HELISAFE TA

Helicopter Occupant Safety Technology Application

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

**Duration:** Mar 2004 - Nov 2007

**Status:** Complete with results

**Total project cost:** €4,753,598

**EU contribution:** €2,699,999

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

**CORDIS RCN:** 72784

**Background & policy context:**

Helicopters are unique in the variety of tasks they can perform and in the types of sites at which they can be carried out. The highest risks of accidents occurring is mainly when lifting off, landing and due to critical manoeuvres at low altitude, often in bad weather conditions. On the other hand the occupant has a great chance of surviving when flying close to the ground at low velocity. To date most of the work on helicopter safety has been concentrated on preventing technical failures and crashworthy design for airframe structures (absorbing elements in the sub floor, landing gear and seats). Nevertheless today’s safety equipment in helicopter still consists of passive harnesses and vertical energy-absorbing seats in new helicopters, which can not reduce the risk of fatal or severe injuries, especially if the impact loads are higher. Since crashworthy structural concepts are now well established, attention has been turned to increased occupant survivability in helicopter crashes based on cockpit and cabin safety through interacting advanced safety equipment. The approach to occupant safety was studied in the European Research Project HeliSafe TA based on these aspects of helicopter safety.

**Objectives:**

The HELISAFE TA project aimed to improve the survivability of occupants in case of helicopter crashes and to minimise the risk of severe injuries in both cockpit and cabin.

The scientific issues concerned a better understanding through full-scale tests and computer modelling of helicopters crash dynamics to improve the knowledge of human body limits and injury criteria. In detail these were:

- improve understanding of the overall crash behaviour of the helicopter structure with regard to the occupant, not only the cockpit / cabin in a rigid environment;
- development of appropriate prediction tools, which need to cover the total airframe behaviour, the cabin and occupant in a crash;
- develop supplemental realistic aviation related injury criteria with focus more on the whole occupant;
- application of previous research technology of HELISAFE to further improve the survivability and mitigate severe injuries like offset, second and third impact, side impact effects;
- improve knowledge of the detailed course of helicopter accidents, by the motion analysis of occupants and resulting contacts with the cabin structure;
- consider intelligent crash management concepts able to predict an accident, choose the necessary safety devices before and during a crash and identify post crash scenarios;
- transfer the high level of passive / active safety standard of automobiles into occupant safety in helicopters and tilt rotors and later into fixed wing aircraft;
- make airworthiness recommendations for certification requirements in the future.

The technical objectives can be summarised as follows:

- adaptation of advanced automotive technology where possible and validation of the concepts;
• develop supplemental passive / active restraint systems to protect occupants independent of their weight, size and seat position;
• develop a modified FAA hybrid III dummy (including hardware and instrumentation) appropriate for helicopter crashes;
• integration of safety features (active / passive) into the seat - harness system to get a modular occupant safety system easy for retrofit in new and / or current helicopter types;
• evaluate intelligent adaptive structure elements which either do not exist or need significant improvements regarding the fuselage;
• assess the effectiveness of proposed safety concepts and equipment by using the HELISAFE HOSS concept

Methodology:

Specification:
The overall spectrum of real world helicopter accidents was studied in this project, in order to define a relevant and representative crash scenario to be carried out in a full-scale drop test. The effects of the helicopter interior and the different seat arrangements were investigated. Supplemental injury probabilities are to be determined to improve the possibilities for self-evacuation, especially in the risk of post-crash events. A realistic crash pulse and loads will be defined, comparable to real world scenarios to determine the improvements for proposed safety equipment.

Development/ Research:
Improved safety equipment hardware was defined and produced to carry out all planned experimental static and dynamic tests. Standard dummies were appropriately modified for helicopter crashes, for injury assessment and critical occupant size. All hardware configurations were transferred to numerical models. A crash sensor/sensor network and an electronic control unit (ECU) applicable for dynamic crash tests was specified.

Analysis/ Innovation:
The safety analysis and simulation tool concept (HOSS - Helicopter Occupant Simulation Software concept) is to be optimised to cover the interaction of all relevant safety equipment, in particular to extend the modelling capability to include the more complex cabin and cockpit systems, extended safety system concepts and more complex crash scenarios. Use of the analysis methods will be made to define an active/passive occupant safety concept for helicopters, by performing parameter studies and assessment regarding effectiveness of injury mitigation.

Testing:
Newly developed safety equipment, interfaces and mock-ups are to be manufactured for a generic helicopter cockpit and cabin to perform all experimental static and dynamic tests. Data will be collected and feedback will be supplied for validation of the simulation tools technology.

