ASPECSS
Assessment methodologies for forward looking Integrated Pedestrian and further extension to Cyclists Safety

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1 Project context and Objectives

1.1 Overall project objectives

According to the World Health Organisation Global status report on road safety 2009, pedestrians account for more than 19% of road fatalities in the EU-27. It is well known that most accidents with pedestrians are caused by the driver being in alert or misinterpretation of the situation. For that reason advanced forward looking integration safety systems have a high potential to improve safety for this group of road users. These systems combine reduction of impact speed by driver warning and/or autonomous braking with protective devices upon impact.

Previous EU research projects resulted in systems which are gradually entering the market. However, such new systems have to be widely deployed in the marketplace to realise their potential benefits.

The objective of the AsPeCSS project is to contribute towards improving the protection of vulnerable road users, in particular pedestrians and cyclists by developing harmonized test and assessment procedures for forward looking integrated pedestrian safety systems. The outcome of the project will be a suite of tests and assessment methods as input to future regulatory procedures and consumer rating protocols. Implementation of such procedures / protocols will enforce widespread introduction of such systems in the vehicle fleet, resulting in a significant reduction of fatalities (30% pedestrians; 20% cyclists) and seriously injured (50% pedestrians; 20% cyclists) among these vulnerable road users.

Main goal of the AsPeCSS project is to develop harmonised test and assessment procedures for forward looking integrated pedestrian safety systems that can be used for consumer rating and regulatory purposes. As such the project is meant to stimulate wide spread introduction of these systems that have high potential to improve safety of pedestrians and, in case adequate detection technology becomes available, also for pedalists.

The AsPeCSS consortium is strongly convinced that significant reductions in fatalities and injuries can be achieved by implementing the project findings and results in future regulatory and consumer rating procedures for vehicle safety. It is well know that consumer rating programmes have a strong influence on manufacturers to build vehicles that consistently achieve high ratings, thereby enforcing introduction of new safety systems that address real world needs into vehicles¹. Moreover, it will raise the public awareness of the benefits of these integrated safety systems by means of easy understandable rating systems.

1.1.1 Scientific and technological objectives of the project

On the basis of the above and the “State of the Art” review presented in section Fout! Verwijzingsbron niet gevonden., the following scientific and technological objectives have been defined:

- To develop harmonised and standardised procedures and related tools for the assessment of forward looking integrated pedestrian safety systems. Such harmonisation shall be provided at European level and will also target a broader scope worldwide. As part of this:
  - Develop a methodology for balancing direct active safety benefit, combined active-passive safety benefit, as well as direct passive safety benefit into one overall safety assessment (based on benefit estimations);
  - Develop methods and means to adapt passive safety test conditions for scenarios with preceding pre-crash action;
  - Develop test targets representing pedestrians for different sensor types
- To gain acceptance for future implementation of test and assessment tools in scientific, industrial, regulatory or consumer rating procedures by extensive evaluation and validation;
- To set the bases and prepare similar activities focusing on the test and assessment of integrated protection systems dedicated to cyclists.

¹ The New Car Assessment Program Suggested Approaches for Future Program Enhancements, National Highway Traffic Safety Administration Department of Transportation, January 2007
With these objectives the AsPeCSS project is directly addressing priorities and actions set by the EC regarding the road safety strategy for 2011-2012. “In view of achieving the objective of creating a common road safety area, the Commission proposes to target of halving the overall number of road deaths in the European Union by 2020 starting from 2010”. In their actions towards reaching this goal, the Commission indicated safety of vulnerable road users to be one of the three main priorities. On a more specific level the use of modern technology, among which Anti Collision Warning or Pedestrian Recognition systems, should be promoted. Accelerated deployment and broad market take-up of such safety enhancing applications needs to be supported in order for their full potential to be unleashed.

WP 1 – Methodology for balancing active and passive safety
- Define and evaluate a methodology for the overall assessment of pedestrian pre-crash systems, that allows balancing of passive safety performance against active safety performance.
- As part of the development of the methodology estimate benefits of the pre-crash braking part of forward looking integrated pedestrian safety systems. Extend estimate to include effect of improved passive / active safety systems.
- Provide additional data to check and weight the relevance of test scenarios for collision avoidance and mitigation testing to ensure that they are representative for Europe
- For cyclist pre-crash systems:
  o Make recommendations for work necessary to adopt test scenarios and extend methodology developed for pedestrians to include cyclists
  o Make initial estimate of additional potential benefits, based on information currently available.

