EASA’s Research Activity for Safety Improvement

General Aviation and European Air Transport System

Third Call FP 7

7-8 July 2009

WARSAW, Institute of Aviation (IoA)

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Mandate for Research Activities

Basic Regulation 216/2008 Article 26 (former 1592/2002, Article 17):

1. **The Agency may** develop and finance research to improvement its activities in the its field of competence,

2. **The Agency shall** coordinate its research and development activities so as to ensure that policies and actions are mutually consistent,

3. **The results of research shall** be published.

» Article 5: Airworthiness  
Article 7: Pilots  
Article 8: Air Operations  
Article 17: Agency’s tasks  
Article 19: Opinions, CS and GM  
Article 22: Air Operations

“... taking into account the latest scientific and technical evidence ... “
Mandate for Research activities

Two fields of research activities

▶ Short term research in support of safety improvement
  ★ Defined and financed by the Agency
  ★ Managed by Executive Directorate (Safety Analysis and Research Department)
  ★ Additionally pre-normative studies by Rulemaking Directorate in support of rulemaking activities

▶ Long term research
  ★ Financed e.g. by EU Framework Programmes and MS
  ★ Results and finale „market ready“ product available in some distant time
Sources of research proposals

- Safety analysis/occurrence reporting
- Accident Investigation Reports & Safety Recommendations
- Experts from EASA Directorates
- ESSI / Safety Team (ECAST, EGAST, EHEST)
- European Aviation Research Partnership Group (EARPG)
- others
European Aviation Safety Agency

Research Coordination and Partnership

- Internal Research Committee
- EC DG RTD and DG TREN, ACARE
- European Aviation Research Partnership Group (EASA, ESSI and Safety Teams, NAAs, EC, EUROCONTROL)
- Helicopter Safety Research Management Committee
- EASA/FAA/TCCA research cooperation
- Industry and research institutes
European Aviation Safety Agency

Example Project Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

- **EASA/2007/OP 18:** Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System
  - Contractor: Technische Universität Braunschweig, Institute for flight Guidance (DE)
  - Final Report approved March 2009

- **Objectives:**
  - **Feasibility of an integrated FDM system on light aeroplanes** (low cost system, < 5000 €; < 2 €/h data analysis)
  - **Demonstrate potential safety benefit**
    - Detection of unusual behaviour or situations that may be hazardous;
    - Identification of potential problems where safety margins may be eroded;
    - Means to observe the history of a flight and show the boundaries of safe flight;
    - Provision of data for the investigation of specific incidents;
    - Automatic detection of abnormal situations;
    - Support training, maintenance, accident investigation.
Example Project  Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

Safety benefit cycle

- Pilot
- Flight Data Monitoring
- Analysis
- Assessment
- A/C
- Feedback
Example Project  Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

Block diagram for FDM system

- Engine electrical output
- Pitot-Static
- Controls
  - Pressure sensors
  - Control sensors
  - Data link for maintenance

- GPS
- Heading
- IMU
- Data acquisition
- Internal data storage for expert use
- Data storage for pilot use
- Removable after each flight

FDM system
Example Project  Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

Initial flight test

- focus on comparison of precision and low-cost sensors

- pressure

- GPS

- Inertial measurement unit (IMU)

<table>
<thead>
<tr>
<th>low cost sensors</th>
<th>high accurate sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>engine parameter</td>
<td>wind vanes</td>
</tr>
<tr>
<td>GPS</td>
<td>GPS</td>
</tr>
<tr>
<td>IMU</td>
<td>IMU</td>
</tr>
<tr>
<td>pressure transducer</td>
<td>pressure transducer</td>
</tr>
<tr>
<td>web-cam</td>
<td>angle sensors control surface</td>
</tr>
</tbody>
</table>

~1350 € ~85000 €
**Example Project**  Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

**Initial flight test**

- Precision IMU
- Low-cost IMU
- Angle sensors
- Pressure transducer
- Engine parameter
- Video camera
- Wing boom with flow angle sensors and Pitot-Static probe
- Data acquisition computer
- Precision pressure transducer

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**Example Project**  Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) System

**FDM safety benefit**

- **Realistic for less than 5000 €**
- **Pilots:** self analysis, student training
- **Operator:** supervision a/c operations, fleet statistics, maintenance
- **All:** accident investigation
- **Legislation:** data base
Example Project
Safety aspects of Light Aircraft Spin Resistance

- **EASA/2008/OP 03:**
  Safety aspects of Light Aircraft Spin Resistance Concept
  - Contractor: Technische Universität Braunschweig, Institute for flight Guidance (DE)
  - Approval of Final Report: End of 2009

- **Objectives:**
  - Primary objective:
    Investigate safety criteria and relevant test methods which will form the fundamental basis for proposing a change to CS-23.221 and any additional explanations for inclusion as interpretive Advisory Material (AMJ) and Flight Test Guide material.
  - Demonstrate the criteria are satisfactory by testing an existing spin resistant aircraft.
  - Secondary objective:
    Increase awareness of the design concept within European industry, and to stimulate European designs.
European Aviation Safety Agency

