time, how they best can be supported (HMI, system settings) and under which conditions.

Driver behaviour in the automation environment: Research should focus on:

- Development of different driver profiles (types and personalities) and relate different profiles to driving styles
- Relate driver profiles to different ways of providing feedback and advice and how to present the information (HMI) under different conditions (environment, workload, fatigue)
- Use the driver profiles to support the drivers in different ways of transfer of control
- Development of HMI recommended practices (how should information be presented under which circumstances)
- Development of integrated, adaptive cockpits (based on all sources of data; in-vehicle; V2X, X2V)
- Unobtrusive measurements of workload, distraction and fatigue. Increasing the reliability by increasing the hit rate and decreasing the false alarm rate.

Driver behavior: support by active safety systems: Most traffic accidents are caused by driver errors, e.g. in misinterpretation of a traffic situation leading to a wrong decision. Human errors in attention and vigilance are among the most common causes of transportation accidents. To support passenger car drivers in making decisions in the increasing complexity of traffic scenarios, a variety of active safety systems is being developed. Active systems not only support drivers during normal driving, but these systems are even capable of taking over vehicle control functions in critical and near collision situations, for instance in cases where the driver is not reacting to warning signals because he is drowsy or distracted. Active safety system interference will improve safety only if the transition from human control to system control and back is seamless and flawless. Active systems will therefore not only register, identify and interpret traffic situations, but will also use input from driver behaviour regarding the capability to perform driving tasks, that is influenced for instance by drowsiness or distraction. It will become increasingly important that active safety systems are aware of the workload that is experienced by the driver and of the amount of information from warning systems that the driver is capable of dealing with.

The technological challenge is to make active safety systems aware of continuously changing
driver behaviour and to make these systems capable to balance the information registration capacity and workload of the driver before interfering and taking over control. This poses high requirements to sensor systems that monitor driver behaviour, to adaptive decision logistics that make use of driver state and to the Human Machine Interface of active safety systems.

5.11 Cooperative and innovative technologies for VRU

Motivation, Content and Scope

- Fully support the driver by adapting the interface and the settings of the safety and information systems to provide the driver with a full benefit of those systems under the conditions that the driver most want and need them.
- Increase user acceptance of ITS
- Increase usage of ITS.
- Reduction of number of fatalities and severely injured, and the number of accidents, due to driver error

Focus of Research:

Cooperative and innovative technologies for VRUs: For many years, the focus of the activities to improve the safety of vulnerable road users (VRU) has been on the safety of pedestrians, the biggest group with the highest numbers of fatalities and serious injuries in Europe. Due to changes in urban mobility and technical innovations, the number of other vulnerable means of transport such as cycles, mopeds and powered twowheelers (PTWs) is increasing. The use of new means of transport such as E-bikes and scoot mobiles (for elderly and disabled people) is growing relatively fast, introducing new safety issues such as higher speeds and interaction with other transport modes. Information is needed about the real-life safety situation of all VRUs and not only about pedestrian accidents. Based on typical accident scenarios for the various types of VRUs, the safety potential of new solutions can be analysed related to infrastructure, vehicles and driver behaviour. There is a need for naturalistic data collection, and better data collection for safety of VRUs. New safety technologies, originally developed to improve occupant safety, can be extended or modified to improve VRU safety. Interesting topics can be: autonomous braking of cars for impacts with all kinds of VRUs, passive safety measures such as exterior airbags, V2V and V2X communication, anti-lock braking systems and autonomous braking for PTWs and enhanced information and warning systems for VRUs.

5.12 Ensuring safety of new technologies and vehicle concepts

Improved Testing Methods for safety systems: Virtual testing of integrated safety systems and developing standard testing scenarios and objective ratings for quality of HMI. Virtual testing allows a wider variety of scenarios to be investigated and can also be used in earlier stages of the development process. With respect to testing HMI systems, the development of fixed testing procedures will address a systematic and more objective exploration of positive and negative impacts on the driver.

Tools for ITS system development, assessment and evaluation: extend current tool
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capabilities to allow assessment of (cooperative) systems for
· Multi-level assessment (network, scenario and vehicle integration level)
· Safety: design an assessment method and calculation model for the safety impacts of ITS.
· Take into account real-life aspects of large-scale FOTs, bundles of functions, improved
driver behavior with information and warning systems for all impact areas (safety, traffic
efficiency, environmental and mobility impacts).

6 Conclusion

Overviews of activities conducted in the framework of the iMobility Working Groups such as
WG-HMI, WGVRU, WG-SafeAPP and WG-R&I show that several research issues and
perspectives covered by the DECOMOBIL projects in the area of “Human Centred Design of
ICT for clean and safe mobility” are considered as high priorities by these Working Groups,
with their own specific views and approaches related to the scope and the objectives of each
WG.

In addition to the production of DECOMOBIL deliverables, and more specifically the Del 2.1
“Roadmap of Information & Communication Technology design for clean and efficient
multimodal mobility” & Del2.2 “Roadmap for research on Human Centred Design of ICT for
clean and safe mobility”, some DECOMOBIL partners have been very active, being co-chairs
and participants to these iMobility WG, and contributed to exchanges allowing coherence of
approaches during all the duration of the project through regular meetings, events and
activities.

