Introduction to ACROSS project

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ACROSS/WP12/THAV/MNGT/PRES/0048 v00
ACROSS

Advanced Cockpit for Reduction Of Stress and Workload
The ACROSS consortium consists of 34 partners from 12 different countries within Europe.
Human factor causes in accidents

- Stabilization of accident rate

- A large percentage of recent accidents can be linked to a human factors issue
  - bad perception of the environment
  - crew misunderstanding of what is happening, what the systems do
  - bad crew coordination, inappropriate reactions-decision to events
  - errors in actions…

  with many root causes: fatigue, healthy, stress, training, HMI…

- Between 1990 and 2010 crew aspects were a factor in 60% of fatal accidents.
  Source: PlaneCrashInfo.com database
Errors and inappropriate reactions are more likely to occur when the workload in the cockpit is high.

Some examples:
- Take-off or landing with last minute changes
- Approach in very low visibility
- High density traffic
- Bad weather
- Failures
- Emergencies…

Permanent 100% readiness of the crew members is not possible.
Peak workload situations (2/2)

Need to support the cockpit crew when managing peak workload situations to improve safety level

Various ways are considered to reduce workload

- Improved human centred automation including consistent HMI solutions
- Improved situational awareness tools
- Improved support in case of abnormal conditions (failures, emergencies, etc.)
Economic pressure calls for reduced crew operations.

Operators require a vision on future possible reductions in required crewmembers for air transport and business aircraft.
Intentionally reduced crew situations (1/2)

Intentionally reduced crew

- Long haul flight
- One pilot is intentionally alone in the cockpit for a **limited period of time** during **cruise**
- Second pilot is in the crew resting area

Need to support the pilot in the cockpit while the other one is at rest during cruise on long haul flights
Specific periods during the flight with only 1 pilot in the flight deck require:

- Monitoring the flight from inside (monitoring system & human observation) as well as by outside parties (i.e. AOC, ATM) for deviations of expected behaviour
- Introduction of new technologies and novel automations
- Adapted design cockpit philosophy
- Changes in the role of crew members
- Enable a single pilot to safely handle all the matters that are currently handled by a two pilots
Reduced & single crew operations

From reduced crew operations in one or two decade(s) from now....

Long-haul flights / cruise phase
- one active pilot
- one “reserve” pilot

Single-pilot cargo flights
- night missions
- traffic at a minimum

Single-pilot business jet ferry flights

... to single-pilot operation in certain flights in the more distant future (out of scope for ACROSS)
Unplanned reduced crew situations (1/2)

Flight crew may be partially incapacitated during a flight (illness, fatigue, heart attack, food poisoning, effect of hypoxia, smoke and fumes, malicious or hostile act, accidental injuries, psychological reasons…)

Remaining pilot(s) needs to manage the situation, probably under significant stress.

Need to help the cockpit crew manage partially incapacitated crew situations

Help the remaining pilot to perform safe completion of the flight to the nearest suitable airport

➢ All tasks normally performed by two pilots have to be done by one.
➢ Single remaining pilot to perform under normal and abnormal events
Unplanned reduced crew situations (2/2)

Flight crew members may be fully incapacitated during a flight (effect of hypoxia, smoke and fumes, malicious or hostile act, accidental injuries…)

Need to help the ground manage fully incapacitated crew situations

- Detect crew incapacitation
- Land safely (up to CAT III) on adequate airport with
  - contribution of the ground
  - intervention of the cabin crew (under review)
Objective 1

Development and demonstration up to TRL 5
Component and/or mockup validation in relevant environment

Fully capacitated crew under peak workload

Improve safety and reduce accident risks through the reduction of stress
ACROSS objectives
Objective 2

Development and demonstration up to TRL 3
Analytical and experimental critical functions and/or characteristics proof-of-concept

Intentionally reduced crew
Long haul flights
Pilot break during cruise phase

Unintentionally reduced crew
1 or 2 pilots incapacitated
Short, medium and long haul flights
Land in safe condition
ACROSS objectives
Objective 3

1. NEW COCKPIT SOLUTIONS FOR PEAK WORKLOAD SITUATIONS MANAGEMENT
   - Identify where possible some **open issues** for the implementation of **single-pilot operations**, taking into account first learning about evaluations done on workload reduction (objective 1) and reduced crew operations (objective 2).

2. NEW COCKPIT SOLUTIONS FOR REDUCED CREW OPERATIONS

3. IDENTIFYING OPEN ISSUES FOR POSSIBLE FUTURE SINGLE PILOT OPERATIONS

Future single pilot operations
ACROSS progress (1/2)

Jan 2013

Step 1
Requirements & concepts definition

Oct 2013

December 2014
ACROSS is here

Step 2
Technologies development

June 2015

Step 3
Final validation & integration of results

June 2016

Oct 2013

December 2014

June 2015

December 2014

Jan 2013

Step 1
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Step 2
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Overview of ACROSS solution under study (1/2)

Monitor physiological and behavioural parameters to assess workload and stress levels of pilots

Balance crew capacity and demand on crew resources

Adapt cockpit applications and systems to challenging situations
- Decision support
- Prioritisation
- Progressive automation
- Decision sharing

Cross cockpit monitoring provided by systems
Overview of ACROSS solution under study (2/2)

In extreme situations where both pilots are incapacitated, in coordination with ATC:

Decision handling
Mechanisms and procedures which temporarily allow ground based flight crew members to remotely fly the aircraft, possibly with help of a non flight crew member in the cockpit.

Full automation
Applications and logic to maintain the aircraft on a safe trajectory,
Then reroute to the nearest suitable airport and autoland.
Safety objectives

- A Functional Hazard Assessment (FHA) is performed in which the maximum allowed probability of occurrence of detected and undetected total loss, partial loss and erroneous operation of the ACROSS functions is determined for various operational scenarios.

- These are taken into account by the ACROSS Technological Work Packages which develop the new cockpit systems.

- Human Factors guidelines and Automation guidelines are set-up specifically for the ACROSS functions, and taken into account by the ACROSS Technological Work Packages during development the new cockpit systems.
Verification against safety objectives

- A Preliminary System Safety Analysis of the technical solutions for the ACROSS functions will be performed to verify to which extend the requirements for the ACROSS functions have been achieved.

- Workload is assessed by pilots using mock-ups of the new cockpit systems.

- A flight crew error analysis of the new cockpit systems will be performed to verify that the likelihood of flight crew error has been minimized.
Gaps in, and potential impact on, applicable regulations and standards to allow certification of the new cockpit systems/functionalities and operational concepts are identified.

To support the future development of amended or new regulations and standards.

Results will be disseminated to EASA.
Advanced Cockpit for Reduction Of Stress and Workload
ACROSS (314501)

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