FSS on Final Approach

Program Overview

Michel Piers, NLR

Future Sky Safety in a nutshell

- H2020 –Coordinated research & innovation for aviation safety
- EREA Future Sky Initiative
- Two main activities:

    1. *Research into specific safety topics*
    2. *Research coordination*

- 33 partners – research, industry & academia
- Duration: ~~48 months~~ 54 months
- Budget: 25M€ budget (15 M€ EU)

Connecting to European Safety Strategies

Consortium

FUTURE SKY SAFETY

nlr
DLR
ONERA
THE FRENCH AEROSPACE LAB
CEiiA
CIRA
Centro Italiano Ricerche Aerospaziali
csem
INTA
VZLU
FOI
EUROCONTROL
Civil Aviation Authority
AIRBUS
AN EADS COMPANY
AIRBUS
DEFENCE & SPACE
THALES
deepblue
Technische Universität München
Lufthansa
EMBRAER
ЦАГИ
ENAV
BOEING
LSE
THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE
Cranfield
UNIVERSITY
Alenia Aermacchi
A Finmeccanica Company
ZODIAC
AEROSPACE
Bordeaux INP
AQUITAINE
KLM
SKYTEAM
SICTA
ENAV
NAVBLUE
AN AIRBUS COMPANY
LEONARDO
INCAS
AIRBUS
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin
dgac
STAC
European Commission

Progress of the program

1st Workshop
T13

2nd Workshop
T27

3rd Workshop
T47

Period 1 (T0 – T18) | **Period 2** (T19 – T36) | **Period 3** (T37 – T48) | **Extension**

MTR1

MTR2

Final Event
T54

View
FUTURE SKY SAFETY
projects

Project #1

COORDINATION OF INSTITUTIONALLY FUNDED SAFETY RESEARCH

Project #2

DISSEMINATION EXPLOITATION AND COMMUNICATION

Project #3

SPECIFIC SOLUTIONS FOR RUNWAY EXCURSION ACCIDENTS

Project #4

TOTAL SYSTEM RISK ASSESSMENT

Project #5

RESOLVING THE ORGANISATIONAL ACCIDENT

Project #6

HUMAN PERFORMANCE ENVELOPE

Project #7

MITIGATING THE RISK OF FIRE, SMOKE & FUMES

P1 – Research Coordination

180

Number of PhD Thesis

5.000

Employees in aeronautics

6.000

Number of Publications

€ 0,5 Bln

Annual research budget

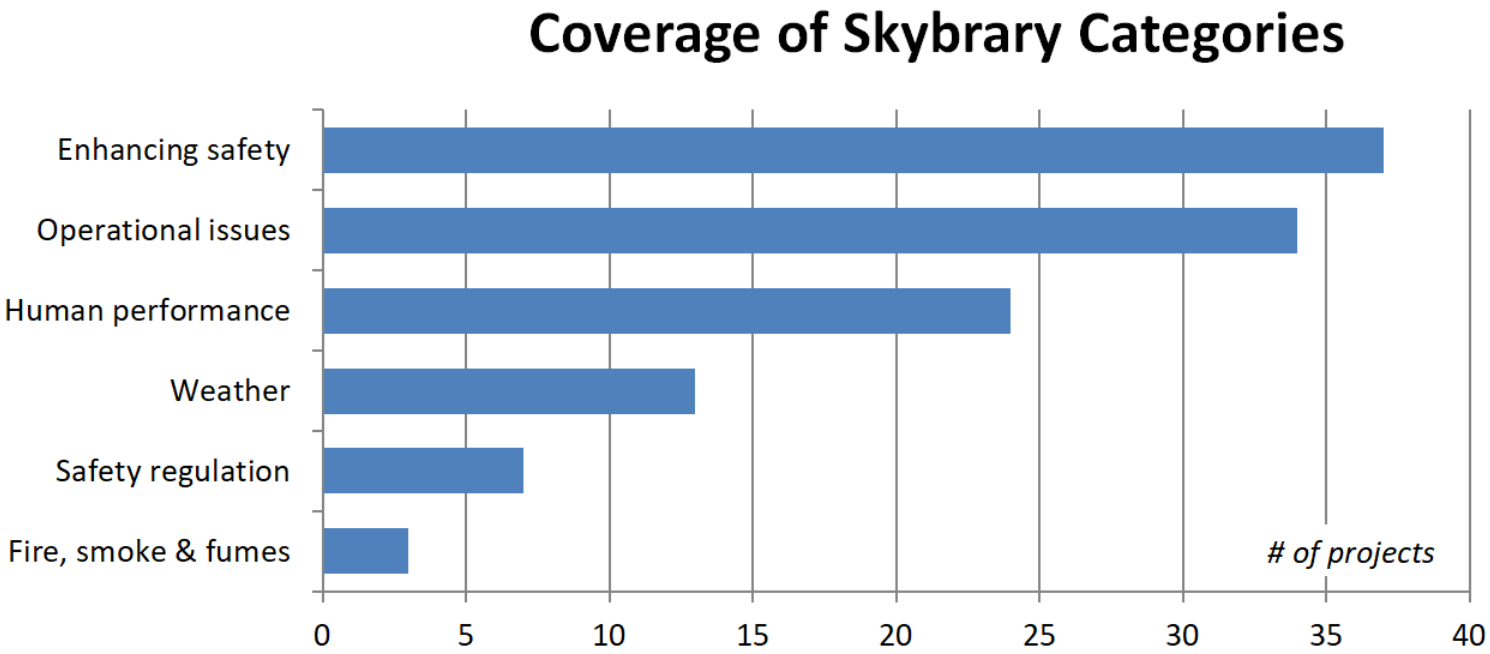
P1 Research Coordination

- Develop and share **Awareness** of the content, results and ambitions of the institutional RE programmes in safety (*Document & platform*)
- **Coordination** of institutionally funded research of the participating Research Establishments in field of safety (*Aviation Safety Research Plan*)
- **Cooperation** in newly initiated institutionally funded projects (*incl. cooperation agreement*)

