FAST 42

JULY 2008

FLIGHT
AIRWORTHINESS
SUPPORT
TECHNOLOGY

AIRBUS TECHNICAL MAGAZINE

FAST 42

AIRBUS

Dear Airbus friends,

What makes a technical magazine a 'good' technical magazine? No doubt one of the most important ingredients is the relevancy and quality of its contents, but so is the quality of its layout. A good technical article is one that conveys accurate, sometimes complex, and useful data in a meaningful and easy way to understand. This is where the quality of the layout, design and illustrations play an important role. These three attributes serve the article to make it easy to read and help the writers pass on their complex technical messages to the reader. The layout must render complex subjects more accessible and the photos and illustrations must contribute to a better understanding of the article.

You may wonder why I am writing an editorial about this today? Indeed, we very seldom include an editorial in regular issues of FAST magazine and only do it for very special occasions. Well, this is the case today… at least in FAST magazine history!

I would like to pay tribute to a person without whom this magazine would not be what it is today. This is Mrs Agnès Massol-Lacombe - the art director of FAST. Agnès has worked on our technical magazine since issue Number 1, back in 1983, and she is now retiring. Almost the end of an era some would say. Through all these years Agnès provided the artistic organization, which makes FAST the attractive magazine it is, as confirmed by readership surveys. Over these past 25 years, printing and graphic design techniques have evolved very… 'FAST'. Agnès successfully adapted herself to this 'FAST' evolving world and above all never fell into the trap of graphic design technology for the sake of technology. She and I share the same views on the role of graphic design and its impact on the quality of a publication.

For sure, thanks to her professionalism and passion for her work, Agnès contributed a lot to the quality of FAST magazine.

On behalf of the FAST readers community I would like to say: 'Thank you Agnès, and enjoy a well deserved retirement!'

Bruno PIQUET
FAST magazine publisher

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Publisher: Bruno PIQUET
Editor: Kenneth JOHNSON

Cover:
The Airbus ACJ parked at the Wilkins runway in the Antarctic.
Blue-ice runway operations are described in the article on page 26

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Flight Management Systems on commercial aircraft

Past, present and future

The Flight Management System (FMS) can be thought of as the 'brain' of the aircraft navigation system, which assists pilots in navigation and flight preparation to compute the most efficient flight in fuel and time savings and automatically navigate the aircraft. It calculates performance data and the most fuel-efficient route to be flown based on typical aircraft parameters such as weight, cruise altitude and actual aircraft position, regardless of weather conditions.

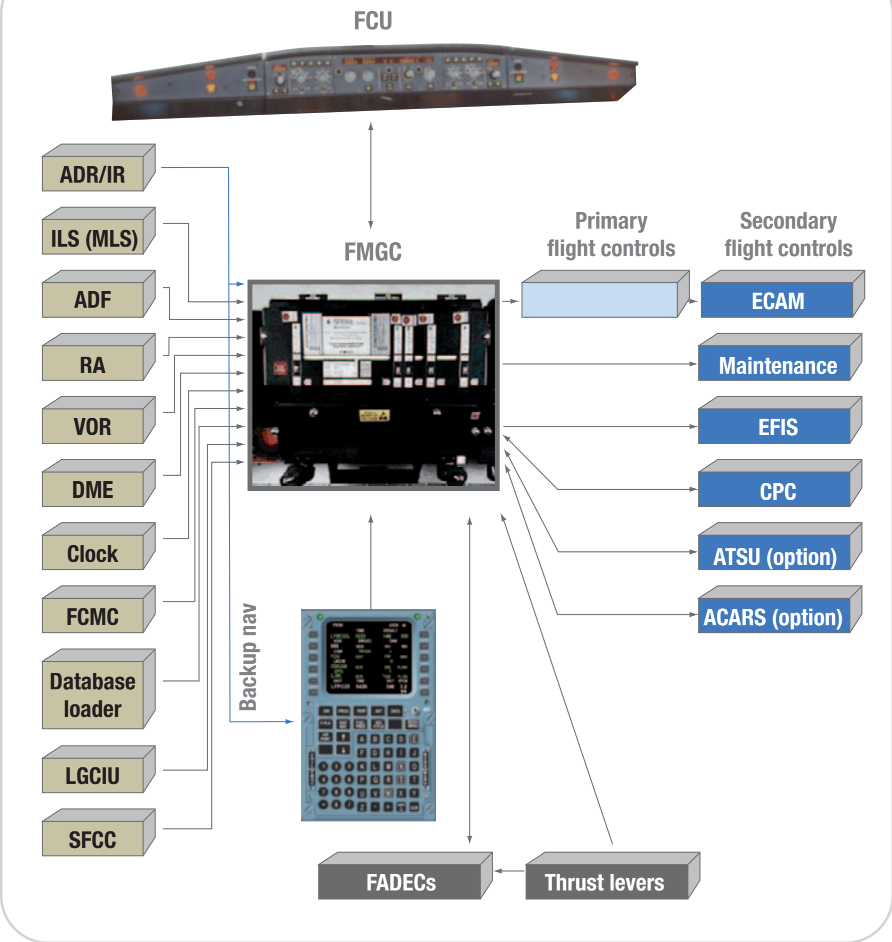
Marino MODENA
Maintenance Marketing
Airbus Customer Affairs

Since the beginning of commercial flight, it was clear to the people involved (pilots, engineers and air traffic specialists) that one of the major challenges was to enable aircraft flight in all weather conditions while maintaining a minimum level of safety.

When commercial flights started to increase significantly in the early 1960s, one of the most im-portant items was to avoid flight cancellation, while taking into account time and fuel savings. At that time every flight was a 'special mission' where the entire cockpit crew (three or more), had dedicated tasks to accomplish.

With the continuous increase in number of aircraft and routes (considered as roads in the sky), it became evident that aircraft had to follow strict rules during all phases of flight, especially for the most significant ones (i.e. take-off and landing). For these reasons the flight had (and still has) to be 'planned' before take-off in all details and for all flight phases for the crew to be prepared for and 'manage' any deviation that could occur.

Typical FMGC architecture



This planning task, while not at all easy, was not only time consuming for the crew but could also divert pilot attention when their efforts should be concentrated on other important duties during particular flight conditions. It was clear that under these conditions an aid for pilots was necessary to maintain and exceed the required level of safety: this 'assistant' is now known under the name of the Flight Management System.

