APROSYS

Advanced Protection Systems

**Funding:** European (6th RTD Framework Programme)

**Duration:** Apr 2004 - Mar 2009

**Status:** Complete with results

**Total project cost:** €29,962,960

**EU contribution:** €18,000,000

**Call for proposal:** FP6-2002-TRANSPORT-1

**CORDIS RCN:** 74297

**Background & policy context:**

The decrease in the number of road transport fatalities and increase in the number of injuries and increasing number of road accidents observed in the late 1990s and early 2000s can, amongst other things, be explained by the introduction of improved technologies for newer vehicles and higher vehicle safety standards.

The European Commission has continuously supported new developments in vehicle safety through subsequent framework projects and other safety initiatives. The FP6 Work Programme was no exception and called for new initiatives for increasing road, rail and waterborne safety.

**Objectives:**

The main objective of this Integrated Project (IP) on Advanced Protection Systems (APROSYS) was to improve passive safety for all European road users in all relevant accident types and accident severities. The secondary objective was to increase the level of competitiveness of the European automotive industry.

The project focused on scientific and technology development in the field of passive safety (crash safety). The field of passive safety concerns in particular human biomechanics (injury mechanisms and criteria), vehicle and infrastructure crashworthiness and occupant and road user protection systems. The goal of APROSYS was to develop and introduce critical technologies that improve passive safety for all European road users in all relevant accident types and accident severities.

The specific objectives of APROSYS were:

1. New injury criteria and injury tolerances;
2. New mathematical models of the human body;
3. New world-wide harmonised crash dummy;
4. New knowledge and tools for intelligent safety systems;
5. Enhancement of virtual testing technology;
6. New test methods (for advanced safety systems);
7. Advanced protection systems for injury reduction in most relevant accident types.

**Methodology:**

APROSYS approached the project in nine inter-connected sub-projects (seven of which were technical), as follows:

**SP1: Car accidents:**

- development of (harmonised) test and evaluation methods that will guide safety design and improve car occupant safety;
- development and demonstration of advanced safety technologies for the improvement of car
occupant safety.

**SP2: Heavy vehicles (HV):**
- evaluation methods and advanced protection systems for heavy vehicles;
- development of HV Aggressivity Index and pedestrian/cyclist friendly design strategies and concepts.

**SP3: Pedestrian/Cyclist accidents:**
- evaluation methods and advanced protection systems for cars, MPVs (Multi-Purpose Vehicles) and SUVs (Sport Utility Vehicles) to protect pedestrians and pedal cyclists;
- test methods for vehicle front ends to assess pedestrian, vehicle based pedestrian and pedal cyclist safety technologies and material models for laminated materials.

**SP4: Motorcycle accidents:**
- evaluation methods and advanced protection systems for powered two-wheelers;
- motorcycle crashworthiness structure, motorcyclists advanced protection systems and forgiving road infrastructure behaviour.

**SP5: Biomechanics:**
- new knowledge on injury mechanisms and corresponding injury criteria and tolerance levels;
- focus on head injuries, new injury criteria for front & side impact and small female side impact dummy.

**SP6: Intelligent safety systems:**
- knowledge and tools enabling the design, implementation and evaluation of intelligent safety systems that improve the crash safety of vehicles;
- development of a pre-crash system with sensors, algorithms and actuators for side impact.

**SP7: Virtual testing:**
- tools and methods for design and evaluation of advanced crash protection systems by numerical simulations;
- modelling technologies for critical issues, stochastic crash simulation models and virtual testing procedure for existing and new regulations.

The two non-technical sub-projects, SP8 and SP9, dealt with Training and Innovation, and Project Management respectively.

**Related Projects:**
- PReVENT (EU FP6 project)
- IMVITER, EuroFOT, ASSESS, AsPeCSS and SAFERIDER (EU FP7 projects)
- SaveCAP (Dutch national project)