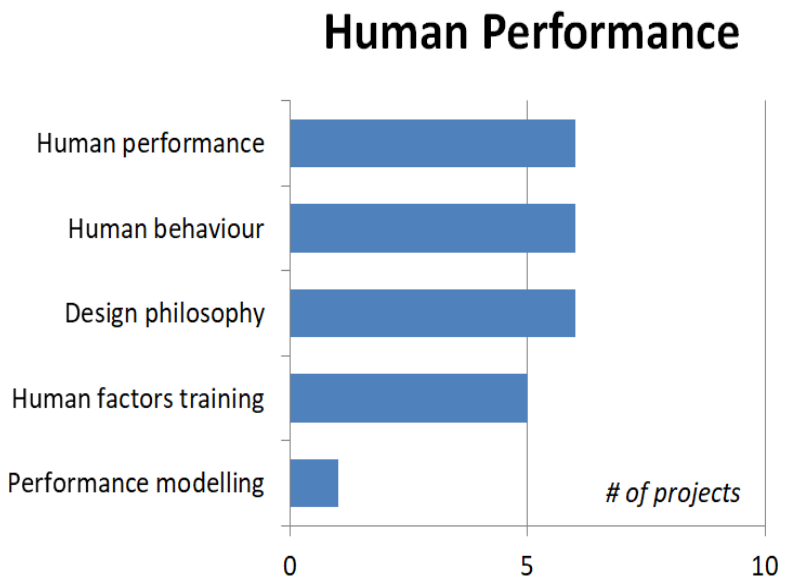
P1 – Results

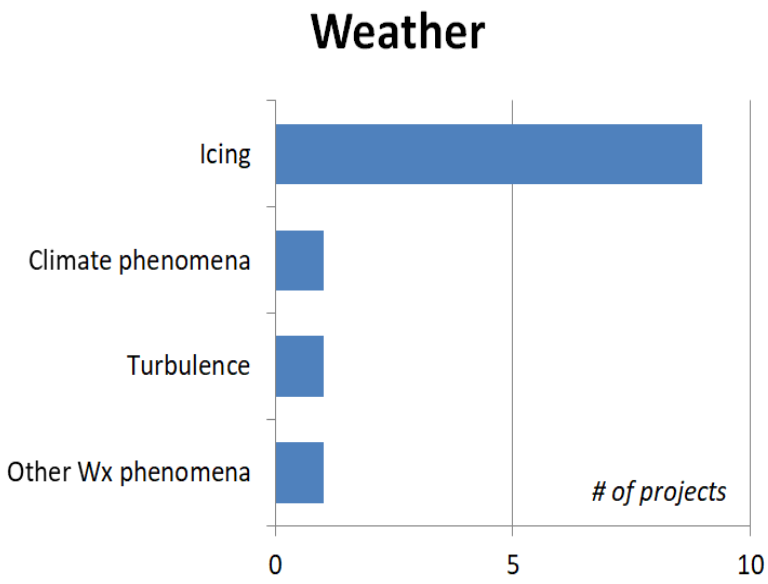
Monitoring of institutionally funded RE research activity:

- 2000 person months (30 M€) per year in safety research



P1 – Results


Human Performance
Human performance
Human behaviour
Design philosophy
Human factors training
Performance modelling
# of projects
0
5
10