D1.1 Scenarios and weighting factors for pre-crash
D1.2 Initial benefit estimate for pedestrian pre-crash systems

WP 2 – Test Procedures for Preventive Pedestrian Safety Systems
- Define a technology-independent test procedure suitable for assessment of preventive pedestrian safety systems.
- The test procedure should be capable of assessing driver-in-the-loop and automatically intervening driver assistance systems utilized for pedestrian protection. The test result should reflect a representative, comprehensive effect of a total system in real life accident scenarios as determined in WP1.

D2.1A Test target specification document, including sensor response requirements
D2.2 Report describing the comparative survey of existing test protocols and test facilities
D2.3 Two prototype test target
D2.4 Report on Driver reaction models

WP 3 – Injury assessment: data for construction of Injury risk curves2-4 pages achievements
The main objective of this WP is to derive injury risk against impact speed curves from pedestrian impactor tests (including virtual) for a selection of vehicles representative of the vehicle fleet.

- Construct HBM simulations that reflect the accidentology and scenarios defined in WP1.
- Define impact conditions for testing according to all
- Generate all requested data to develop the injury risk functions, based on the biomechanical values from test and simulation data. To develop injury risk curves it will be necessary to perform tests to determine injury risk wherever a pedestrian head may impact, i.e. tests will have to be performed on points all over the car not just points chosen on a worse case basis.
- As part of the above establish pedestrian impact conditions for relevant accident scenarios and impact parameters as identified in WP1

D3.1 Pedestrian kinematics and specifications of new impact conditions for head- and legform impactors gi

WP 4 – Dissemination and exploitation
Overall objectives for the dissemination and exploitation workpackage are:
- To maximise the dissemination of results and to express them in terms that are readily

understandable to stakeholders (e.g. governments, industry and suppliers) in order to accelerate the implementation of the research findings.
- To promote the dissemination of the project findings through presentations at the project workshops, scientific publications and preparing information for the project website.
- To facilitate technology transfer and accelerate dissemination of on-going research activities.
- To achieve an optimum knowledge management including appropriate handling of IPR's; implementation and exploitation of the obtained results;

D4.1 Project website, public and partner restricted part, project templates for reports, presentations an
D4.10 Technical publications listed and executive summary published on the public website
D4.2 Dissemination database with relevant stakeholders, interest groups and their contact details
D4.3 Flyer publication with general project information for public project dissemination
D4.4 Dissemination and exploitation plan
D4.5 First Project Advisory Board meeting and public workshop
D4.6 Newsletters describing new developments and results from the project
2 Work performed and results achieved

2.1 WP 1 – Methodology for balancing active and passive safety

Within Task 1.1 ("Definition of scenarios and weighting factors for testing of pre-crash part of integrated pedestrian safety systems") substantial steps for the entire project could be achieved in the first phase of the AsPeCSS project. Due to the high amount of analysis needed in addition to the original planning, this task and the related Deliverable 1.1 were delayed but are completed within period 1. Within Task 1.2 ("Estimate benefit of pre-crash braking part of integrated pedestrian safety systems") the methodology for a first estimate of the potential benefits of integrated safety systems is developed based on accident data and theoretical system models. This task currently evaluates different approaches to estimate the benefit of pre-crash braking for GB and Germany and aims to scale for Europe. A methodology has already been applied for GB and Germany. This task interacts strongly with Work Package 2 since data for vehicle performance in test scenarios is required. The benefit estimation is supposed to be analysed for current prototype vehicles (i.e. by input from BMW, Toyota, and PSA) and a virtual reference vehicle (i.e. to show the technical limitations). The final methodology developed will form the first part of the overall assessment methodology for Task 1.3.

Within Task 1.3 ("Develop methodology for overall system assessment (balancing passive / active safety)") a methodology will be developed converting both the passive safety assessment and the active safety assessment for the vehicle under evaluation. This task accompanies the time period of the entire AsPeCSS project and interacts strongly with Work Packages 2 and 3. Progress is good in this task. Task 1.4 will start in period 2.

In task 1.5 IDIADA has monitored the technical progress and coordinated the input/output flows between work packages and tasks. Due to setting meetings once per month with all WP leaders corrective actions were discussed and applied when needed. Furthermore, all the technical deliverables have been checked, reviewed and approved within this task.