The contribution of the DECOMOBIL project to the iMobility WGs has been punctual, but
effective and concrete.
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**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>AAM</td>
<td>Alliance of Automobile Manufacturers</td>
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<tr>
<td>ADAS</td>
<td>Advanced Driver Assistance System</td>
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<tr>
<td>ACC</td>
<td>Advanced Cruise Control</td>
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<td>ARAS</td>
<td>Advanced Rider Assistance Systems</td>
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<td>BAS</td>
<td>Brake Assist Systems</td>
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<td>CCC</td>
<td>Car Connectivity Consortium</td>
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<td>CEN</td>
<td>European Committee for Standardization</td>
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<td>ECTRI</td>
<td>European Conference of Transport Research Institutes</td>
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<td>EPoSS</td>
<td>European Technology Platform on Smart Systems Integration</td>
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<td>ERTRAC</td>
<td>European Road Transport Research Advisory Council</td>
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<td>ESoP</td>
<td>European Statement of Principles</td>
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<td>EUCAR</td>
<td>European Council for Automotive R&amp;D</td>
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<tr>
<td>EV</td>
<td>Electric Vehicle</td>
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<td>FCD</td>
<td>Extended Floating Car Data</td>
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<td>FOT</td>
<td>Field Operational Test</td>
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<td>Genivi</td>
<td>Non-profit industry alliance committed to driving the broad adoption of an In-Vehicle Infotainment (IVI) open-source development platform</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>HMI</td>
<td>Human Machine Interaction</td>
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<td>ICT</td>
<td>Information and Communication technology</td>
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<td>ISA</td>
<td>Intelligent Speed Adaptation</td>
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<td>ISO</td>
<td>International Standardisation Organisation</td>
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<td>ITS</td>
<td>Intelligent Transport System</td>
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>IVIS</td>
<td>In-vehicle Information System</td>
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<tr>
<td>JAMA</td>
<td>Japanese Automobile Manufacturers Association</td>
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<td>NFC</td>
<td>Near Field Communication</td>
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<td>ND</td>
<td>Nomadic Device</td>
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<td>NDF</td>
<td>Nomadic Device Forum</td>
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<td>OBIS</td>
<td>On-Bike Information Systems</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<td>ERSO</td>
<td>European Road Safety Observatory</td>
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<td>PROS</td>
<td>Priorities for Road Safety Research in Europe</td>
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<td>POI</td>
<td>Point-of-interest</td>
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<td>PTW</td>
<td>Powered Two Wheelers</td>
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<td>RDS</td>
<td>Radio Data System</td>
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<td>SafeAPP</td>
<td>Safety of applications</td>
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<td>SSE</td>
<td>Safety State Estimator</td>
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<td>TMC</td>
<td>Traffic Message Channel</td>
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<tr>
<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
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<tr>
<td>V2V</td>
<td>Vehicle-to-Vehicle</td>
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<tr>
<td>V2I</td>
<td>Vehicle-to-Infrastructure</td>
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<tr>
<td>V2X</td>
<td>Vehicle-to-Everything</td>
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<tr>
<td>VERA</td>
<td>Visions on the European Research Area</td>
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<td>VMS</td>
<td>Variable Message Signs</td>
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<tr>
<td>VRU</td>
<td>Vulnerable Road Users</td>
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<tr>
<td>worldDMB</td>
<td>Global industry forum for digital radio</td>
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References


2. JAMA Guidelines for In-vehicle Display Systems – Version 3.0 August 18, 2004


6. ITU-T FG Distraction V1.0 03/2013:
   a. ITU-T Report on User Interface Requirements for Automotive Applications (P.UIA)
   b. ITU-T Report on Situational Awareness Management (G.SAM)
   c. ITU-T Report on Vehicle to Application Communication Interface (G.V2A)

7. Solutions and documentation of the Car Connectivity Consortium.
   a. MirrorLink™ Global Driver Workload and User Interface Application Guidelines for Drive-Ready Certification
   b. MirrorLink™ European Statement of Principles Driver Workload and User Interface Application Guidelines for Drive-Ready Certification
   d. The CCC Application Certification process and tool
Appendix A  Background to ESoP

A.1  History of the ESoP


In July 2001 the Commission’s Expert Group published a report on updating and expanding the principles. During 2003/4 the eSafety WG on HMI provided a forum for stakeholders to discuss the ESoP further and finalised its report to the European Commission in early 2005. The Commission made some funding available through existing HMI-related projects HUMANIST and AIDE and invited a small group of HMI specialists to implement the WG-HMI recommendations concerning the ESoP. A specific focus for attention was the increasing popularity of portable “nomadic” devices by drivers within vehicles.


Following a request for clarification from ACEA, a further ESoP was published on 12th August 2008 (OJ L 216/2008) which includes minor modifications (one footnote) clarifying visual displays’ mounting.