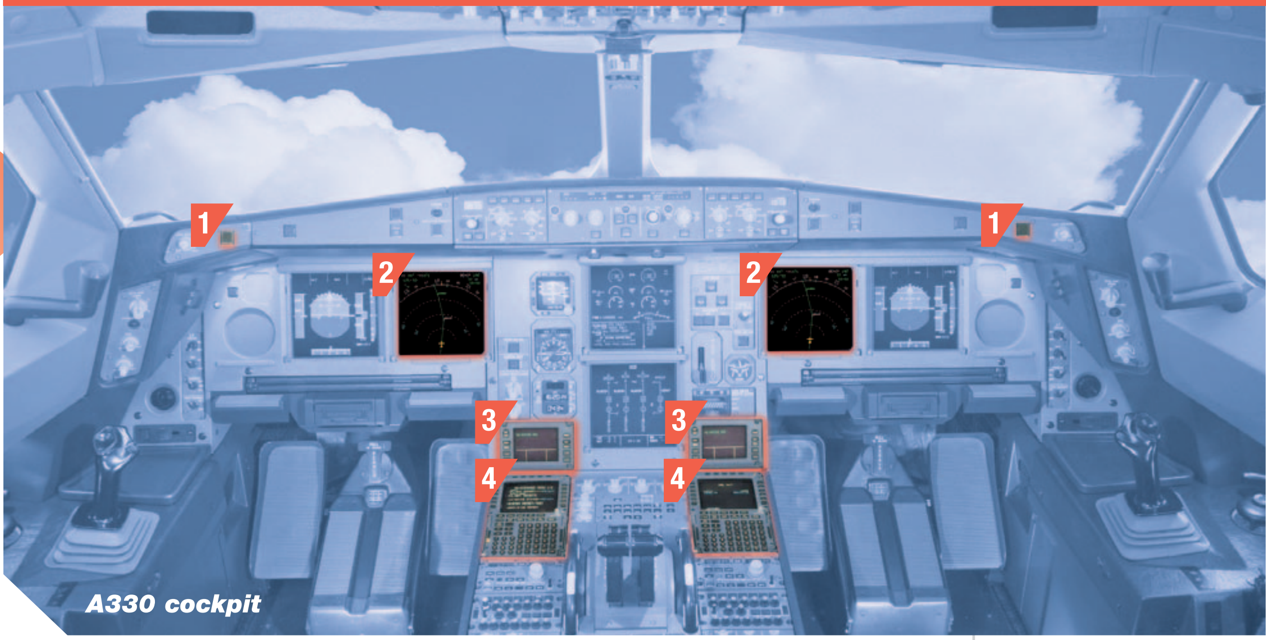
FMS only became standard equipment on commercial aircraft at the beginning of the 1970s, with the first automatic FMS using external position sensors for fuel management and pilot awareness. These sensors (e.g. the Inertial Reference System) were (and are) used by the FMS to calculate a precise aircraft position based on direct distance to various ground stations. The FMS uses this aircraft position to assist the flight crew in flight plan preparation, allowing them to build-up the lateral and vertical trajectory that the aircraft should follow during the various phases of the flight: take-off, climb, cruise, descent, approach and landing.

Present Flight Management Systems

With today's FMS the crew workload is significantly reduced and they can easily optimize aircraft performance to fly the most fuel economic route or choose the fastest route to a destination.

Glossary:

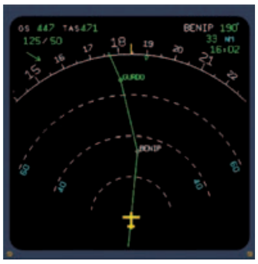
ACARS: Aircraft Communication Addressing & Reporting System
ADF: Automatic Direction Finding
ADR/IR: Air Data Reference/Inertial Reference
ATSU: Air Traffic Service Unit
CPC: Cabin Pressure Controller
DME: Distance Measuring Equipment
ECAM: Electronic Centralized Aircraft Monitor
EFIS: Electronic Flight Instrument System
FADEC: Full Authority Digital Engine Control
FCMC: Fuel Control & Management Computer
FCU: Flight Control Unit
FMGC: Flight Management & Guidance Computer
ILS (MLS): Instrument Landing System (Microwave Landing System)
LGCIU: Landing Gear Control Interface Unit
RA: Radio Altimeter
SFCC: Slat Flap Control Computer
VOR: VHF Omni-directional Range.



A330 cockpit

1 ATC push button

2 Navigation Display



3 Data Communication Display Unit - DCDU

4 MCDU

A320 cockpit, MCDUs

To do this, the FMS takes into account and estimates the time and fuel required for a flight and the optimum cruise level for a minimum fuel burn. The parameters that are considered for this calculation are the cruise flight level, the gross weight of the aircraft, the Cost Index (CI = ratio of cost of flying time to the cost of fuel), the external temperature and the winds average.

Moreover, as the flight progresses, the FMS tracks the fuel consumption, considers the updated winds and re-estimates regularly the flight time taking into account the aircraft position. In effect, the FMS regularly monitors the position information of the aircraft received from all of the sensor systems, synthesizing them to produce the actual position of the aircraft. That position is then used by the FMS system to predict aircraft performance by using some aerodynamic, engine and atmospheric models together with predicted temperature, wind, speed and actual aircraft weight and centre of gravity.

The results of this aircraft performance are made visible to the pilots by the main interface between pilots and the FMS that is called, in Airbus aircraft, the Multifunction Control Display Unit (MCDU), or Control Display Unit (CDU) on A300/A310 Family). This is a sort of notepad or virtual book with many chapters that enables pilots to enter data and programme the FMS. Two MCDUs are today fitted in the cockpit of the A320 Family (two CDUs on A300/A310 Family) and three MCDUs are fitted in the A330/A340 Family's aircraft.

Through the MCDU pilots can enter and modify a flight-plan, insert data such as aircraft weight, speeds, cruise flight level, etc. and interface with other systems, for example the Aircraft Communication Addressing and Reporting System (ACARS), today included in the Air Traffic Service Unit (ATSU) which allows pilots to send and/or receive messages and flight parameters to/from a ground station. Moreover, the MCDU is also used as an interface tool for the maintenance staff to test aircraft systems and equipment.

For crew awareness the MCDU also has the capability to display messages (in the lower part of the screen). These messages can be displayed as a result of a pilot action or to request a data entry when necessary (for example an entry that crew have to add in the flight plan).

Another important interface between pilots and the FMS are the Navigation Displays (NDs), two screens in the cockpit showing the actual position of the aircraft in relation to the position esti-mated by the flight plan. Looking at the NDs, the crew can easily follow the aircraft position evolution as flight progresses, being alerted to any possible deviation that may occur from the original flight plan.

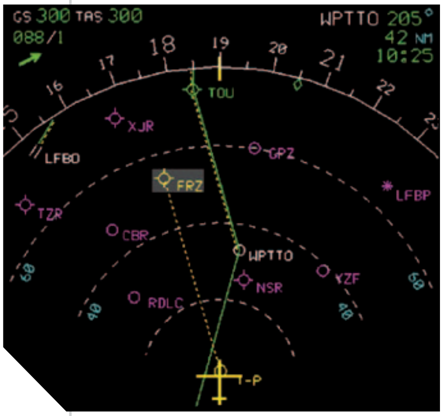
To build-up a flight plan the FMS uses pilot input and information stored in the Navigation Data Base (NDB). The NDB, which contains updateable software that has to be loaded every 28 days, is a key part of the FMS. It provides pilots with information about navigation aids (navaids), airports, air traffic control frequencies, runways, waypoints, company routes (most frequently used route is usually already recorded in the NDB) and other data extracted from a worldwide database. The NDB is an efficient way to drastically reduce crew workload.

As a result, the FMS is able to manage the entire flight from take-off runway to landing (through all flight phases), by performing all the complex navigation calculations that the crew would otherwise have to do to achieve the highest efficiency and cost savings.

By reducing pilot workload, the FMS lets the crew manage other tasks so that they are more operational and concentrated in case of need. For example, instead of having to check through detailed navigation and airport charts to find an alternate route or airport in case of necessity (e.g. bad weather conditions), the FMS can provide the crew with a detailed analysis of the best alternate solution at the push of a button.

In recent years progress has been made on FMS design (known as FMS second generation), enabling operators to customize many options that can be loaded directly on-board without removing the Flight Management & Guidance Computer (FMGC), which contains the FMS part. One of today's major options requested by operators is the interface with the ground management system for data link communications between the aircraft and their airline operations' centre. This produces more efficient flight movement, improving data management like engine trend monitoring and maintenance reports and anticipating any possible parts replacement, thus optimizing spares and costs management. These types of FMS reports have experienced a big growth in functionality and support to pilots and more is still to come.

A further step has been made with the latest FMS now in service and fitted in the A380. This new system provides a better crew interface and improves the user friendliness of the FMS to reduce pilot workload. Moreover, in the A380 a third flight management unit (there are two in other Airbus family aircraft) has been introduced



Example
of a lateral flight plan

Flight Management
& Guidance Computer (FMGC)

to improve availability of all FMS functions during all flight conditions. Another advantage offered by the A380 FMS is the vertical situation profile of the flight plan on the Navigation Display (ND), in addition to the normal lateral flight plan.

