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CabinAir - Innovative approach to improving air quality in aircraft cabins

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Overall aim

Improving air quality in aircraft cabins using 'measurements in the sky' and innovative designs and technologies

- To address the widespread concerns about air quality in commercial passenger aircraft
- Enable airlines to provide a healthier environment for passengers and crew

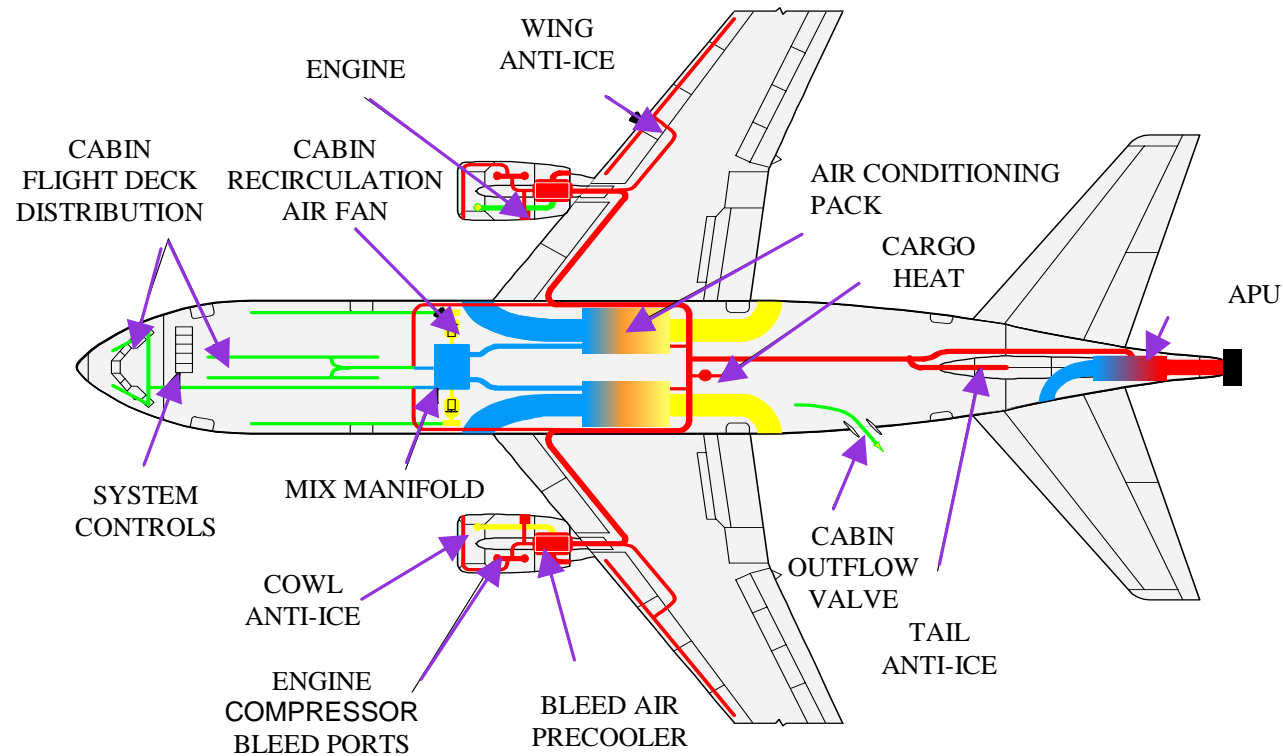


Need for this work

- Serious and widespread concern about impact of cabin air on passengers and crew
- Exacerbated by growth of air traffic, and future generation of aircraft
- No European or international Standards for environmental quality in aircraft
- Problems clearly transnational and needed to be addressed as such



Environmental control system (ECS)