2.2 WP 2 – Test Procedures for Preventive Pedestrian Safety Systems

Test target development

During the first months of 2012 the Harmonisation Platform on Test Targets came with a draft specification for pedestrian dummy targets. Specifications were developed in the vFSS, ASPECSS and AEB projects. It was decided to have two sizes of dummies, one representing adults and one representing children. In order to mimic pedestrians as close as possible for sensor systems like radar, camera and PMD initial specifications for all these sensors were defined. The workshop as held on 26 and 27 June at BASt was largely meant to verify and refine the draft specifications. The table below summarizes some of the specifications for the dummy and the test environment. The aim of second the dummy testing workshop at IDIADA (15-17 October 2012) was to prove the testability of test scenarios which were worked out in AsPeCSS WP2. As a consequent following step after the dummy comparison workshop at BASt (26.–27. July), where the focus was to test different dummies with different sensor systems, the second Workshop targets the evaluation of test scenarios towards repeatability and reproducibility. Also different sensor systems were considered. This workshop was organized by AsPeCSS and HP2, therefore in addition to the AsPeCSS Members, there were also OEMs and suppliers from HP2 involved.

The AsPeCSS Base Test Scenarios have been defined by WP1, D1.1 and are based on information collected in the 2nd Dummy Workshop, where reproducibility and repeatability have been tested. Based on these scenarios, an ongoing task is to develop a assessment protocol for AEB Pedestrian systems. This assessment will be delivered to EuroNCAP for AEB Pedestrian Phase I in 2016.

Driver model

The Aim of Task 2.2 is to develop a driver and pedestrian reaction models suitable for assessing the effectiveness of pedestrian protection systems.

Scope:

- Models applicable for a representative range of physical and mental human skills including age-specific capabilities
- Spectrum of driver reaction to warnings, braking support or automatic intervention, including controllability will be quantified
A Driver Model was defined.

2.3 WP 3 – Injury assessment: data for construction of Injury risk curves

WP 3 conducted a main part of the simulation and testing activities needed to generate input data required for the construction of the injury risk functions by WP1. The activities are in general running according to planning.

Pedestrian kinematics and specification of impact conditions by means of human body simulations has been finished. All required vehicle models and simulations matrixes are defined and the simulation results are obtained and analyzed. The results needed as input for Task 3.2 are forwarded. The report for Deliverable 3.1 is one month delayed by a slightly late start by some of the partners. This delay has no effect of the overall WP3 planning. The final version of this deliverable will be committed by the end of April. Further worthwhile to mention that the results obtained by this Task will be published at the ESV 2013 conference.

Experimental and virtual testing task is ongoing and on schedule. This task will deliver input for the development of injury risk curves (task 3.3) which will be used in task 1.3 for the overall injury risk assessment. In this task subsystem simulations and tests will be performed. Most of the work is done on virtual testing, only a limited amount is done on physical tests to validate the simulation results. The subsystem tests and simulations are performed on points all over the car and not just points chosen on a worse case basis (as is done in the current Euro NCAP approach). Within the tests and simulations several performance cars (ranging from good to poor) and vehicle categories are taken into account. The test and simulation data is generated for a range of vehicle speeds, impact locations, pedestrian sizes and different vehicle types.

2.4 WP 4 – Dissemination and exploitation

Activities in WP4 – Dissemination and exploitation are running well in the first period. Many activities in this WP are performed in the first 18 months. Although some slight changes to the original workplan, all activities has been done and even more.

The public website was setup in the beginning of the project and afterwards maintained and updated on a frequent basis, including Logo creation and used for all type of templates.

▷ General ASPECSS presentation is available on the website. This presentation is maintained on a regular basis and used for external communications (like for instance the recent workshop held at TRL March 2013).

▷ Flyer was released, sent to all contact on dissemination database and published on public website

▷ First newsletter was released, mainly on the first test event and was sent to all contact on dissemination database and published on public website

▷ Dissemination plan created and the deliverable D4.4 – Dissemination and exploitation plan released and submitted.

External dissemination actions

Dissemination database is extended, original is based on the ASSESS database, complemented with the ActiveTest database. Further, stakeholders are contacted frequently.