Future Flight Management Systems

The A380 FMS has taken new FMS concepts a step further, but FMS functions or concepts after this must take into account continuous traffic growth and operator demand for faster system reactivity.

A recent FMS forum with operators emphasised the necessity to keep operator's informed of new FMS evolution strategy, not necessarily linked to mandated new processes or procedures, but also new concepts and capabilities that are 'most desirable' to operators. This will assist future development and keep the Airbus operator's community aware of new strategies and options that could be effectively applied in future FMS development.

Due to heavier traffic in specific dense areas, airspace is becoming increasingly saturated. This necessitates a reduction in aircraft separation while maintaining the equivalent level of safety. It is clear that increasing airspace capacity, enhancing operational efficiency and fuel savings, while ensuring the best safety level of air traffic cannot be reached without a combined use of air and ground elements.

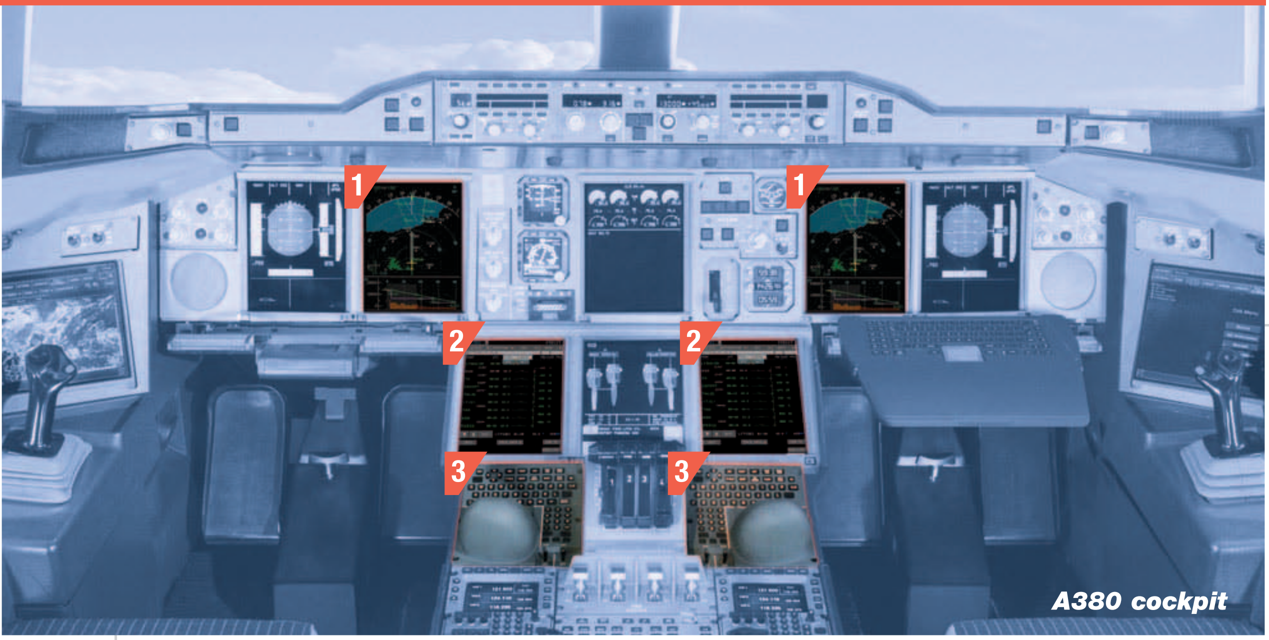
New implementations being studied now require aircraft to maintain a specified level of accuracy and precision in the position update in all flight phases and in particular during aircraft landing. Recent navigation systems offer the required navigation performance to achieve these objectives, in conjunction with increased routing flexibility.

Based on today's forecast, some areas seem more appropriate for a new type of operation such as the so-called Area Navigation or RNAV, the Required Navigation Performance (RNP) concept, the Future Air Navigation System (FANS A and B) enhancement concept and new approach and landing capabilities based on FMS (so-called FMS landing system) or FLS (Flight Management Landing System).

RNAV involves the development of navigation procedures based on instrument flight (particularly important in adverse weather conditions), enabling aircraft to fly point-to-point without conventional ground-based radio navigation aids. It can be used en-route in association with the RNP concept, but also for terminal area navigation (approach phase) and for instrument approach procedures.

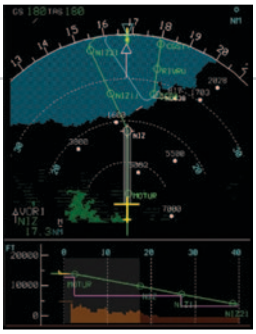
RNP is a navigation element that is expected to affect current and future existing airspace structures. It concerns navigation performance accuracy that is essential to fly the aircraft in RNP airspace. Aircraft must meet or exceed these performance and precision requirements to fly in that airspace.

RNAV and RNP are two key elements of a more global concept that is FANS. This new enhanced concept involves not only navigation (with RNAV and RNP), but also surveillance and communication areas through an air traffic management link. Surveillance will allow the Air Traffic Control (ATC) to receive the aircraft position and its planned route in order to reduce aircraft separation and communication will assist in the automatic sharing of real-time information and digital communication between pilots and ATC.

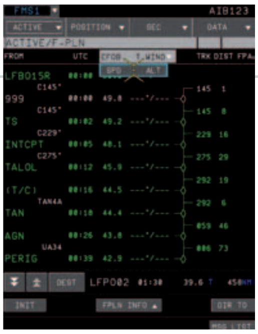


A380 cockpit

1 Navigation Display



2 Multi Function Display



3 Keyboard Cursor Control Unit

For these reasons FANS can be seen as a chain linking a pilot and a traffic controller.

The main crew interface used for the FANS application is based on the two Data Communication Display Units (DCDUs) located in the cockpit just above each MCDU which displays data link written messages sent/received by the crew to/from the ATC in real-time (a sort of operational 'chat' line).

The FMS will play a key role in the navigation, surveillance and communication of FANS, providing aircraft actual and planned position and coordinating, processing and exchanging data with the ATC and the airline operations' centre through the ATSU system.

As far as new landing capabilities based on FMS are concerned, the FMS Landing System (FLS) is a new concept that applies to the existing Non Precision Approaches (NPA) procedures. FLS is a new way to fly these existing NPA approaches based on an ILS 'look alike' concept for which the virtual approach path is built by the FMS based on NDB stored data.

This will allow conducting NPA in the same way as a precision approach (based on instrument flight) with similar display, guidance and warnings.

For these new concepts, the FMS human computer interface needs improvement to make best use of the increasing number of features to ease pilot interaction with the system. Such improvement of the FMS and its high level of automation will further change the pilot's role considerably.

These anticipated future concepts consider capabilities and functions that will be required to manage the increasing traffic growth, reduced fuel consumption and continuous safety improvement demands, while not ignoring preparation for future requirements and will significantly drive the development of new flight management systems.

The A380 cockpit layout has made some steps towards these concepts with two new display units called Multi Function Displays (MFDs), an interactive display much larger than the MCDU display. All FMS functions (including data-link exchange messages) are now accessible through the MFDs via two Keyboard Cursor Control Units (KCCUs). KCCUs consist of a keypad and a trackball system, which enable movement of a cursor on the MFDs to insert data or change menu pages (just like a cursor in a normal home computer).

A380 cockpit

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Conclusion

Since the very beginning of commercial flight it was clear to the pilot community that strict rules were fundamental for safe and successful flight and with continuous traffic growth an efficient flight had to be prepared in advance and in all details - increasing pilots workload. Introduction of the FMS became a necessity to assist pilots in their flight preparation and for airlines to obtain the most fuel-economic route to be flown.