Environment that we need



CabinAir consortium



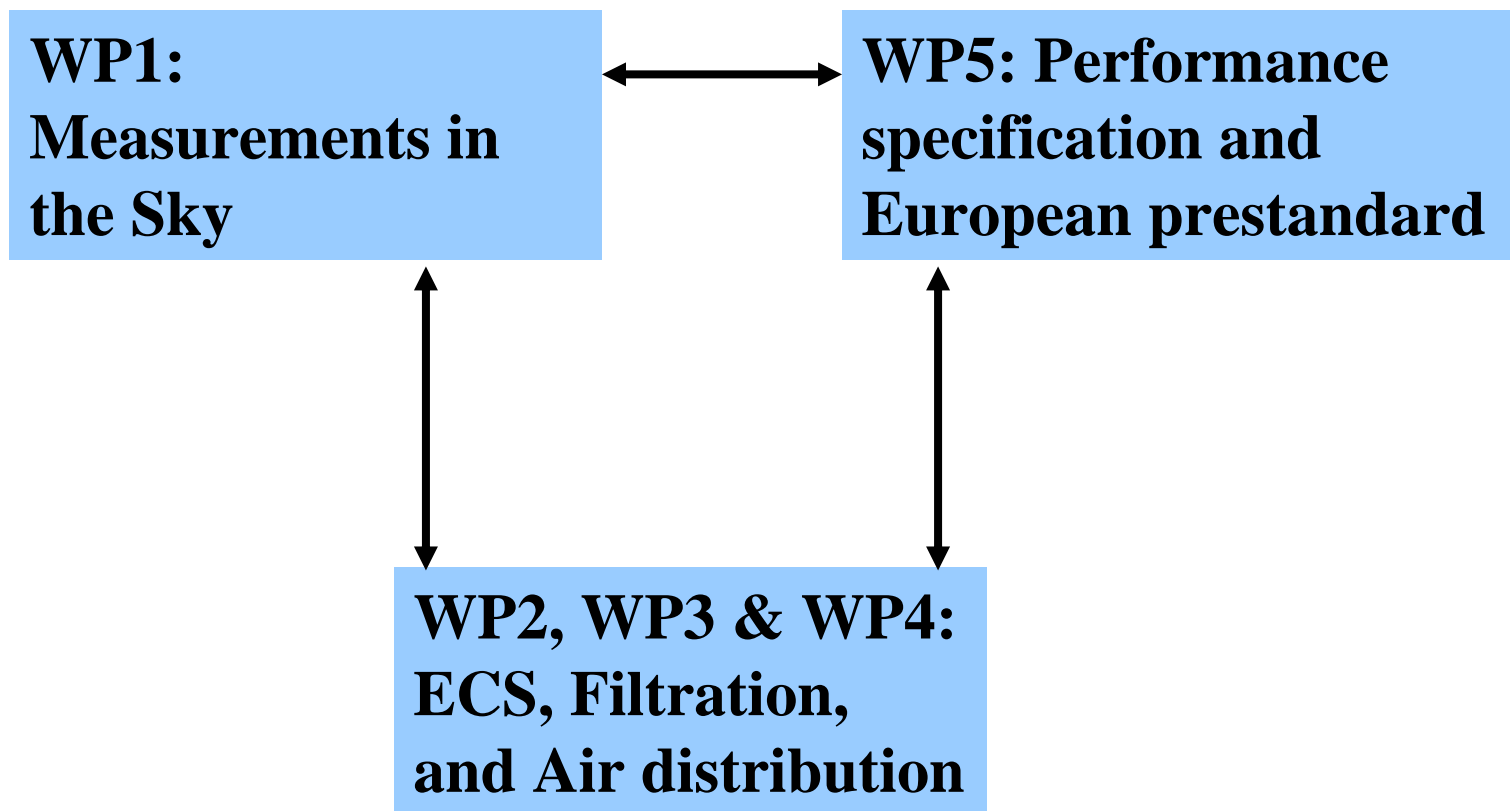


Key objectives

- Establish current air quality through ‘measurements in the sky’
- Produce information on relationship of air quality with ECS, filtration, air distribution and ‘impact’ performance
- Provide innovative designs in ECS, filtration, air distribution, and control
- Develop performance specification and propose draft Pre-Standard



Workpackage inter-relationship





WP1: Measurements in the Sky

- To establish current air quality in four generic aircraft types representing commercial passenger fleet
- Comprehensive investigation through a planned programme of monitoring and surveys of aircraft in flight