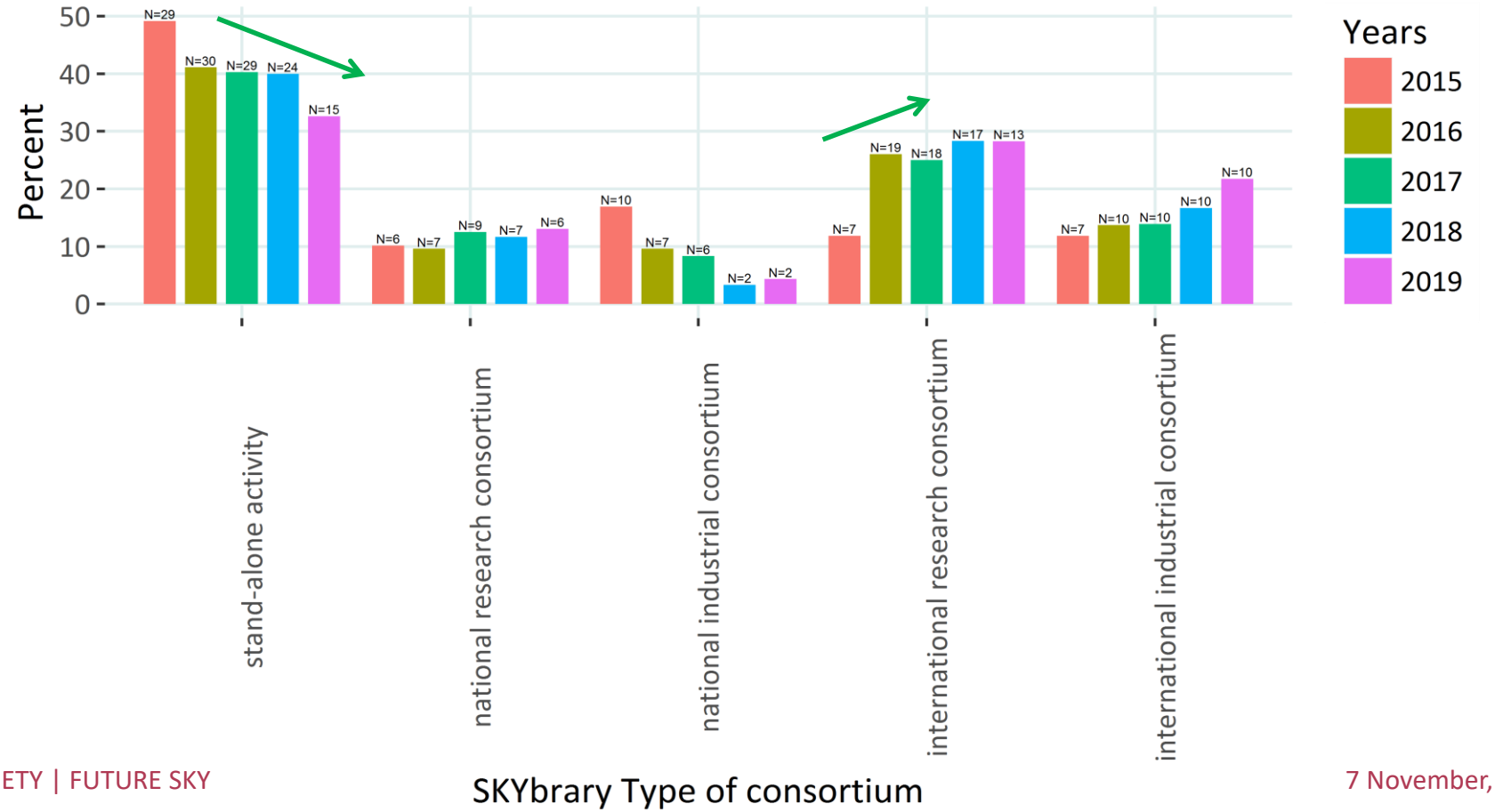

Weather
Icing
Climate phenomena
Turbulence
Other Wx phenomena
# of projects
0
5
10

P1 – Results

Decline in stand-alone activities

Tendency for more international research consortia

} = goal of P1!



P1 – Results

- **3 General Coordination Workshops** (with nearly 100 scientists)
- **14 Workshops / Meetings** organised on specific topics
- **8 cooperation projects** running or already finished
- **225 PM of institutional cooperative safety research** outside EC funding FSS
- **Exchange of personnel** between multiple Research Institutes

Resulting in Coordinated Institutional Activities

2015 and ongoing

- **DLR-ONERA**: HOTAS
- **DLR-ONERA**: ADAWI
- **DLR-NLR**: multiple works

2016

- **DLR-ONERA**: Modelling of operator's behaviour
- **DLR, NLR, ONERA, CIRA**: Aircraft Wake Turbulence
- **DLR-CSEM**: Human Performance Envelope in the ATC Context

2017

- **CEIIA, CIRA, DLR, ILOT, NLR, ONERA & VZLU**: Safety embedded in aircraft design and operations
- **CEIIA, CIRA, DLR, NLR & ONERA**: Helicopter safety
- **CIRA, CSEM, DLR, INCAS, INTA, ONERA & VZLU**: Icing
- **CIRA, DLR, INTA, NLR & ONERA**: Remotely Piloted Aircraft Systems (RPAS) safety (excl. ATM)

2018

- **CIRA, DLR, INCAS & ONERA:** Volcanic ash
- **CEIIA, CIRA, DLR, INTA, NLR & ONERA:** Remotely Piloted Aircraft Systems (RPAS) safety (excl. ATM)
- **CEIIA, CIRA, CSEM, DLR, INCAS, NLR, ONERA & VZLU:** Health monitoring

2019

- Small autonomous electric AC
- Advanced flight envelope protection
- Human Performance envelope
- Mitigating the risk of fire, smoke and fumes
- Remotely Piloted Aircraft Systems (RPAS) safety (excl. ATM)

1st Future Sky Safety Coordination Workshop in Brussels

2nd Future Sky Safety Coordination Workshop at ONERA

3rd Future Sky Safety Coordination Workshop at NLR

P3 Specific solutions for runway excursion accidents

- The European Action Plan for the Prevention of Runway Excursions (EAPRRE) has identified research needs to further reduce risk:

  1) Flight mechanics of slippery runway ops in crosswind,
  2) Impact of fluid contaminants on stopping performance,
  3) Advanced methods to monitor risk factors in flight data.

* Other than ROPS



P3 Objectives

- Improve methods for analysing aircraft ground control on slippery runways under crosswind;
- Quantify impact of water/slush covered runways on braking performance for modern tires and anti-skid systems;
- Develop new methods to identify veer-off risk using operational flight data;
- Explore new concepts* for prevention of excursions and reduction of consequences of runway excursions.