Today, the new developed FMS (FMS 2nd generation) reduces the pilot's workload by managing the entire flight from take-off to landing by performing all the complex navigation calculations that the crew had normally performed in the past to achieve the highest efficiency and cost savings.

In the frame of this FMS evolution, Airbus goal is to assure that pilots interact with different FMSs in the same way regardless of the different Airbus aircraft families, leaving to operators the choice of their fleet standardization when a new standard with new concepts become available.

It is worth noting that FMS, being a 'live' system, needs to follow and, above all, to anticipate new concepts and capabilities taking into account economical, fuel-efficient, safety and airworthiness aspects. In the new FANS concept today under development, the FMS plays a key role not only for navigation providing aircraft present and planned position during the flight, but in surveillance and communication linked with real-time information shared with air traffic control and the airline ground operation centre.

These new concepts known as FANS, RNAV and RNP are essential to cope with estimated evolution of the worldwide air traffic, by reduction in aircraft separation minima while maintaining the required level of safety. The global concept is to increase the air space capacity enhancing operational flexibility based on new satellite technology and on digital communication for position and data exchange. Moreover, FMS will also play a basic role with FLS, a new way to fly NPA approaches.

With the future concepts now under development it will be fundamental to continuously improve pilot's awareness considering faster system reactivity and providing different option choices to operators while maintaining a similar FMS crew interaction regardless of the aircraft type in use.

AIRBUS

New flight operations documentation for the A380

Electronic documentation brings major improvements in usability and efficiency

Starting from the Middle Ages with the invention of printing, books have been the common support material for storing and retrieving information for knowledge or reference. Aviation did not deviate from this and from the beginning of commercial aviation a multitude of paper documents were used for reference in aircraft daily operations. The aircraft flight operations manuals are an important part of this documentation. However, paper documents have some disadvantages, particularly for flight operations manuals which are very dynamic documents that have to provide the flight crew with the right information at the right time and are subject to regular updates to stay current with the deployed fleet. Amongst its disadvantages paper has low operational capabilities (e.g. no easy way to retrieve the needed information or to navigate within several books) and offers low flexibility and high cost in revision management or customization. New electronic technology in information management offered modern capabilities to introduce new concepts for the flight operations manuals in an Electronic Flight Bag (EFB) and even more integrated electronic documentation (eDoc) in the A380 Onboard Information System (OIS). This article explains the path from the EFB to the advantages of eDoc and its integration in the A380 OIS.

Francis PAYEUR
Director A380/A350/A400M Operational standards
Flight Operations and Line Assistances
Airbus Customer Services

Beginning with the EFB

Airbus was a pioneer in the development of the EFB via the Airbus Less Paper Cockpit (LPC) project.
The LPC project began in the mid 1990's, and was implemented first in line operations in 1997. It led the way towards the era of electronic documentation in the cockpit, with first the reduction of paper, then paper elimination. The first step in this significant transition involved performance calculations (e.g. takeoff, landing, weight and balance computations) and then the introduction of the first electronic manual: the Flight Crew Operating Manual (FCOM) based on SGML (Standard Generalized Markup Language) data. This format was then adopted for the Master Minimum Equipment List (MMEL).

This solution provided flight crews with readily accessible, updated, and optimized information to perform operational tasks in the cockpit - their working environment. It also presented numerous cost and management advantages to airlines by simplifying the tedious and costly paper preparation and distribution process, and by providing optimized data to comply with specific operational needs. With this innovative LPC project, and its pioneering introduction into service, Airbus gained a wealth of experience in the domains of digital documentation and the EFB and from this the eDoc concept was born.

With the advent of the A380, new opportunities emerged for an inventive concept of enhanced and fully digital operational documentation displayed on the OIS terminals integrated in the cockpit. This new A380 concept of electronic documentation not only benefits from the experience obtained during the development of the LPC, but also from all of the new opportunities offered by a fully digital format and by the integration of the OIS within the cockpit and its connection with other aircraft systems.

The OIS can host the entire EFB package and provides the flight crew with all the operational and mission oriented material that they need in their daily operations. This includes technical information, operating manuals, performance computation and mission management information. The OIS eliminates the need for paper in the cockpit and replaces it by a package of comprehensive applications within the OIS. The birth of the OIS sets up the eDoc concepts, and revolutionizes customization capabilities for the flight operations manuals.

OIS general overview

The OIS, also referred to as Network Server System (NSS), has two sides: the NSS AVNCS (avionics) side and the FLT OPS (Flight Operations) side. The flight crew can select the side to be displayed on the two dedicated terminals in the cockpit.

NSS AVNCS SIDE

The NSS AVNCS has two servers that mainly host the applications and manuals used for maintenance purposes.
Two-way communication between the NSS AVNCS and the aircraft avionics systems is possible via a secure interface. The NSS AVNCS also hosts applications for the flight crew:

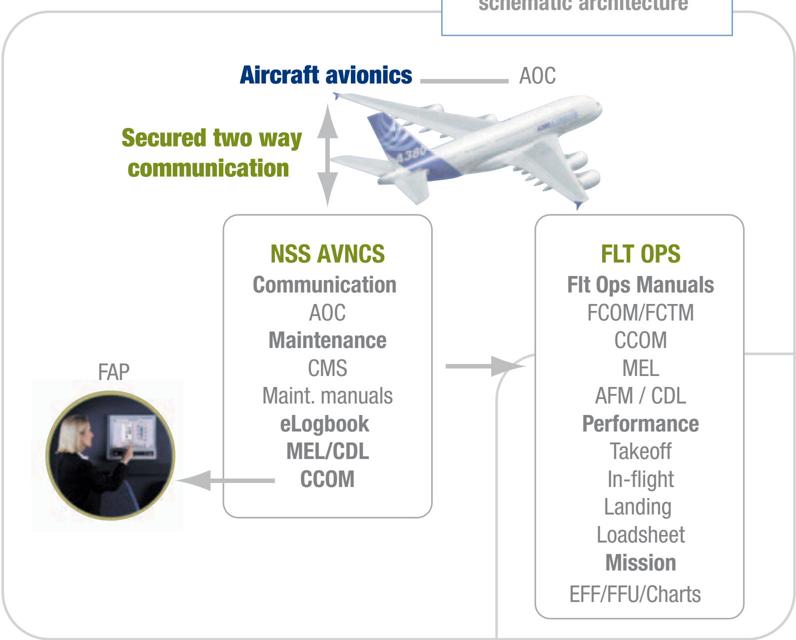
- The Airlines Operations Control (AOC) that the flight crew uses to communicate with their airlines flight ops department,
- The electronic logbook.

The NSS AVNCS also hosts the Cabin Crew Operating Manual (CCOM) that is displayed on The Flight Attendant Panel (FAP) and the Minimum Equipment List that is available for maintenance purposes.

FLT OPS SIDE

The FLT OPS side is the main side used by flight crews and has two laptops that are attached to the aircraft and connected to the OIS network. The flight ops side can receive information from the aircraft avionics via the NSS AVNCS and a diode designed to secure communication from/to the aircraft avionics. An additional backup laptop is available that is electrically powered by the aircraft, but is not connected to the network. The laptops host all the flight ops applications:

- The ops library that contains all the electronic manuals that can be used by flight crews:
  - Flight Crew Operating Manual (FCOM),
  - Flight Crew Training Manual (FCTM),
  - Cabin Crew Operating Manual (CCOM),
  - Minimum Equipment List (MEL),
  - Aircraft Flight Manual /Configuration Deviation List (AFM/CDL),
  - Weight and Balance Manual (WBM),



OIS simplified schematic architecture

Airlines can keep or remove any of the Airbus produced manuals and put their own manuals in the OIS. They can also customize the content of the Airbus manuals to fit their needs or comply with any local requirements.

