Canadian Aeronautics Networking Programme for Europe

Case Study - ACROSS

Advanced Cockpit for Reduction of StreSs and Workload

CANNAPE (Canadian Networking Aeronautics Project for Europe) is an EC-funded project, aimed at creating a platform for enhancing aeronautics and air transport research and development (R&D) cooperation between Europe and Canada, and to explore the potential for and, where appropriate, to promote the participation of Canadian stakeholders with their European counterparts in common activities.

Cabin crews are under high amounts of pressure, especially at peak flight times, while economic pressures push for the reduction of crew itself, to the point of single-pilot operation for the majority of short-haul flights. To enable this, novel technical solutions to tackle the potential problems of crew incapacitation are necessary.

The Need

One of the major remaining challenges for Air Transport safety is related to crew performance, especially in peak workload conditions. In parallel, economic pressure calls for reduced crew operations in specific cases, such as cruise phases for long-haul flights (one active pilot, one "reserve" pilot), cargo flights or business jet convoy flights (single pilot). Peak workload reduction is one of the clear enablers for this type of future operations. The ultimate target for reduced crew operation could be single-pilot operation in most flights. This long-term evolution will only take place if adequate solutions can be found to address crew incapacitation situations allowing safe flight termination under all conditions. Acceptance of developed concepts by stakeholder communities (passengers, crew members, etc.) is one of the essential conditions required for success. Acceptance of developed concepts by stakeholder communities (passengers, crew members, etc.) is one of the essential conditions required for success.

The Solution

ACROSS will develop, integrate and test new aviation system solutions including cockpit solutions that will facilitate the management of the peak workload situations that can occur during a flight, in order to improve safety and ensure the reduction of accident risks through the reduction of stress.

ACROSS will also investigate, develop, integrate and test potential new cockpit solutions that will allow reduced crew operations in a limited number of well-defined conditions.

Finally, ACROSS will identify remaining open issues for the implementation of potential single pilot operations.

Human factors, safety and the identification of key issues for future certification and regulation will drive the approach. The new system proposal will balance the crew capacity and the demand on crew resources.

Potential solutions proposed within the ACROSS project will be developed. For instance a Crew Monitoring environment could offer the capability to monitor physiological and behavioural parameters to assess workload and stress levels of pilots. Cockpit applications and systems could then be adapted to such challenging situations:

Decision support: cockpit interfaces could be adapted to focus crew on overriding actions,

1. Prioritisation: critical elements could be made more visible and compelling out of the possible clutter of non-critical applications/ information,
2. Progressive automation: during the execution of their operational tasks, novel automation elements could increase the level of support when the crew workload increases,
3. Decision sharing: in case of a persistent crisis situation, an additional information link with the ground could be established to further assist the crew.

In extreme situations where both pilots are incapacitated, further steps in coordination with ATC could be for example:

1. Full automation: applications and logic to maintain the aircraft on a safe trajectory, then reroute to the nearest airport and autoland.
2. Decision handling: mechanisms and procedures which temporarily allow ground based flight crew members to remotely fly the aircraft.

These innovative solutions developed within ACROSS will be assessed technically and operationally by pilots and other experts from different stakeholder communities.

To achieve that goal, ACROSS provides a large team of key European stakeholders who are committed to deliver innovation in the field of air transport safety.

All the suggested solutions take benefit of previous European projects including FLYSAFE, ALICIA, ODICIS, SAFEE, and SOFIA.

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CANNAPE Intervention:

The ACROSS consortium comprises a wide range of expertise. However, the need to involve other stakeholders in the civil aviation system has been acknowledged. Consequently, the ACROSS consortium is forming an External Experts Advisory Group (EEAG), the members of which are invited to participate in reviews and provide feedback to results of the project. To date, 22 people are already committed, and 12 more have been invited. The background of the External Experts Advisory Group includes Airframers, Airline Management, Certification & Safety, Cockpit Crew, Human Factors, Legal/Law, aero medical, Union representatives, Aviation weather. One person may represent different backgrounds, e.g. cockpit crew & union.

CANNAPE programme contributed to the identification of one Canadian expert for the ACROSS External Expert Advisory Group (EEAG). Mr. Robert Erdos, Chief Test Pilot, Flight Research Laboratory, National Research Council of Canada was invited to participate in the ACROSS EEAG.