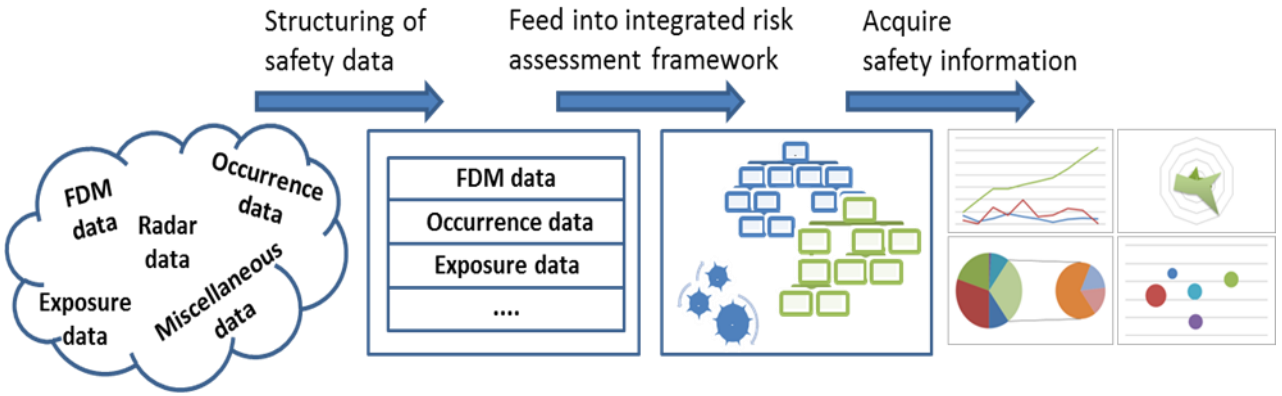
* Other than ROPS

P3 Main Results

- Identification of shortcomings in aircraft ground models
- Real tests on wet/flooded runways (yawed tyre, Citation, Airbus A400)
- Improved models for braking performance
- New algorithms to analyse flight data for runway veeroff risk factors
- New Concepts (CLAS, CORSAIR)
- Several results ready for application

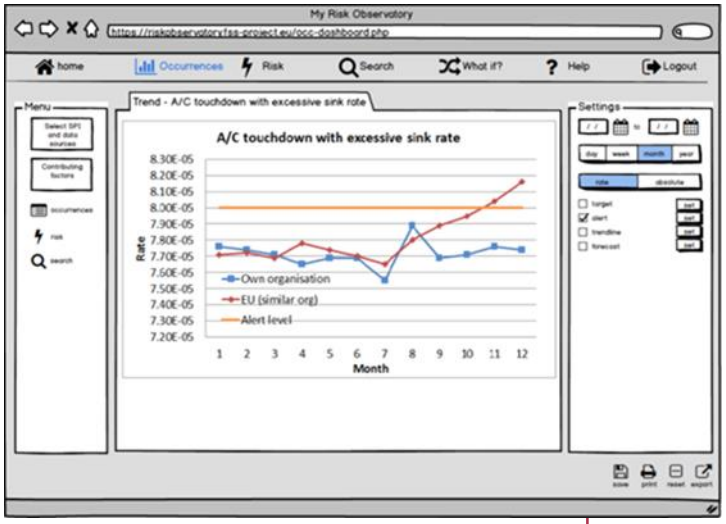
P4 Total system risk assessment

- Adequate means for safety risk assessment and safety performance monitoring of large, complex and dynamic systems of sufficient accuracy and depth not yet available.
- Project builds on progress made in several programs (ASCOS, EUROCONTROL IRP/AIP, FAA-ISAM, ASIAS, CATS-NL) and could develop knowledge in support of Data4Safety initiative.



P4 Objectives

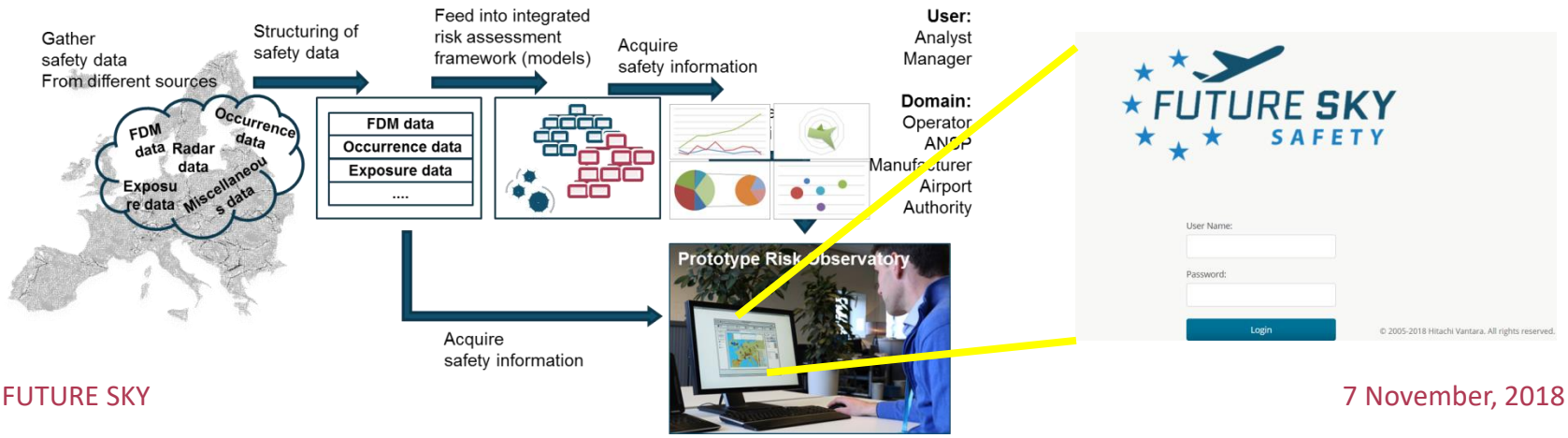
- Develop a risk assessment framework that integrates risk assessment models from different domains.
- Develop a prototype risk observatory as an enabling tool for safety management:
  - Identify business requirements
  - Define user, functional and system requirements
  - Develop preliminary architecture
  - Develop early “look-and-feel” prototype
  - Stakeholder review of early prototype
  - Deliver first total aviation system risk picture