Measurement Programme

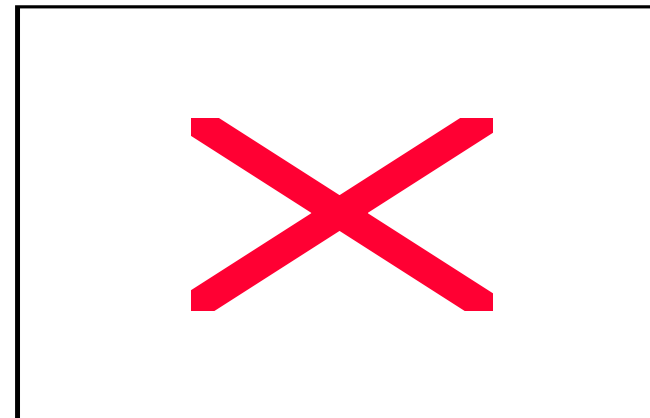
- Four types of generic aircraft
 - Short narrow body (SN)
 - Long narrow body (LN)
 - Twin aisle (TA)
 - Double deck (DD)
- 50 commercial flights (plus ground tests)
- National flag-carrier airlines: BA, SAS, KLM





AHWG cabin air monitoring

- **Aircraft used in high-volume, short haul operations**
- **Two older generation aircraft**
 - **BAE146 (UK regional operator)**
 - **B737 Classic (regional, 'budget', or flag-carrier)**





Physical Measurements

- Cabin altitude
- Air and globe temperature
- Air velocity
- Carbon dioxide
- Relative humidity
- Ozone
- Carbon monoxide

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Contaminant Measurements

- Organic compounds
 - Aldehydes and ketones
 - Very volatile organic compounds (VVOCs)
 - Volatile organic compounds (VOCs)
 - Semi volatile organic compounds (SVOCs)
- Microbiologicals
 - Fungi
 - Bacteria
 - Endotoxins
 - Cat and mite allergens
- Ultrafine particle counts



Cabin crew questionnaire

- Change in symptom intensity during flight
- Assessment of the cabin and galley environments