- The performance applications: Takeoff, landing, in-flight, loadsheet,
- The mission applications: Nav charts, Electronic Flight Folder (EFF)/Flight Follow Up (FFU).

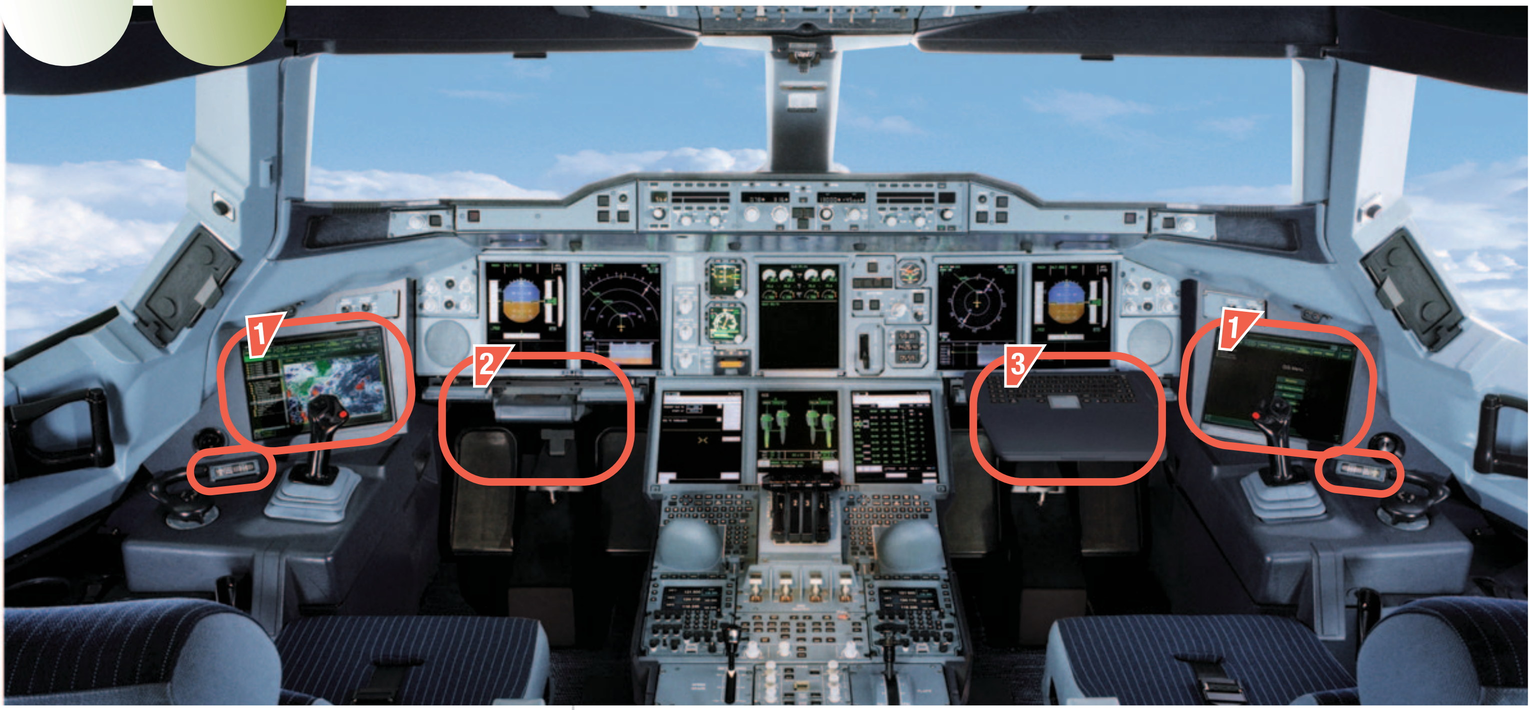
OIS installation in the cockpit

On board the aircraft the flight crew uses two dedicated terminals, referred to as Onboard Information Terminals (OIT), to display and operate the flight ops applications. The flight crew operates each terminal by using a dedicated keyboard attached to the folding table, a pointing device that is fitted in the folding table, and/or additional keys near the terminals. In accordance with regulations, the A380 OIS installation being fixed, attached to the aircraft and using aircraft displays and interface, it is classified as a Class 3 EFB installation.

Overview of OIS flight ops applications

- **A Class 1 EFB** has no installation in the aircraft (stand alone laptops connected for electrical supply only).
- **A Class 2 EFB** is a Class 1 EFB with an installation in the aircraft to fix the laptop for use.

OIS in the cockpit



1 OIT and additional keys

2 Folded keyboard

3 Keyboard

eDoc on OIS

eDoc is designed to fit this new electronic format on the OIS. This new format enables the introduction of a considerable number of new functions within the A380 operational documentation. In particular, these include:

- New, structured, electronic documentation,
- A new Human Machine Interface (HMI),
- Enhanced consultation modes,
- Information layers,
- Line and training-oriented development,
- New revision processes and,
- Customization capabilities.

Operational manuals are also used outside the aircraft, in an office or on a standalone computer for example. However, for training and for operational efficiency purposes, they will always be presented and used exactly in the same way, regardless of the support that may be used to display them. Only the functions that require direct information from the aircraft are not available when the documentation is consulted outside the aircraft.

eDoc structure

The first step of the eDoc implementation for A380 was development of specific tools at Airbus. This started in 2001 with the specification and development of tools to support the new format and all the main new features of the A380 ops documentation. These tools, namely OPS DATA, enable the writing, management and production of the A380 eDoc.

The primary electronic format developed for A380 operational documentation is XML (Extensible Markup Language) stored in the OPS DATA databank. The output is also a set of files in XML format, and is used as the basis for electronic consultation and customization of data by airlines.
The electronic manuals are structured in Documentary Units (DUs).

A DU is a small piece of information that is usually self-explanatory, self-sufficient, and independently understandable on its own. It is made up of a succession of well-organized objects and corresponds to the different types of data that can be found within the different manuals.

For example:

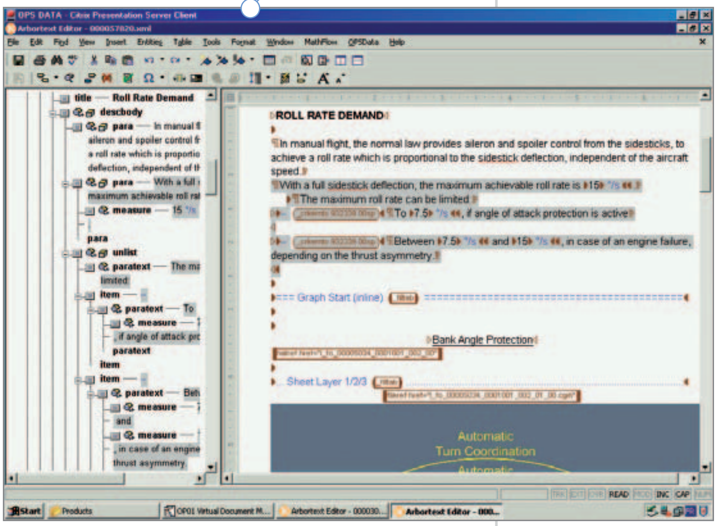
- For the FCOM: Descriptions, procedures, limitations, performance,
- For the MMEL: Descriptions, malfunction assessment, dispatch items, operational procedures.

Each DU has a Document Type Definition (DTD), which defines its content, structure and metadata (information associated with the DU). The DU can be structured text, and/or can have illustrations (in Computer Generated Metafile - CGM - format), multimedia data (sound, video), colour, interactive zones and links (e.g. internal links, or links to external manuals or applications). DUs enable such new functions introduced by the A380 eDoc as 'contextual access' or 'information layers' (both described later).