Platform to harmonise assessment methods and tools

The Harmonisation platforms as setup in the ASSESS project are further continued to streamline the information exchange towards the stakeholders. For HP2 three meetings were held (Feb 2012 BMW, May 2012 ADAC, September 2012 aligned with ActiveTest event). In addition 3 telecalls were held to discuss the reporting. Draft report on dummy specifications delivered to Euro NCAP November 2012. This report is integrated in the ASPECSS Deliverable D2.1. In a workshop organised March 2013 at TRL all projects were called together to discuss results and findings on accidentology (scenarios), pre crash test set-up and test experience as well as assessment methodology. Representatives from Euro NCAP joined this meeting.
3 Expected final results and their potential impacts

3.1 Expected impacts listed in the work programme

The AsPeCSS project contributes to the expected impact of:

- Increase the level of safety and security of both the whole transport system and its components, thus contributing to the overall scope of reducing the number of fatalities and the severity of injuries caused by transport accidents.
- Enhance the positive interactions between pilots-drivers/infrastructure/vehicles-vessels in order to decrease the level of human error and increase the safety performance of the infrastructure.
- Maintenance/increase of the level of safety and security of the transport system, whilst applying innovative technologies contributing to the mitigation of green house effect and the reduction of CO2 emissions.

By delivering the following main (exploitable) results:

1. Test and assessment methods for the evaluation of integrated pedestrian safety systems for the protection of the pedestrians (and cyclists). Exploited by:
   a. test houses (TNO, TRL, BAST, IDIADA) via direct services offered to the car industry,
   b. OEM and suppliers (Bosch, BMW, PSA, Toyota, TRW, Autoliv) in terms of performance requirements / design targets for designing new systems.
2. Test equipment mainly test targets representing pedestrians and cyclists for different sensors. Exploited by:
   a. Test equipment providers (HUMAN) via sales of test equipment.
3. Increased equipment rate of available integrated vehicle safety system for pedestrian (and in the further future cyclist) detection technologies and accelerated market introduction of new technologies. Exploited by:
   a. Suppliers (Bosch, BMW, TRW, Autoliv).
4. Increased knowledge at the end user level (vehicle buyer) about the functionality and the benefits of integrated pedestrian safety systems and therefore push the market demand for it mainly exploited by OEMs (BMW, PSA, Toyota).

Implementation of test and assessment methods in consumer rating programs and regulatory procedures is expected to result in a reduction of:

- 30% of the pedestrian road fatalities in Europe and;
- over 20% of the pedal cyclists road fatalities.
- Reduction of over 50% of pedestrian road seriously injured in Europe and
- over 30% for pedal cyclists seriously injured hit by passenger cars.

The anticipated main project results and their expected impact are explained in the following sections.

3.1.1 Projected impact of the AsPeCSS project

The societal problem

Road safety is a major societal issue. In 2009, more than 35,000 people died on the roads of the European Union, i.e. the equivalent of a medium town, and no fewer than 1,500,000 persons were injured. The cost for society is huge, representing approximately 130 billion Euro in 2009. In view of achieving the objective of creating a common road safety area, the European Commission proposes the target of halving the overall number of road deaths in the European Union by 2020 starting from 2010. In their actions towards reaching this goal, the European Commission indicated safety of vulnerable road users to be one of the three main priorities. On a more specific level seven actions were defined for the next decade to improve road safety. This includes objective n° 5: “Promote the use of modern technology to increase road safety”. Under this objective the possibility of extending the implementation of Advanced Driver Assistance Systems (ADAS) such as Lane Departure Warning, Anti Collision Warning or Pedestrian Recognition systems are specifically indicated. It is

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also stated that accelerated deployment and broad market take-up of such safety enhancing applications needs to be supported in order for their full potential to be unleashed.

A) Societal impact of AsPeCSS - improving road safety
Integrated Vehicle Safety Systems - combining elements from active and passive safety - have a high potential to improve both comfort and safety of vehicles, their occupants and their opponents. It is well known that most accidents are caused by human error. In the case of accidents with pedestrians several studies world-wide showed that a majority of car drivers does react but not to a level at which the crash is avoided. For that reason pedestrian detection systems coupled with driver warning and/or autonomous braking action are recommended to facilitate accident avoidance or reduce the impact speed. Regarding the speed, various studies showed that the impact speed reduction, even at moderate level, can significantly decrease the injury risk for the pedestrian in an impact. In fact passive countermeasures for the bonnet, A-pillars, and lower windscreen areas, which have a high potential on its own, would benefit greatly from the addition of autonomous braking, and vice versa. As reported by Fredriksson & Rosen passive countermeasure in the 40 km/h are particularly efficient at slow speed, reducing several injuries (AIS3+) up to 90% for impact speed lower than 40 km/h. However, the protection decreases rapidly for higher speed. This finding emphasises that the potential of combined active passive countermeasures in reducing impact speed and in protecting the pedestrian upon impact (at lower speeds).