P4 – Main results

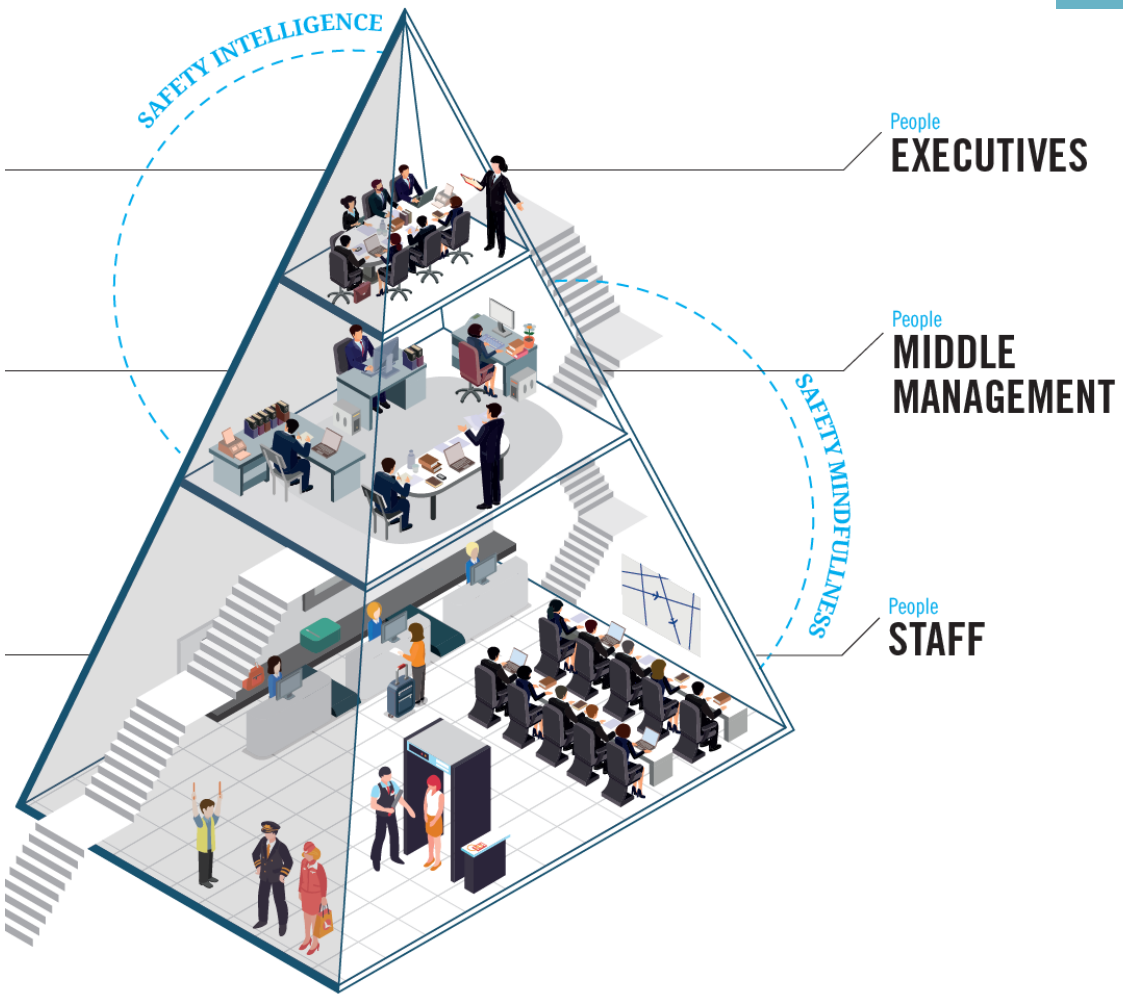
- Developed the business model for a risk observatory with stakeholders
- Developed integrated risk assessment framework
- Delivered the RE (Runway Excursion) and MAC (Mid-Air Collision) backbones models
- Integrating building blocks into a Proof of Concept Risk Observatory:
  - Providing an integrated (aviation) risk picture
  - Showing the contribution to risk from several domains
  - Supporting the safety impact assessment of changes within several domains

(full implementation, maintenance and operational use are beyond program horizon)