**Parent Programmes:**
- FP6-SUSTDEV-2 - Sustainable Surface Transport

**Institute type:** Public institution
**Institute name:** European Commission
**Funding type:** Public (EU)

**Lead Organisation:**

Nederlands Organisation For Applied Scientific Research

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| Siemens Ag                       | Wittelsbacherplatz 2
80333 MUENCHEN
Germany                   | [http://www.siemens.com](http://www.siemens.com)                        |
| Politecnico Di Torino            | Corso Duca Degli Abruzzi
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| Technische Universiteit Eindhoven | Den Dolech
5612 AZ Eindhoven
Netherlands                  | [http://www.industrialdesign.tue.nl](http://www.industrialdesign.tue.nl) |
| Fundación Para La Investigación Y Desarrollo En Automoción | Parque Tecnológico de Boecillo, P.209, Boecillo
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Czech Republic               | [http://www.skoda.cz](http://www.skoda.cz)                             |
| To Be Defined                    | Crowthorne House Nine Mile Ride
WOKINGHAM
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<th>Organisation Name</th>
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<td>Partnership For Dummy Technology And Biomechanics</td>
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<td>Toyota Motor Engineering &amp; Manufacturing Europe</td>
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<td>Federation Of European Motorcyclist' Associations</td>
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<td><a href="http://www.fema.ridersrights.org">http://www.fema.ridersrights.org</a></td>
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<td>Bolton Institute Of Higher Education</td>
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<td>Centro Ricerche Fiat - Societa Consortile Per Azioni</td>
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http://www.renault.com |
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<p>| Hierros Y Aplanaciones S.a.                      |                                                                          |                                                  |</p>
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<td><a href="http://www.zcu.cz">http://www.zcu.cz</a></td>
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<td>Cranfield Aerospace Limited</td>
<td>Crandfield University Campus Hangar 2</td>
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### Technologies:

- Safety systems
- Vulnerable road users' protection systems

**Development phase:** Research/Invention

### Key Results:
The project produced nine major results, as follows:

1. **New human body mathematical models**, where a significant step forward has been achieved in demonstrating that this technology is mature enough to be used for product development even though their use for regulatory purposes is still some way off. Additionally, several basic studies were undertaken to produce fundamental data such as soft tissue properties and knowledge on injury mechanisms that could not yet be included in the models within the project but which could be used in the future. Other developments were made that can be directly implemented, including the provision of up-to-date human models on the three crash software codes represented in the consortium. Lastly, the whole-body model was used to evaluate the injury risk sustained by motorcyclists in impact against road barriers and improved model based head injury criteria have been used for a new pedestrian head impact proposal, and also for longer term helmet standard evolution.

2. **WorldSID 5th percentile female dummy for side impact**. Scaling methodologies were used for development of injury risk functions to be used with the WorldSID 5th small female dummy. The risk functions were also used in a new side impact test method for comparison of injury risk between different dummy types and occupant sizes. The WorldSID 5th has been used within the project and results from testing are to be taken further by the WorldSID task group in the evaluation of this new dummy.

3. **Side impact protection system for car occupants**. The side impact protection system for car occupants employs pre-crash technology in order to offer an optimal protection potential. Collaboration with PreVEnT, an FP6 project studying advanced sensing technologies, was undertaken through a joint seminar and identified possible synergies in the fields of sensor fusion techniques, tracking algorithms and accidentology. Additionally, an actuator for the side impact protection system was developed using finite element simulation of a side crash. Lastly, for evaluation, a generic assessment methodology for advanced safety systems was applied and feedback was given back in terms of system feasibility and applicability.

4. **Generic assessment methodology for advanced safety systems**. The generic evaluation methodology is intended to be applicable to a wide range of advanced safety systems and describes the different steps that should be taken in the development of a performance.

**Technical Implications**

Several of the APROSYS results are being taken further by the partners, in some cases in terms of directly marketable products, for example an updated helmet and the thorax protector, both for motorcyclists, and the small female dummy for side impact in the WorldSID 5th. This dummy currently is in a worldwide harmonisation process.

Knowledge and experience gained in the development of the advanced side impact system are being taken further by partners in new, customer related projects, with many issues likely to be further addressed by Euro NCAP, EEVC (European Enhanced Vehicle Safety Committee) working groups and other international bodies, indeed discussions on several specific topics will continue after the official end date of the project, by 'dedicated champions' representing APROSYS. These include the Generic Assessment methodology, the Advanced side impact test method, the Full width frontal test for Europe, the specific test methods for pedestrians, cyclist and motor cyclist, application of the Aggressivity Index for heavy vehicles and the implementation of virtual testing in regulation.

New FP7 projects are also continuing to develop many of the APROSYS results, including IMVITER (virtual testing), EuroFOT, ASSESS fully focusing on the Generic Assessment methodology, and SAFERIDER.

**Policy implications**

The project furthers research that feeds into, justifies, and seeks to fulfil a number of current policies and directives. For example the reduction of road casualties as put forward in the European Commissions, Programme for 1997-2001: 'Promoting Road Safety in the European Union', which advocated a cost-benefit approach in the formulation of future road safety policy, establishing that there is economic justification for taking measures costing up to one million Euros in order to save a single life.

The more recent European Commission 'White Paper for Transport', calls for a reduction in the numbers of deaths on the road by half, specifying the responsibility of the European Union and the role of new technologies to achieve this. Reduction of the risk and severity of injuries in accidents by means of vehicle and other safety technologies, being the scope of APROSYS, is one of the most effective strategies to reduce the road safety problem.
STRIA Roadmaps:
Cooperative, connected and automated transport, Vehicle design and manufacturing

Transport mode: Road transport
Transport sectors: Passenger transport, Freight transport
Transport policies: Safety/Security, Digitalisation
Geo-spatial type: Other