Assessment:
Relevant data is collected to evaluate the HeliSafe TA results concerning transferability to fixed wing aircraft. The authorities will be supported on their decision process for future rule making on how the proposed safety concept could be introduced in existing/future helicopters.

Parent Programmes:
FP6-AERO-1.3 - Improving aircraft safety and security

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

Lead Organisation:

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<tr>
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Organisation Website: [http://WWW.AUTOFLUG.COM](http://WWW.AUTOFLUG.COM)
EU Contribution: €0
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<td>6060 DELFT</td>
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Via Maiorise s/n
81043 CAPUA (CE)
Italy

Organisation Website:
http://www.cira.it
EU Contribution: €0

Deutsches Zentrum Fr Luft Und Raumfahrt E.v

Address:
Linder Hhe
12489 KLN
Germany

Organisation Website:
http://www.dlr.de
EU Contribution: €0

Eurocopter

Address:
Aéroport International Marseille-Provence
BP 13 MARIGNANE
France

Organisation Website:
http://www.eurocopter.com
EU Contribution: €0

Eurocopter Deutschland GmbH

Address:
Industriestr. 4
86607 DONAUWOERTH
Germany

Organisation Website:
http://www.eurocopter.com
EU Contribution: €0

Politecnico Di Milano

Address:
Piazza Leonardo Da Vinci 32
20133 Milano
Italy

Organisation Website:
http://www.polimi.it
EU Contribution: €0

Siemens Restraint Systems GmbH

Address:
Carl-Zeiss-Strasse 9
ALZENAU
Germany
EU Contribution: €0
**Key Results:**

Within the duration of HeliSafeTA the main achievements have been:

- Definition of a crash scenario suitable to carry out a drop test with a full scale helicopter structure;
- Execution of a baseline full-scale drop test to establish injury levels with standard safety equipment and to get realistic accident data;
- Definition of an advanced Helicopter Occupant Simulation Software (HOSS) concept, in particular to extend the modelling capability to include the more complex cabin and cockpit systems, extended safety system concepts and more severe crash scenarios;
- Definition of an enhanced HeliSafe FAA Hybrid III hardware dummy with enhanced instrumentation for injury assessment under severe crash loads. Determination of a nonstandard dummies (95th percentile) representing the critical occupant size appropriate for helicopter crashes;
- Execution of baseline sled tests to determine the state-of-the-art technology in order to compare later the improvement of HeliSafe TA designed safety equipment;
- Development of an enhanced restraint system consisting of harnesses, airbags and seats;
- Perform parameter studies in order to get an enhanced occupant safety system with high crash survival capabilities;
- Conducting final sled tests to confirm the effectiveness of the enhanced HeliSafe TA safety equipment;
- Definition and prototyping of a crash sensor system including Electronic Control Unit (ECU);
- Execution of a final full-scale drop test to assess and validate the achieved improvement of the safety equipment developed in HeliSafe TA;
- Assessment of helicopter safety improvements based on simulation and hardware tests;
- Assessment of the HeliSafe TA results with respect to transferability to fixed wing aircraft;
- Airworthiness recommendations for future helicopters. If required, authorities will be supported in their rule making process;
- Implementation strategy plan for HeliSafe TA advanced technology.

**Technical Implications**

After finalisation of the project, the results may set new standards for aviation safety systems resulting in new specifications. Since US competitors started intensifying their research on pilot/passenger survivability some time ago, European helicopter manufacturers also have to address this subject in order to remain competitive.

With the knowledge they have gained, the research facilities in HeliSafe TA are now able to assess the level of safety as a centre of excellence for a broad variety of helicopter users. They will be able to predict the behaviour of a HeliSafe TA Integrated Safety System in a given environment in order to stay below advanced HeliSafe TA injury criteria thresholds which have to become the standard by aviation authorities.

Strengthening the European aeronautical industry this way will create new jobs which will have a positive influence on social and economic conditions. Spin offs of the new technologies may be used in other applications such as, but not limited to, inflatable passenger restraint systems in helicopters or general aviation aircraft with a broad application.

Documents:
- [Publishable Final Activity Report Period (Final report)]

**STRIA Roadmaps:** Vehicle design and manufacturing
- Water transport (sea & inland)

**Transport sectors:** Passenger transport, Freight transport
- Decarbonisation, Societal/Economic issues,

**Transport policies:** Safety/Security

**Geo-spatial type:** Other