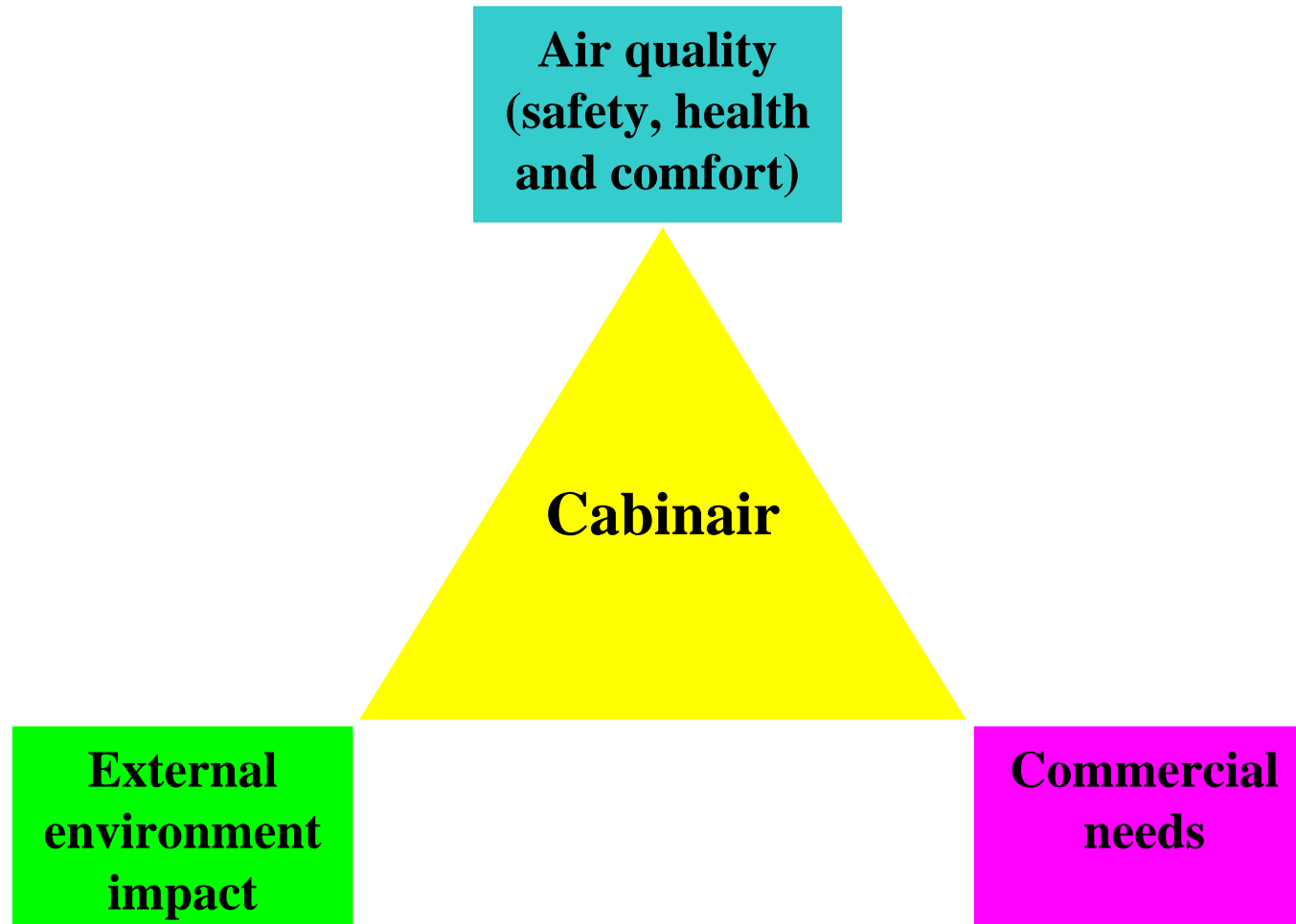
WP2: Environmental Control System



- To provide innovative designs and technical solutions in the areas of the ECS
- Evaluating the impact and influence of ECS on cabin air quality and environment and providing and assessing improved designs



Cabinair strategy





WP3: Filtration system

- To provide innovative designs and technical solutions in the areas of filtration
- Providing new designs and technologies - striking a balance between filtration efficiency for contaminant removal, and energy consumption





WP4: Air distribution

- To provide appropriate air quality for passengers and crew together with local control and maximum effectiveness
- Developing new design strategies and technologies





WP5: European Prestandard

- Guidelines for draft European Prestandard (ENV) on cabin air quality
- Developing specifications and proposing Standards that are technically feasible, and economically justifiable





Development of Prestandard

- Review existing JAA, FAA, SMACs from NASA
- Assess standards, guidelines and regulations concerning other indoor environments
 - transport, buildings : EU, WHO, ASHRAE, AGCIH, ...
 - air pollutants : TLVs, time of exposure, health effects
 - CO₂, CO, O₃, NO_x, VOCs, particles, ...
 - thermal comfort : temperature, radiation, air velocity, humidity
- Evaluate data from CabinAir 'Measurements in the Sky' for full international fleet
- Markers for air pollution (safety and health) and thermal (comfort) established



Specification of markers

- prEN 4618 only performance based, without any requirements concerning technical solutions
- Criteria established according scientific reasons
- Scientific justifications and references given for each criteria
- Measurement method of associated markers provided (description or references)

- No sectorial considerations
- No requirements for ventilation rate level
 - Possibility to reduce current ventilation rate if existing alternative solution to guarantee an equivalent air quality level
 - Information about current regulation's requirements