A.2  Content of the ESoP

The first part of the ESoP incorporates 37 principles formulated as generic goals to be achieved by the design of a safe and user-friendly HMI of in-vehicle information and communication systems intended to be used by the driver while driving.

These principles of the ESoP (2008) are organised into 6 groups:

- Design goals (5)
- Installation principles (6)
- Information presentation principles (5)
- Principles on interaction with displays and controls (9)
- System behaviour principles (5)
- Principles on information about the system (7)

In addition, there are principles concerning Recommendations on Safe Use which comprise essential safety aspects related to use of, and influencing use of, in-vehicle information and communication systems. Following text concerning the context of use, principles are presented relevant for Employers, Point-of-sale, Vehicle Hire Companies and drivers themselves.
A.3 HMI standards

International standards provide process, design and performance advice in documents reached through a process of expert consensus building. A range of standards products exist including full standards and technical reports. These are not legally binding but can often be regarded as "state-of-the-art guidance. Amongst the groups working in areas relevant to vehicle design and usability are:

- ISO TC 22 SC13 WG8 covering basic standards for human factors design of in-vehicle systems;
- ISO TC 204 WG14 concerning vehicle and cooperative services (and some interface issues) including, for example, Lane Departure Warning and automatic Emergency Braking Systems; and
- ISO TC 204 WG17 concerning nomadic and portable devices for ITS services.

Where appropriate, the ESoP refers to standards such as those concerning visual and auditory information presentation, dialogue management and visual behaviour measurement.

A.4 Other context

A meeting with Member States on 30th September 2008 made a number of recommendations and requests including the re-activation of the WG-HMI under the eSafety Forum. The WG-HMI then worked from January to October 2009 and produced a consensus report containing detailed recommendations for short-term ESoP development as well as for future investigations. It was reported that verification criteria for the ESoP as a whole was not considered achievable, but in some cases might be desirable. The WG-HMI identified a need to monitor on-going developments such that the ESoP can be re-visited periodically (at least every three years) providing a balance between current relevance and stability and the WG also stressed that solutions at the level of individual Member States or regions should be avoided.

In 2012 NHTSA in the USA published work reviewing research on distraction and international guidelines (including the ESoP). They also proposed as voluntary guidelines a series of lock-out requirements for specific functions and verification criteria for visual-manual interfaces to limit distraction while driving. Following consultation and feedback a final set of guidelines was published in April 2013.

Nomadic device (ND) integration is a specific challenge and requires co-operation between automotive industry and nomadic device manufacturers. A Nomadic Devices Forum, was established as a WG under the eSafety umbrella and reported in September 2009 with proposals for technical safe integration. Since then, there has been considerable commercial activity, including proliferation of Smartphones and also establishment of the Car Connectivity Consortium.

In parallel, but separately from the WG-HMI, the iMobility working Group (WG-SafeApps) is being established to consider verification and certification procedures for integration of Nomadic Devices into vehicles.
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It should also be noted that the EC’s ITS Action Plan identifies HMI as an area for potential action. However, the EC’s intentions are yet to be clarified.

Appendix B  Definition of a Safe App

“Safety is a very dangerous word”

[Francois Hartemann, 1989, founding Chair CEN TC22 SC 13 WG8 on in-vehicle HMI]

Apps are applications (services) that use Smartphones or other hardware platforms to interact with, and provide information to, users. Apps are increasingly found in the driving environment even if not designed specifically for that environment.

When used by drivers, Apps can support safe driving; for example, by increasing driver awareness of conditions on the road ahead and by keeping the driver more attentive.

Concerning the provision of information to drivers while driving (which is the main purpose of the Apps that we consider), the principal safety concern is distraction. If to be called “safe” an App is required to involve a complete absence of distraction risk, then safety not possible.

In practical terms “safe” has to be related to the level of distraction involved in the use of the App so “minimum distraction with maximum information” can be stated as the goal of a safe App. Nevertheless, this goal needs to operationalize in a clear way.

The risk of unsafe consequences when interacting with an App (such as distraction leading to a momentary loss of situation awareness resulting in a crash) depends on:

- Frequency of use
- Length of use
- Intensity of interaction

The risk will also depend on external factors in the driving environment which will affect a driver’s workload at any one time. Some of these factors can be assessed by the driver, such as traffic density, but there will also be less predictable elements such as the behaviour of other road users. The driver has a responsibility to “drive safely” and this includes managing their own workload such that they are able to properly interact with the external driving environment. It is ultimately their choice about how they distribute their attention between tasks both within and outside their vehicle.

The design of an App will depend on many factors including its intended function. Some general characteristics of a well-designed App are likely to involve information which is:

- Presented at the right time …
- …in a clear way, which can be quickly gathered by the user …
- … and likely to be easily understood

A safe App is one that assists the driver to make good choices and continue to drive in an appropriate manner but actually verifying that an App is “safe” is problematic. However, it could be approached in a number of ways:
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Measuring the consequences of driver behaviour during and after interacting with an App would require very extensive field trials. Simulator and bench tests would be possible but rather artificial and the resulting measures are controversial.

A benchmark based on design could be more easily adopted such that if an App is in accordance with the ESoP, then it is considered as safe.
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