DUs are also basic elements that enable configuration management by technical criteria such as modifications or Service Bulletins (SBs). A new management process enables SBs to be taken into account in the operational manuals, even before they are applied, as soon as airlines have accepted the SB and decided to incorporate the modification. In this way, data for operational manuals can contain not only the current aircraft definition, but also, in anticipation of an SB retrofit, the definition of an SB (Pre/Post SB Management) after incorporation.

This Pre/Post SB Management does not apply to the approved manuals (e.g. AFM, MMEL).

OPS data tool



All DUs are no longer classified in volumes, but are organized in a tree structure according to the type of information. For instance, the structure of the FCOM is organized according to the four different types of information (descriptions, procedures, limitations and performance) that can currently be found in it. This structure, reflected in the OIS navigation tree facilitates navigation within the manual and simplifies the task-oriented and contextual approach of the FCOM.

From XML data to the display on board the aircraft

All DUs are produced in XML with the graphics in CGM; multimedia objects are also incorporated as needed.
To cope with all possible needs, the frequency of the exchange of revised data between airlines and Airbus is contractual with each airline defining how often they need to receive revisions from Airbus. The shortest frequency is monthly. These customized revision frequencies provide air-lines with the possibility of regularly obtaining eDoc revisions for updating documentation onboard the aircraft and increases the flexibility of the data customization process. Furthermore, regard-less of which revision frequency is selected, Airbus can also initiate revisions for the dispatch of urgent information (e.g. 'real time' up-dates). For the benefit of custo-mers, XML data packages that are produced are available on the Airbus customer portal (AirbusWorld). The XML raw data are either:

- Used as is for OIS consultation. In this case, the XML data is simply converted into Hyper Text Markup Language (HTML) format using a publisher tool developed by Airbus: OPS PUBLISHER,
- Used as source data for establishing a customized and in-house developed airline operating manual. In this case, airlines can use Airbus developed editing and management tools (ADOC – Airbus Document system or FOSP – Flight Operations Standard Package) or their own XML tools to customize the Airbus data as needed, or as required by their local authorities.

One of the greatest advantages of the A380 eDoc is its customization capability.

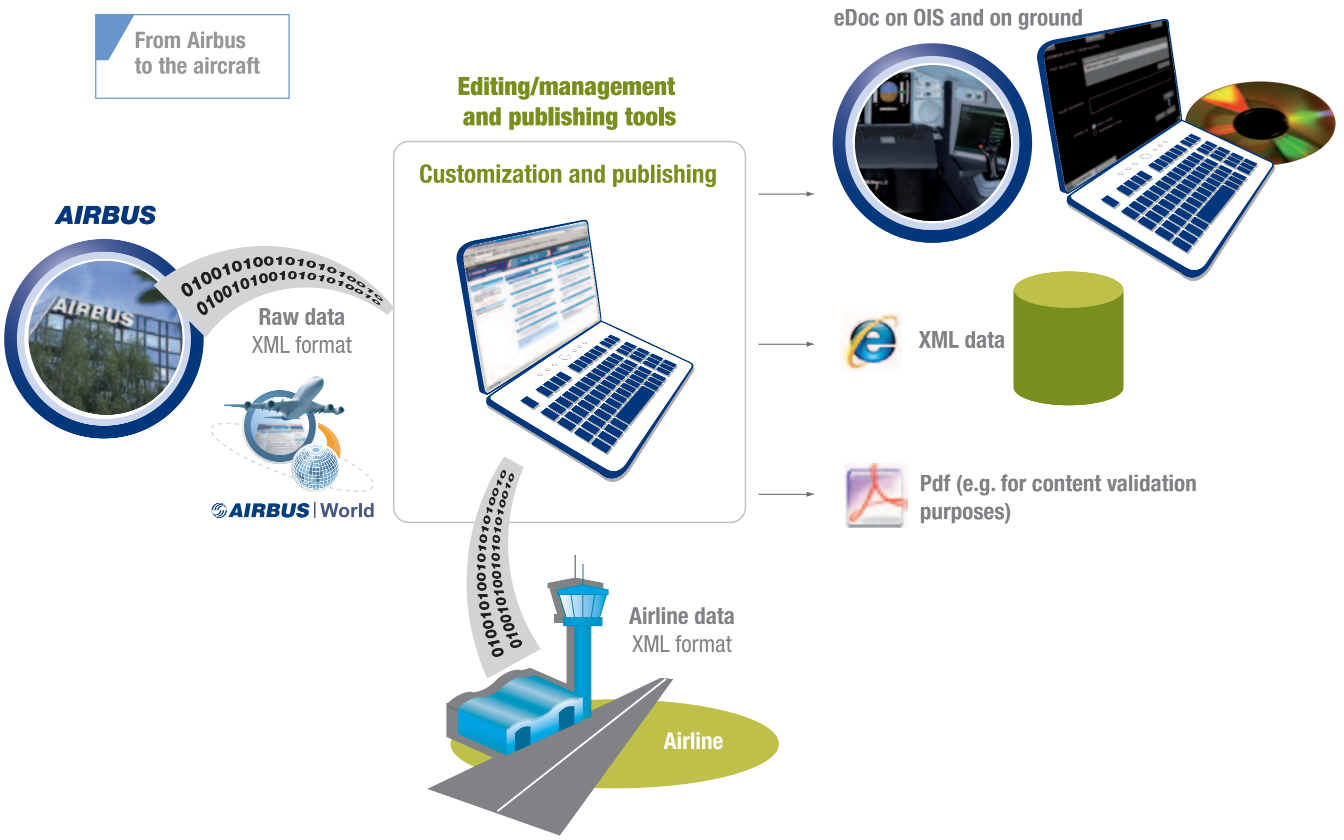
This helps airlines cope with their operational needs, offers them increased flexibility and facilitates their workload and the reworking of Airbus data. In addition, it helps airlines benefit from all of the new Airbus eDoc functions.

All airlines manage and update their Airbus operational manuals in different ways, such as:

- Used, as is, for line operations, or,
- Complemented by some other information, operations manuals, or modified to suit operational needs, airline policy, or airworthiness requirements. Some of the reasons include:
  - To ensure fleet commonality,
  - To specify the applicable standards enforced by the airline,
  - To comply with an applicable operational regulation (e.g. Joint Airworthiness Requirements -JAR OPS-, Federal Aviation Requirements part 121) and/or the need for a local adaptation of these regulations.

With these different variables, it is possible that not only the structure of the manuals may change, but also the technical content. For some manuals this customization is necessary and even required by regulations, for example, to transition from the Airbus MMEL to the airline's Minimum Equipment List (MEL), which is then modified according to local requirements.

The editing, management and publishing tool has a function to publish the XML raw data in the consultable format of HTML. The end result of this is data ready for loading into the OIS onboard the aircraft. The OIS has a specific application that has been defined and developed by Airbus to display the data on the OIS: The Flight Ops Consultation Tool (FOCT). This development has been made in a fully integrated way within



the A380 programme development. Therefore, due to its integration within the A380 cockpit, Human Factor considerations have been applied for its development.

Human Machine Interface (HMI)

With the fast growth of electronic information for direct use by the flight crew in performing their tasks in the cockpit, various stu-dies, directives and regulations have been issued to provide Human Factors (HF) considerations in developing and using electronic documentation.

Among all the published documents, the Federal Aviation Agency/Volpe Center document: 'Human Factors Considerations in the Design and Evaluation of Electronic Flight Bags' (ref DOT-VNTSC-FAA-006-22) provides an extensive reference for the development and definition of the A380's eDoc HMI.

The eDoc HMI is also defined in accordance with general OIS HMI rules, and in compliance with cockpit HMI rules.

In addition, in the OIS platform certification or, more extensively, in the cockpit HF certification process, special HF demonstrations for OIS applications, including eDoc have been run with a large variety of pilots from airlines, authorities and Airbus.