Although the potential of forward-facing integrated pedestrian safety systems was indicated in projects like SAVE-U, eIMPACT, TRACE, APROSYS, exact numbers on the benefit were not retrieved in detail (the main reason being the fact that technology was not available at that time, hence required information on parameters like expected impact speed reduction were not available). Accordingly, AsPeCSS partners made a first estimate: Based on the speed reduction of 20 km/h as claimed by some systems currently in the market, benefit estimation methods as developed for the European Commission yield a reduction of more than 30% of number of pedestrian road fatalities in Europe and more than 20% for pedal cyclers road fatalities hit by passenger cars. Quantitative results using naturalistic data and advanced stochastic modelling techniques have been obtained by the vFSS Group and can be shared in this project to further refine these estimates.

B) Environmental impact of AsPeCSS
The ambition of reaching Integral Pedestrian Safety Systems (or, at least, work facing that direction) is not only a need of the international community in order to solve the safety problem of road users (with special attention to the most vulnerable ones), but will offer other significant benefits, one being a possible positive impact on the environment.

The increase of sustainable mobility including cyclists and pedestrians requires an improvement of the safety of vulnerable road users, particularly children. This project will contribute to their safety and will thus encourage environmentally friendly transportation and individual mobility.

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1. EC co-funded projects such as: TRACE, eIMPACT, Save-U, Chameleon, APROSYS and PReVENT
2. GIDAS database
3. TRACE, TRaffic Accident Causation in Europe, FP6-IST Project 027763
4. M.C. Simon et. al., Intersection Road Accident Causation: A European View, Paper presenting results of the TRACE project, ESV Paper 09-0370
5. PEDESTRIANS, Development of a comprehensive service of pedestrians protection by the definition of new test procedures more representative than the current ones IDIADA 2009
7. Fredriksson and Rosén Ircobi 2010
8. "INTEGRATED PEDESTRIAN COUNTERMEASURES" Rikard Fredriksson and E. Rosén1 IRCOBI Conference - Hanover (Germany) - September 2010
9. Lawrence, et al., A study on the feasibility of measures relating to the protection of pedestrians and other vulnerable road users, 2006. Project Report UPR/VE/045/06 under Contract No. ENTR/05/17.01 to the European Commission
Also countries are aware of the environmental problems generated by motorised traffic in cities and encourage the development of non-motorised traffic in order to improve living conditions for both road users and urban residents. This aim cannot be reached unless safety conditions cease to be a deterrent to walking and cycling.

**C) Strategic and economic impact of AsPeCSS**

The cost of road accidents is in the order of 130 billion Euro in 2009. The sums spent on improving road safety fail to reflect the severity of the situation outlined above. Efforts to prevent road accidents are still inadequate, corresponding to less than 5% of the total costs of those accidents, i.e. EUR 8 billion. As argued in the previous section, AsPeCSS could significantly contribute to improving road traffic safety and herewith contribute to the reduction of the societal cost of road accidents.

Another important economic (and employment) impact is the preservation of the competitiveness of Europe’s automotive industry. The automotive sector spends over €20 billion per year on research and technological development (RTD), making it the largest private investor in RTD in Europe. It directly provides 1.9 million direct jobs and a further 10 million indirect jobs in Europe. It has an annual turnover of €489 billion and represents 3% of the European Union’s GDP.