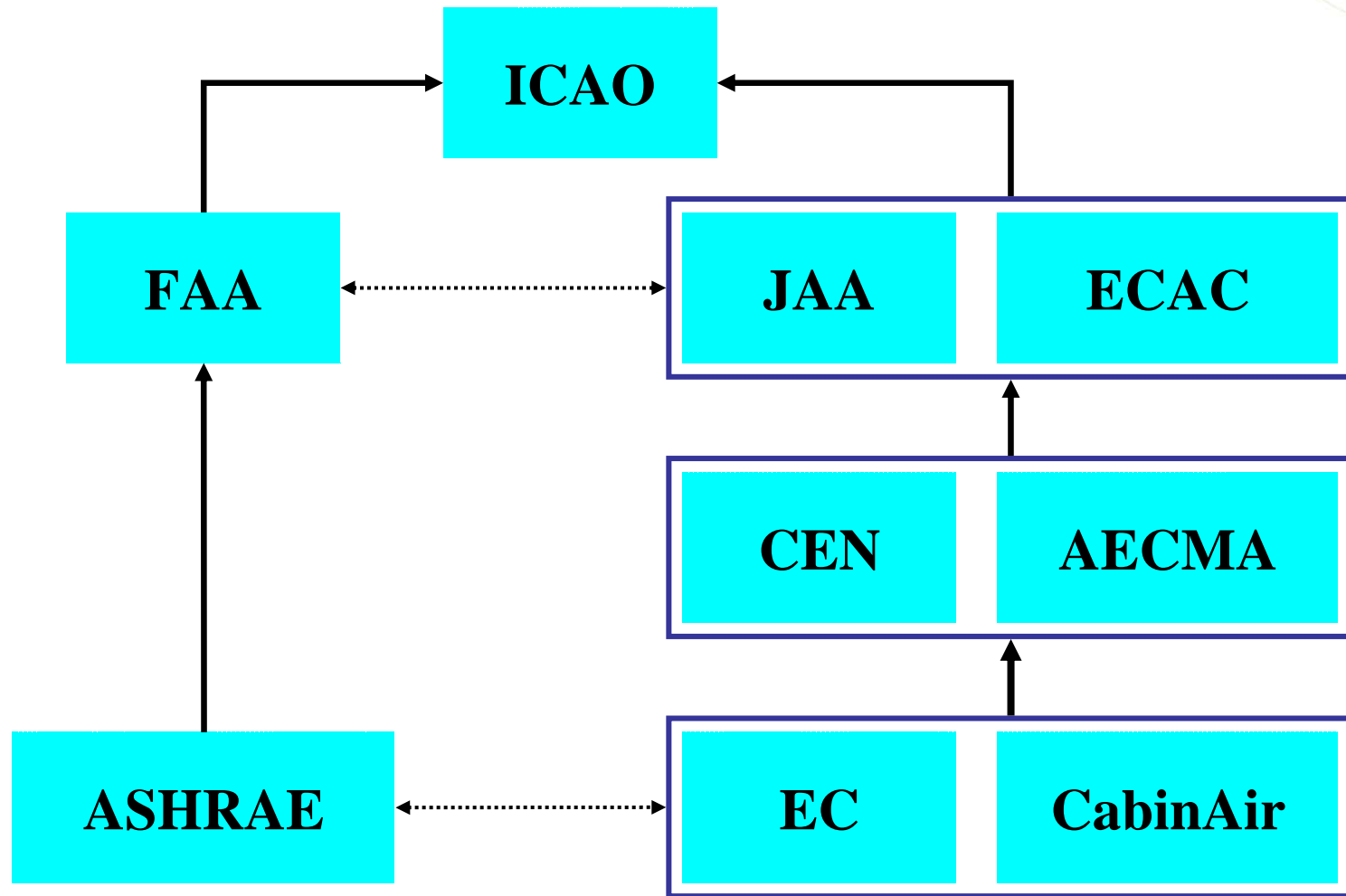


Markers for air quality

Pollutants	Sources
CO ₂	Occupants, Galleys
CO	Engine failure
Ozone	External atmosphere
PM _{2,5} ; PM ₁₀	Occupants, Food
Ultra-fine particles	Exhaust gases, Food preparation
Ketones	Solvents, Fuel
Acetaldehyde	Lubricants, Solvents
Acrolein	Lubricants
Formaldehyde	Lubricants, Solvents, Plastics, Cleaning agents
Benzene	Exhaust gases, Fuel
ToCP	Lubricants, Hydraulic fluids
Methyl Chloride	Solvents
Naphtalene	Fuel, Oil
Endotoxins	Gama Negative Bacteria



CabinAir and its linkages





Some of the outputs

- Survey of cabin air quality in generic aircraft types
- Instrumentation to mimic thermal and microclimate of passengers
- New ECS design proposals
- Demonstrator for assessing new filtration systems
- New approach to air distribution
- External environmental impact assessment
- European Pre-Standard

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