The eDoc and its operational use was also evaluated in the generic operational approval of the OIS applications conducted by Airbus. This generic approval eases the operational approval to use the electronic documentation that is required for each individual airline.

In this way, an integrated Joint Operational Evaluation Board (JOEB) made of representatives from the Federal Aviation Agency (FAA), European Aviation Safety Agency (EASA) and Transport Canada evaluated the use of the eDoc in an operational environment. From this, HF aspects were taken into consideration in defining the final role of eDoc and its HMI, which was designed to help the end-users –flight crews– to access the correct information, at the right time, with the correct level of detail, and to provide the right interface to easily navigate through the information.

Among the main HF criteria used to define the eDoc HMI were: Learning capacity, efficiency, clarity, consistency, safety…

eDoc main new features

The eDoc electronic format offers many possibilities for enhanced consultation and navigation within the flight ops manuals. It enables the introduction of attractive, useful and easy to use functions to facilitate consultation and displays the information in an attractive way in colour with realistic representations of aircraft displays and pilot's interfaces.

ENHANCED CONSULTATION MODES

Various consultation modes and search capabilities are available. The eDoc can be consulted in a conventional way by steering through the navigation tree in a linear mode. With this, users can recognize the typical structure of flight ops manuals and select in the navigation tree the information they need. Some of the other capabilities include:

WORDSEARCH

The electronic format offers word search to find any information containing the selected word(s).

CONTEXTUAL ACCESS

One of the greatest advantages of the electronic format, due to its integration in the cockpit environment, is the possibility to receive data from the aircraft avionics systems. This is known as contextual access and permits

Contextual access

a task-oriented access to information. Contextual access offers the flight crew an easy and rapid way of accessing information from the eDoc (particularly the FCOM and MMEL) without needing to know the manuals structure and/or where to look for relevant information as the eDoc finds it for them. This is automatically achieved via alerts that come from the ECAM (Electronic Centralized Aircraft Monitor). An ECAM alert is used by the OIS to automatically pre-select relevant information from the eDoc. For HF and certification reasons, the OIS does not automatically display the information so the flight crew can continue to concentrate on their basic tasks and are not distracted.
They can access this pre-selected information when desired.
In addition, if an ECAM alert has an impact on landing performance, the OIS LDG PERF application also receives this information so that the flight crew can easily compute any performance impact. This automatic function will be available on board aircraft with the OIS version available by April 2009.
The contextual access function significantly reduces and even virtually eliminates the time required to search for and retrieve information. Consequently, this enables the flight crew to easily and readily access information and respond more quickly to operational situations.

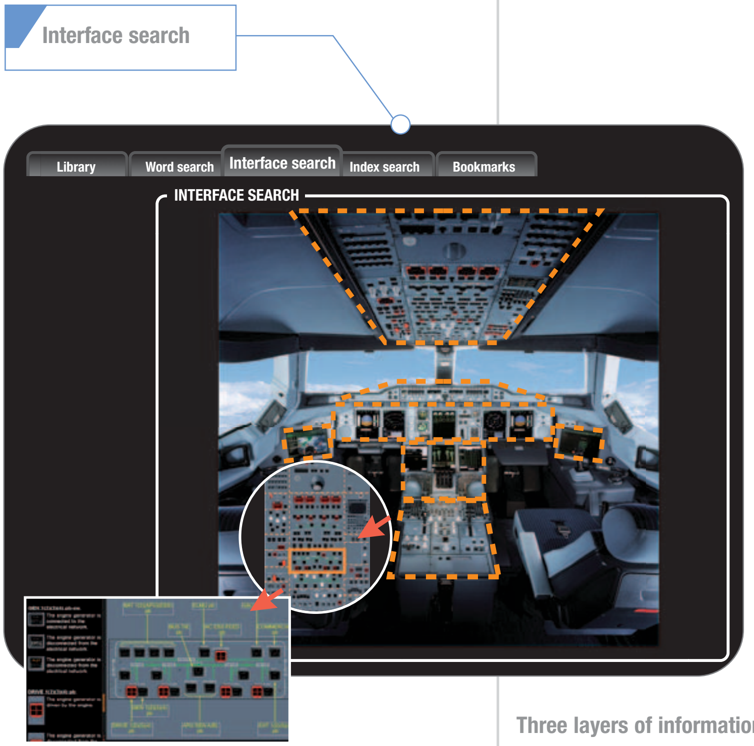
INTERFACE SEARCH

Another access mode is the interface search. By selecting a panel on a cockpit diagram, the user can access information that relates to the panel. This function will be available with the OIS version available by April 2009.

ENHANCED CONSULTATION FUNCTIONS

INFORMATION LAYERS

Operational documentation, and particularly the FCOM, has many varied uses. Basically, flight crews use the FCOM to perform their daily tasks. However, the FCOM is also commonly used by airlines for training purposes and by their operations and scheduling personnel.
The FCOM can also be used as a reference document for the creation of an Airlines Operations Manual (AOM). As such, it can be used as is, or complemented, or even reworked and customized with specific airline material (e.g. airline policy, training philosophy, national requirements).
Airlines have therefore expressed varying needs for the level of information that they would like the FCOM to provide. To support these needs, information layers are now implemented in the A380 FCOM: up to three layers of information are available and users can filter this information in accordance with their needs and the level of detail required. The A380 FCOM is directly written conside-ring these layers. Selection of the layer desired for consultation is made via dedicated controls on the OIS and the function applies to both text and graphics.



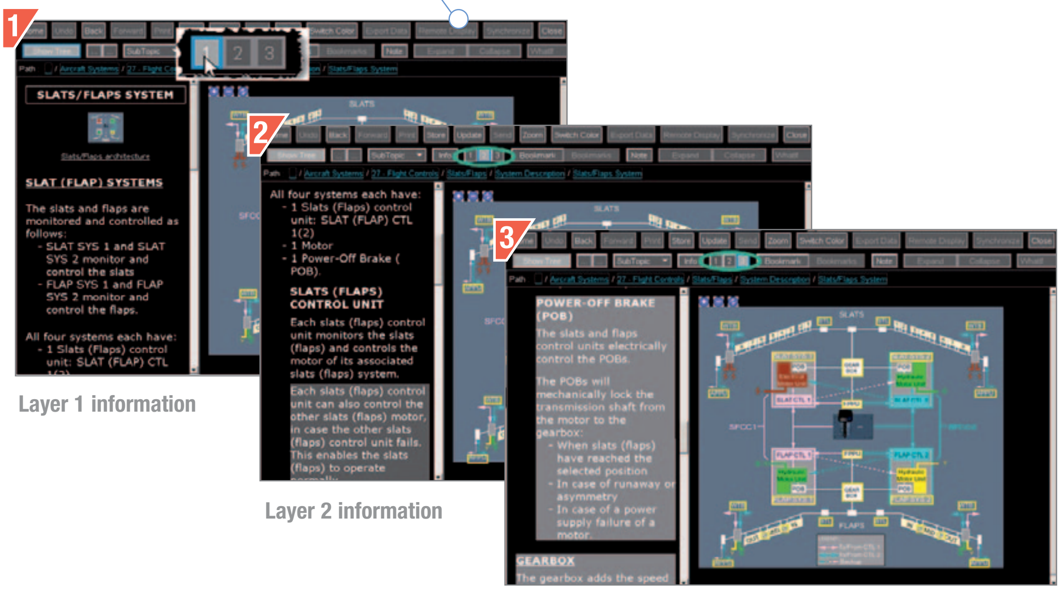
Three layers of information

- **Layer 1** provides 'need to know' information: Typically, this is the minimum amount of information necessary for the flight crew in operations and basically corresponds to information they need to know for their initial training. Computer Based Training (CBT) contains almost the same level of information

- **Layer 2** provides 'nice to know' information: This can be used as reference for the flight crew to fully understand the logic of the aircraft-pilot interface