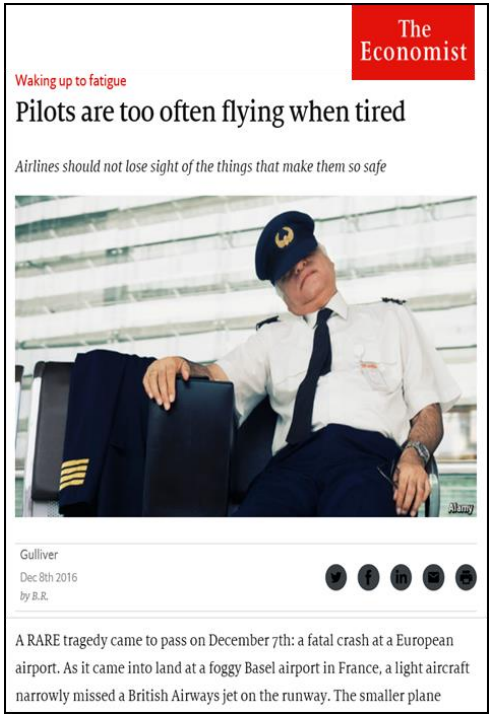
P5 Resolving the organizational accident

- Many accidents in complex systems have their roots in organisational factors.
- With increasing cost pressures, more agile business models, new entrants…
- How do we support aviation organisations in managing this source of risk?



P5 - Objectives

- Develop Safety Intelligence at the Top
- Consider how Safety Dashboards are utilised
- Begin Safety Intelligence for Middle Managers
- Develop and test Safety Mindfulness Concept
- Conduct safety culture surveys
- Develop Agile Response approach
- Integrate these concepts into an an organisational risk management capability within the SMS framework



The Economist

Waking up to fatigue

Pilots are too often flying when tired

Airlines should not lose sight of the things that make them so safe

Gulliver

Dec 8th 2016

by B.R.

A RARE tragedy came to pass on December 7th: a fatal crash at a European airport. As it came into land at a foggy Basel airport in France, a light aircraft narrowly missed a British Airways jet on the runway. The smaller plane

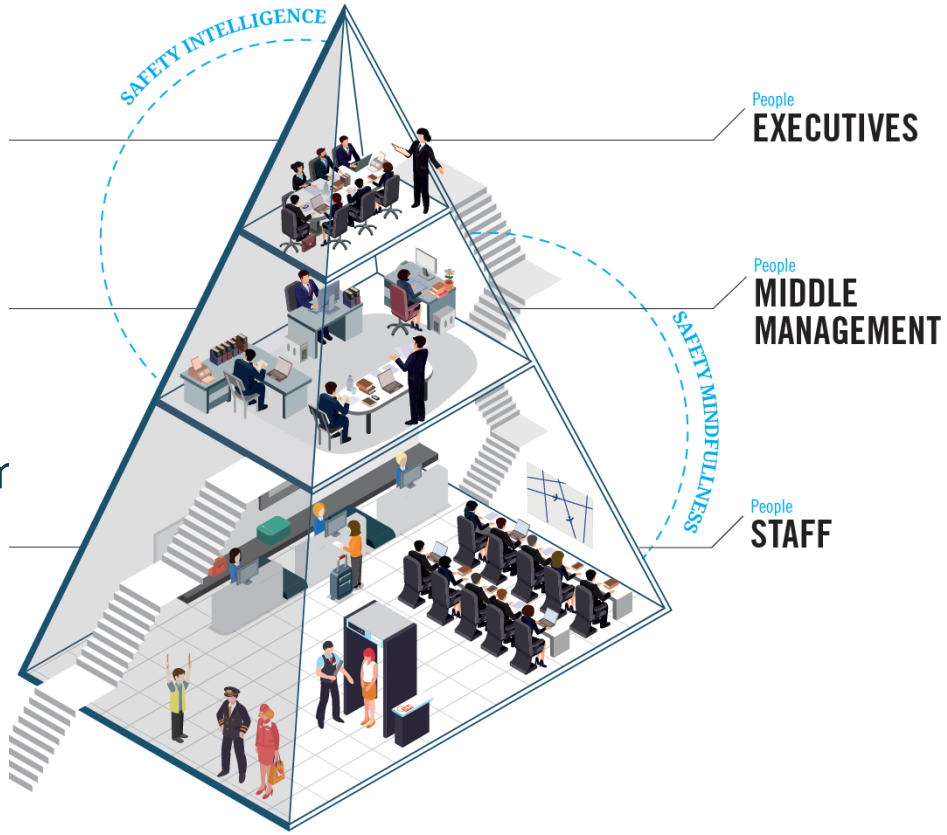
P5 Main Results

A Portfolio of Tools for Organisational Safety Management

- Safety Wisdom
- Safety Dashboard

- Safety Blueprint
- Safety Dashboard
- Agile Response
- Safety Culture
- Safe Performance System

- Safety Culture
- Safety Stack
- Mindfulness App



P6 Human Performance Envelope

Objectives

- Develop definition of the Human Performance Envelope
- Conduct preliminary experiments to select and assessment of physiological sensors and fine-tune simulation scenario's
- Conduct flight simulator experiments to validate the HPE and physiological measurements and to identify performance decrement limits
- Determination of recovery measures
- Evaluation and validation of solutions for augmenting the envelope