This was possible due to the presentation made by Thales Avionics in the first CANNAPE workshop at Paris where ACROSS was presented to the audience as part of the session Ideas for AAT Research Proposals for the 5th Call and beyond. This collaboration continued in the 2nd CANNAPE workshop where Isdefe (in representation of Thales Avionics) gave a presentation on the EC funded projects in Avionics to support future air transport operations including ACROSS. In a side meeting (during the 2nd workshop) a call for experts for the EEAG was done. the National Research Council expressed their interest to be part of the EEAG.

Programme Aims:

The ACROSS project targets to develop, integrate and test new cockpit solutions for short-medium and long term time frame. Through these solutions, 3 objectives can be achieved: 1) facilitate the management of the peak workload situations, 2) allow reduced crew operations, and 3) identify the remaining open issues for the implementation of single pilot operations.

The first objective is to develop, integrate and test new cockpit solutions that facilitate the management of the peak workload situations that can occur during a flight, in order to improve safety and ensure the reduction of accident risks through the reduction of stress. This means to provide improved support to crew for situation awareness, decision making, simplification and reduction of crew action, improving HMI to ease pilot tasks, including improved automation feedback. Additionally, by the prioritization of information according to its criticality and the context, it is possible to provide optimized work share as a function of workload per flight phase. For this objective, solution will be developed with the assumption that 2 pilots are permanent in the cockpit, and considered always in the loop. No full automation is studied here.

The second objective is to develop, integrate and test new cockpit solutions that will allow reduced crew operations in a limited number of well-defined conditions that will be:

1. Long haul flight reduced crew, for a limited period of time during cruise, with the need to support one crewmember in the cockpit while the other one is on rest (requiring concepts of crew monitoring and innovative functions to support flight monitoring)
2. In case that one crewmember is incapacitated; analysing solutions to help the remaining crewmember to land in safe condition (considering as a first step, that other parameters such aircraft status, and external environment are nominal)
3. For the extreme case that the full crew is incapacitated, during short-medium range flight, from cruise to landing until aircraft stops

The third objective is to identify the remaining open issues for the implementation of single pilot operations, taking into account the evaluations done on workload reduction (objective 1) and reduced crew operations (objective 2). With the support of the main relevant stakeholders, it is possible to define high level requirements for a system able to support single pilot operation in the future. Furthermore, mapping the state of the art and the achievements of ACROSS, it is possible to understand how much these requirements have been addressed. Both of these supports (operational provided by the stakeholders and literature provided by the state of the art) allow to identify the remaining open issues for single pilot operations, and suggest potential solutions and/or mitigations to be addressed in further studies.

Expected Results:

As expected outcomes, ACROSS will provide:

1. For each crew task (aviate, navigate and manage mission, communicate, manage system), especially during peak workload, a set of new avionics functions with the demonstration of global performance improvement, crew and system.
2. A set of technology solutions matured for crew monitoring (prerequisite before reduced crew or single pilot operation)
3. A supplementary step in the technical capability to fully control the aircraft for safe landing in case of crew incapacitation.
4. Based on first human factor evaluations, recommendations for management of reduced crew, and single operations: training, system evolutions.

This approach, via an adaptive and progressive concept, allows at the same time to define short-term solutions which could be implemented "quickly" in the cockpit to better support crews in degraded cases in the current configuration: permanently 2 pilots in the cockpit. This will allow the development of new innovative solutions for long range operations with reduced crew. Such configurations need to be able to cater for taking control of the plane until completion of the landing roll at a suitable alternate airport in the ultimate case of incapacitated crew. This study will also allow a first identification of the problems to resolve to reach effectively a single pilot configuration.

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ACROSS Programme Details

Programme Cost: €30,255,456, including an investment of €19,482,059 from the EC.

Duration: 3.5 years (January 2013 – June 2016)

Category	ACROSS partners
Airframers	AIRBUS, DASSAULT AVIATION, BOEING
Large Industrial Companies	THALES Avionics, BAE SYSTEMS, Continental, DIEHL Aerospace, Isdefe, JEPPESEN, ZODIAC AEROSPACE, THALES Training & Simulation, SELEX GALILEO, TAI, gmv
National Research Centers	DLR, NLR
Research Centers inside large Industrial Groups	EADS Innovation Works, THALES Nederland BV
Universities	TRINITY COLLEGE DUBLIN, UNIVERSITY OF MALTA, Technische Universität Braunschweig, WARSAW UNIVERSITY OF TECHNOLOGY, TU Delft
Small and Medium Enterprises	DEEPBLUE, TRIA GNO SYS, TONY HENLEY CONSULTING, CERTIFLYER, STIRLING DYNAMICS, use-aces, qtd

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