Example Project
Safety aspects of Light Aircraft Spin Resistance

Position of stall/spin related accidents

+ accidents with SR20/22
× accidents with other aircraft
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949</td>
<td>Elimination of mandatory spin training from US regulations</td>
</tr>
<tr>
<td>70ies</td>
<td>Extensive research by NASA on Spin Resistance</td>
</tr>
<tr>
<td>80ies</td>
<td>Implementation of Spin Resistance into FAR23</td>
</tr>
</tbody>
</table>
| 1991 | 3 options of certification:  
- spin recoverable  
- incapable of spinning  
- spin resistant |
| 1996 | Option "incapable of spinning" removed |
Possible solution

- Revised spin resistance paragraph:
  - Spin recoverable after "any input"
  - Improved representatives of operational situations
  - Maximum loss of height while recovery: 300ft
  - Probable manoeuvre:
    - PWR 30..50%, bank 30deg, speed rate 5kn/s, rudder +30..50%,
      full aileron against direction of turn

- Improved stall warning (Conventional spin testing necessary)
- True envelope protection (No spin testing necessary)
**EASA/2008/OP 34:**
SIoBiA - Safety Implication of Biofuels in Aviation

- Selected contractor: Fachhochschule Aachen
- Approval of Final Report: End 2009

**Objectives:**
- Evaluate danger potentials originating from potentially increased ethanol content in MOGAS, especially
  - Vapour locking
  - Materials incompatibilities, e.g. tank, seals, pipes
  - Phase separation
  - Carburettor icing
- Identify potential advantages for the environment if an increased amount of ethanol would be admixed to MOGAS
Vapour Locking

Accidental rise in vapour pressure if differently ethanol-admixed MOGAS or AVGAS brands are mixed.

Material incompatibilities

Do parts manufactured from traditional materials work for raised levels of ethanol admixtures?
If gasoline accidentally contains much undetectable, solved water before take-off, a phase separation, induced by a temperature drop in the tank, may impose a more severe threat in MOGAS with larger ethanol content.
**Methodology**

- Flight experiments
- Dynamic vapour pressure determination for simulated a/c fuel systems on custom test rig
- Cool-down experiments of water-containing gasolines
- Temperature drop determinations in carburettors of grounded a/c engines, operated with ethanol-admixed MOGAS
Work Packages:
- Literature survey
- Phase separation
- Icing
- Vapour locking
- Material incompatibility
- Life-cycle analysis of biofuels in aviation
- Identification of measurement methods for solved water in fuels
- FMEA
Phase Separation

- Perform flight experiments
  - to get information on realistic temperatures,
  - temperature changes along a mission,
  - vibration levels,
  - tank breathing, pressures

- Chemical analysis
  - of commercially available ethanol blends
  - => Different BOBs (basestock for oxygenated blending) for different EtOH admixtures.

- Turbidity analyses on temperature ranges identified by flight missions for selected ethanol blends:
  - Perform controlled, well-stirred cool-down experiments to identify turbidity points in a repeatable manner.
Long-Term Fuel Composition Changes

Objective:
Determination of fuel quality changes due to long-term storage (up to 6 months, with prior, intermediate and final sample analysis)

- Storage with differing boundary conditions (complete fill, half fill)
- Exposure to environmental influences (temperature changes, solar irradiation, atmospheric pressure)
- Tanks equipped with original venting system
- Experiments performed with E0 and custom-mixed E10
Future Projects

Prior Information Notice PIN on EU web site TED http://ted.europa.eu

- Study on regulation of ground de-icing and anti-icing services in EASA member states
- Aviation fuel under extreme cold weather conditions
- Safety implications from the use of hardware design tools for programmable airborne electronic hardware items
- Pulse oxygen system to protect passengers
- Power reserve for rotorcraft
- De-icing of smaller helicopters
- Significance of pre-load upon impact behaviour of composite structure — composite material equivalence to metallic structure
- Study on sampling and measurement of aircraft particulate emissions — SAMPLE II
- Engine icing — mixed phase and ice crystals conditions
- Water behaviour in fuel under cold temperature conditions
- Suitability of existing minimum performance standards (MPS) for Mode S transponders
- Instrument approach systems on oil and gas platforms
- Composite damage metrics and inspection (high energy blunt impact threat)
More on EASA Internet

- **Research**
  [http://www.easa.europa.eu/ws_prod/g/g_sir_research.php](http://www.easa.europa.eu/ws_prod/g/g_sir_research.php)
- **Procurement**
  [http://www.easa.europa.eu/ws_prod/g/g_procurement_main.php](http://www.easa.europa.eu/ws_prod/g/g_procurement_main.php)

Questions?

Thank You!