**Impact to vehicle manufacturers**

Europe’s car industry has a 32% share of the world market. Europe has its unique opportunity for EU-automotive industry to reinforce its innovation leadership by supporting Europe as place for ‘centre of innovation and technology’ and by proposing harmonized regulations/assessment to the global automotive industry. Growth through innovation creativity and technology is the only viable route to a healthy and sustainable automotive future. Within the project, there is established a beneficial cooperation with Toyota to get a connection with the Japanese market where pedestrian accidents cause a big amount of 34.9% of all accidents fatalities. Compared to Europe this is a 2 times higher value (in Europe 17% fatalities by pedestrian accidents). So we can find our studies to a wide spread data basis. Our target is to improve the sustainability of our cars, especially for vulnerable road users, in all of our sales markets. This target is emphasized by European an Japan OEMs. The connection to Japan OEMs is therefore highly appreciated to harmonize the requirements on future preventive protection systems.

By offering the ability to integrate knowledge & resources in order to design cost-effective (i.e. competitive) and safer vehicles and in line with current and future pan-European vehicle safety regulations, AsPeCSS will contribute to the reinforcement of competitiveness of the EU-automotive industry and their suppliers and preservation of employment in this important sector.

The main innovation of AsPeCSS are the results related to a test method suitable to evaluate the overall safety performance of a vehicle to vulnerable road users in particular pedestrians, including the pre-crash performance and the crash performance of the vehicle. At present, only the passive safety performance of a vehicle has to meet certain requirements and is evaluated in regulatory and consumer tests. With the increased market launch of advanced safety systems, also such systems must be considered in the overall safety rating of a vehicle. AsPeCSS will take steps to make this happen for pedestrian safety related systems. As a result public awareness could be increased herewith creating demand – and willingness to pay for – such systems and the cars that have them onboard.

**Impact to safety system suppliers**

The total EU market size of frontal restraint systems was about 2.8 billion Euros in 2003, and is expected to grow to over 3.0 billion Euros by 2010. Systems for frontal collisions (airbags and seat belts) form the largest portion, covering over 2.0 billion Euros by 2010. There is a downward trend in revenues from these systems because of strong competition among suppliers and the fact that increasing the safety of vehicles to higher levels becomes more and more difficult (meaning higher investments in research and development). This average price decline, however, is slowing down due to advancement in technologies e.g. intelligent airbags.

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13 OECD (Organisation for Economic Co-operation and Development), Safety of Vulnerable Road Users, Report by scientific expert group on the safety of vulnerable road users (RS7), August 1998

14 Number taken from Reference 3 Based on the value of a statistical life calculated by the HEATCO study (6th Framework Programme for Research and Technological Development).

15 CLEPA European Association of automotive suppliers paper; Education, Training and Learning to Increase Competitiveness in the Automotive Industry 2005
pre-crash activated seatbelts etc. AsPeCSS can provide valuable insight on the efficient active-passive system integration (for the particular case of protection of vulnerable road users). But above all harmonising test procedures on new vehicle safety systems which will reduce development efforts and time to market. This will accelerate market implementation of these systems and consequently growth and market demand. Also the risk for investment in new technologies/products can be significantly reduced when the technical requirements are clearly known: this is one of the most important outputs of AsPeCSS.

**Impact to test & assessment tools suppliers**
Evaluation of integrated pedestrian safety systems (in particular pre-crash sensing systems), that are currently being developed will require new tools and installations. AsPeCSS will result in design specifications of test tools for the evaluation of pedestrian safety, remote sensor systems and crash performance at reduced impact speed. Main goal is to arrive at standardized test tools based on experiences gained with prototypes developed in the project. Currently, no standardized tools exist. The market for dedicated equipment for the evaluation of pre-crash and crash performance of such systems is estimated at 75 MEuros worldwide, including hardware and numerical tools.

**Impact to RTD parties**
RTD parties in automotive safety have dedicated crash facilities. In 2003, the first pre-crash test facilities have been developed and in use. These facilities are and will increasingly be used for the assessment of pre-crash safety systems, including pedestrian protection systems. As no harmonised assessment methodology for pre-crash pedestrian safety system exists yet, this type of testing is below the explicit need for balanced assessment of in-crash and pre-crash protection of vulnerable road users. AsPeCSS will come with this methodology, the test tools and the laboratory requirements, needed to raise this type of assessment to the needed level, shown by the OEM developments.

The RTD development activities of dedicated sensor systems, based on radar, vision and lidar systems, for the detection of pedestrian and other VRU such as cyclists will increase and gain efficiency as soon as standardized test methods will be available. In addition, the main public will be informed objectively about the effect of these systems. The new sensor systems will be used for avoidance (braking / steering), mitigation (braking) actions and to trigger passive measures such as pop-up devices and airbags.