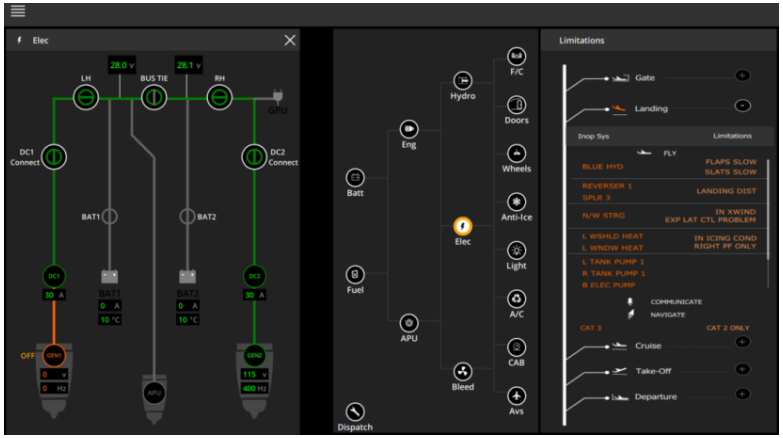
P6 Results

- HPE concept defined
- Sensors selected and assessed to measure the HPE
- First flight simulator experiments conducted in an A320 full flight simulator:

  - ➢ HPE concept validated
  - ➢ Sensors validated
  - ➢ Competency evaluation tool developed and applied to assess situation awareness, problem solving and decision making of the pilots
  - ➢ Cognitive walkthrough performed to analyse mental representation of the pilots before, during and after a critical situation
  - ➢ Necessary recovery measures determined

P6 Results

- New HMI developed based on results and analyses of first flight simulator experiments
- Second flight simulator experiments conducted in the Avionics 2020 Cockpit Simulator
- New HMI validated



P7 Mitigating the risk of fire, smoke & fumes

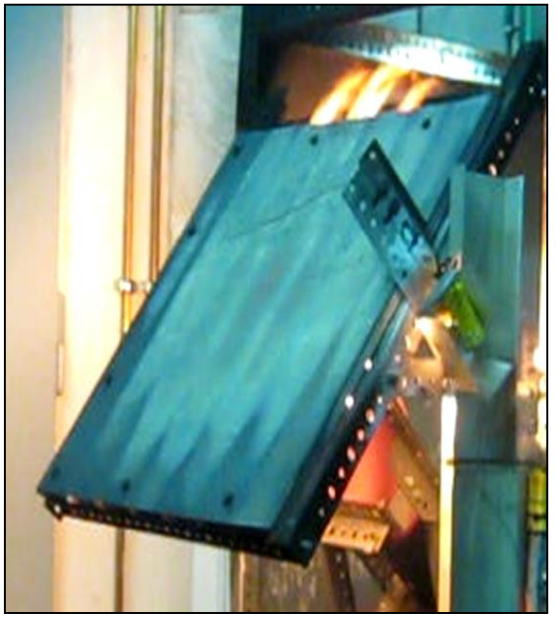
Objectives

- Understanding and characterising the fire behaviour of primary structure composite materials.
- Improving material solutions to mitigate fire, smoke and fumes in the cabin environment.
- Study the effects of new materials, technology and fuel systems on the on-board air quality

P7 Main expected results

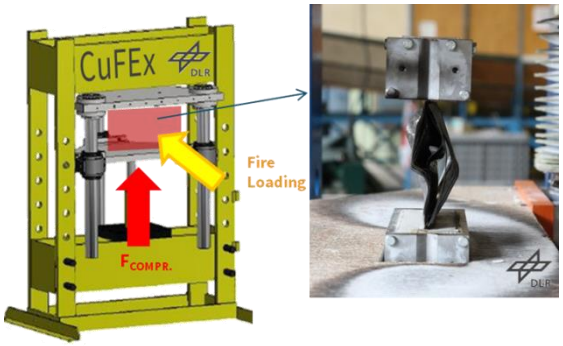
- Contribution to test standards and new test protocols
- Sharing of experimental data and scientific results for future modelling purposes (expensive tests)
- Establishing/giving design recommendations
- Methodological guidelines to deal with onboard air quality issues

Glass/Phenolic

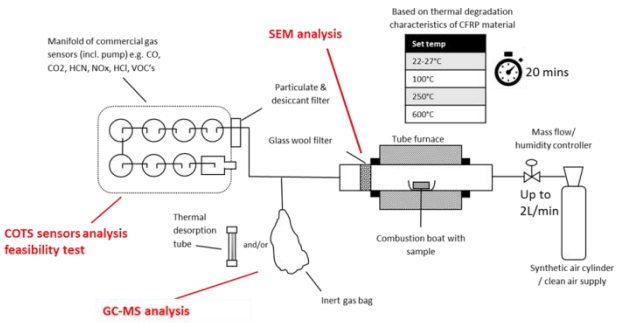

Carbon/Polysialate

P7 Main Results

- Contribution to test standards and new test protocols: BLADE (laser heating), CuFeX (compression under fire), AFNOR NF X70-100-2 (OBAQ)
- Sharing of original experimental data and scientific results on T700/M21 for modelling purposes (development and validation)
- Screening of new material solutions (GeoPolymer resin, natural fibres, recycled carbon fibers, and combinations thereof)
- Developed design recommendations for dealing with onboard air quality issues



DLR CuFeX test facility for mechanical load under fire

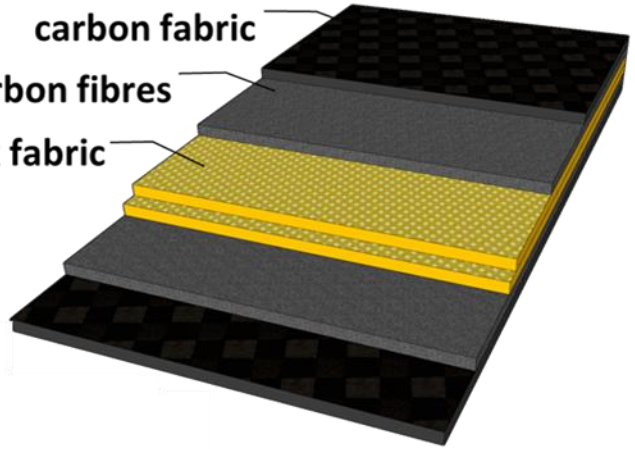


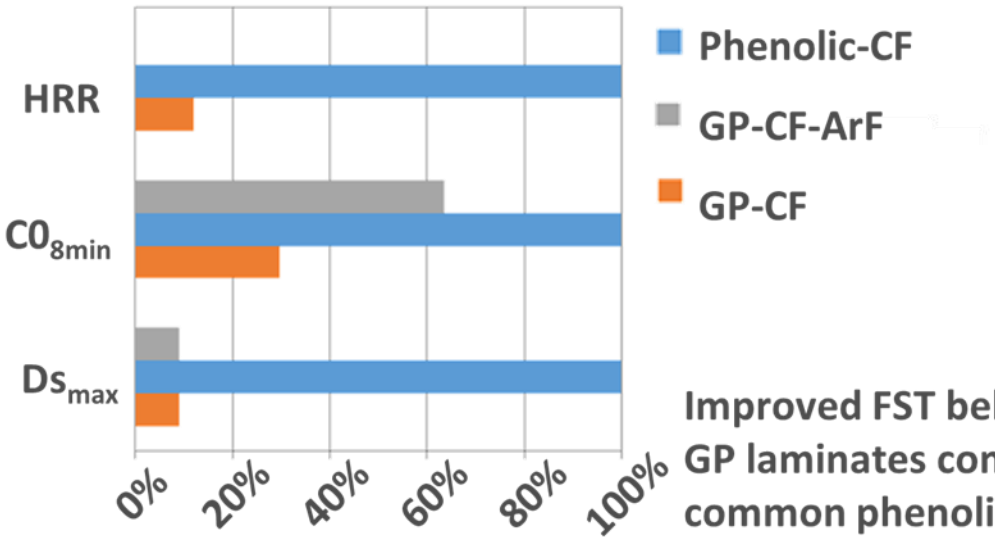
Air quality test procedure for composite materials (based on AFNOR standard

P7 – Main Results

Development and characterization of new material combinations for improved fire behaviour :

Layup of Geopolymer panel demonstrator with natural fibres and recycled carbon fibers





Improved FST behavior of GP laminates compared to common phenolic laminates


Carbon fibre GP composite structure after fire exposure

Focus in 2019 on exploitation actions

- Workshop/trial with airlines & FDM
- Risk Observatory trial with airline
- Safety dashboards for ANSPs
- Smart Vest for real-time physiological data
- Structural prototype new material solutions

Agenda

Five Technical Sessions

1. Runway Excursion **DAY 1**

2. Total aviation system risk prevention and mitigation

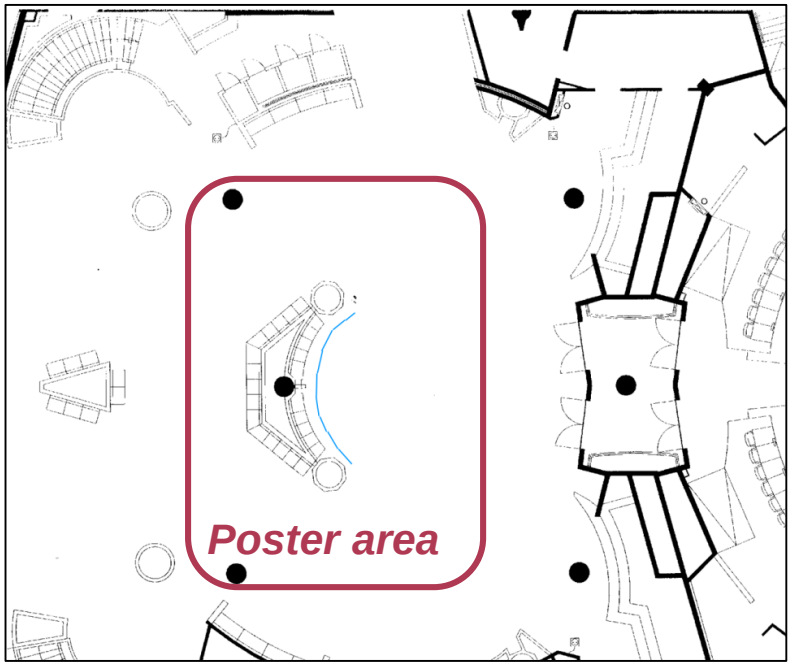
Poster session & Partnering Event

DAY 2

3. Resolving the organisational accidents
4. Human Performance Envelope

5. Mitigating the Risk Of Fire Smoke & Fumes

Posters & Partnering



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