- **Layer 3** provides 'detailed information': This is not likely to be used in flight, but provides more expertise, rationale and explanation with clarification and amplification material that can be used at an airline's discretion

Information layers in the FCOM

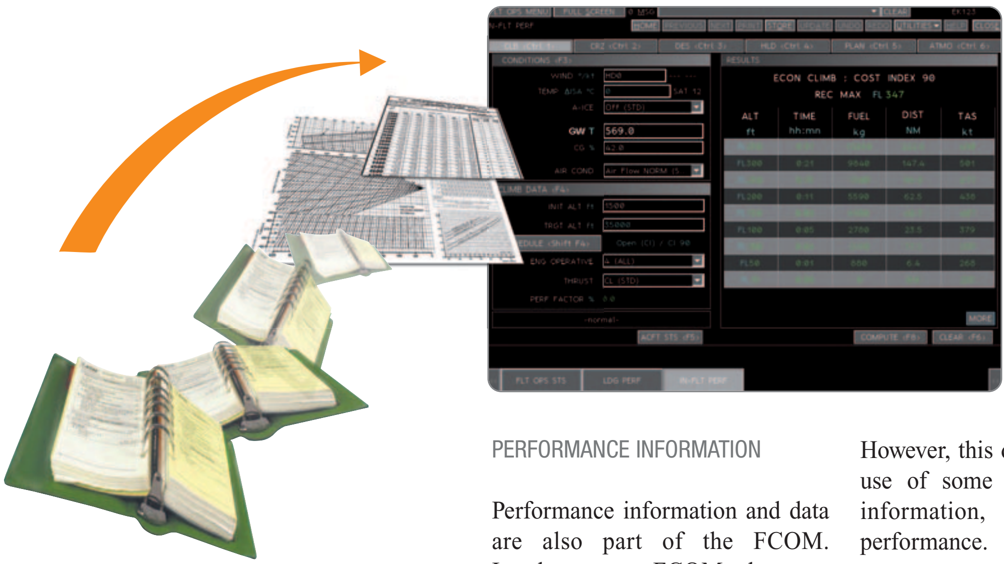


Layer 1 information

Layer 2 information

Layer 3 information

From paper to electronic performance data



PERFORMANCE INFORMATION

Performance information and data are also part of the FCOM. In the paper FCOM the performance sections are made of basic operational performance information together with a suite of performance charts and tables for takeoff, landing and in-flight performance.

In the LPC, and for airlines having implemented it, takeoff and landing performance was already available in electronic format with the LPC takeoff and landing modules.

However, this did not preclude the use of some paper performance information, e.g. for in-flight performance.

The A380 FCOM and OIS go beyond this with no need for paper performance data. All the charts previously available in the FCOM are replaced by performance applications. To ensure full coverage of performance data in electronic format, a new performance application, the 'In-Flight Per-formance Application' has been created.

OTHER ADVANCED CONSULTATION FUNCTIONS

Taking advantage of the electronic format, various advanced consultation functions are implemented in the A380 eDoc to enhance consultation and ease navigation within the whole flight ops documentation and include:

LINKS

Each eDoc manual is no longer consulted as a standalone manual. Users can directly navigate from one manual to any other linked manual or operational application. For instance, links between the FCOM abnormal procedures and the MMEL enable easy assess of dispatch conditions for associated failures. For MMEL items with a performance impact, the relevant performance application is linked to the MMEL item to ease performance computation in a degraded configuration. These links between the ops manuals or applications enable flight crews to quickly and easily navigate between them. In addition, and most importantly, they not only reduce the flight crew's workload by preventing multiple data entries, but also increase accuracy and safety by preventing sources of errors from such multiple data entries.

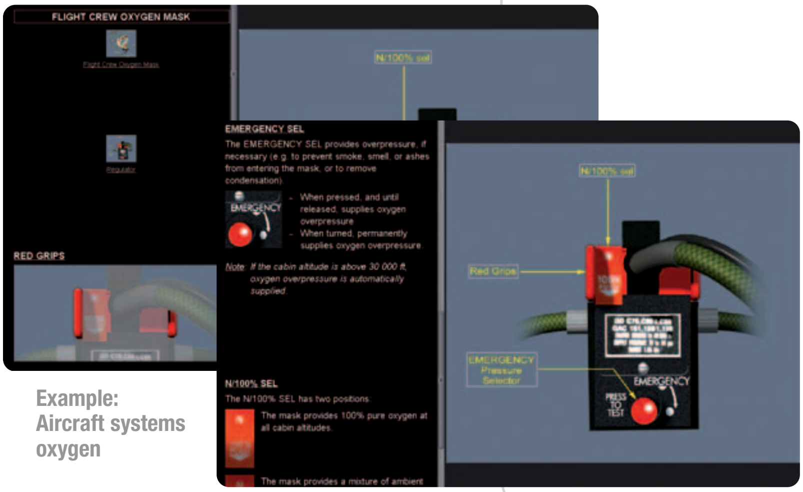
MULTIMEDIA/INTERACTIVE ZONES

The flight ops manuals and particularly the FCOM description part is mainly constructed around graphics with interactive zones. By clicking on these zones users can access any information for this part of the graphic.

SOUNDS

The FCOM also includes all sounds that can be generated by the aircraft systems (e.g. Flight Warning System or Surveillance System) and some videos (e.g., to show sequences of actions).

Interactive zones



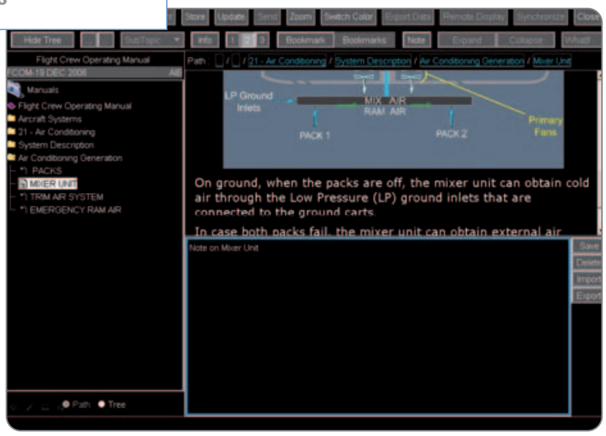
Example:
Aircraft systems oxygen

Audio and video in the FCOM

PERSONAL NOTES

In some cases flight crews may need to add personal notes on the manuals for their own records, so the manuals provide an annotating function. The notes are attached to each Documentary Unit and can be easily retrieved via the navigation tree, which automatically creates a specific chapter with all notes available. Additionally, the notes can be exported for sharing with other users.

Notes in the flight ops manuals



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Conclusion

Previous paper operational documents suffered from disadvantages in consulting in an operational or training environment and also in the time, process and frequency of updating with revisions, the difficulty of integrating airline and Airbus content and various others.
When electronic documents became available, with the introduction of the Airbus LPC, they offered opportunities to reduce these disadvantages. These were a first step towards a new concept of flight operations documentation.
Now, the advanced technology of the A380 enables a further step to be made with an enhanced concept of electronic operational documentation that can be displayed on the OIS of the aircraft.
This new concept benefits from the experience gained by the airlines and Airbus with the LPC and is enriched by the new opportunities offered by A380 systems and electronic documents to enable a much better integration of task oriented operational documentation in the cockpit. Customer satisfaction was a prime objective for the new A380 flight operational documentation so airlines were deeply involved from the beginning, particularly in the FCOM, FCTM and MMEL.
The A380 operational documentation is setting new standards for ease of use, functionality, airline and Airbus data integration and numerous others.
This will be beneficial for existing and future projects such as the A400M and the A350 XWB. In addition, it will benefit the evolving Airbus 'Going Digital' project for the A320, A330/A340 families and will help operational documentation to cruise to new heights of usability.

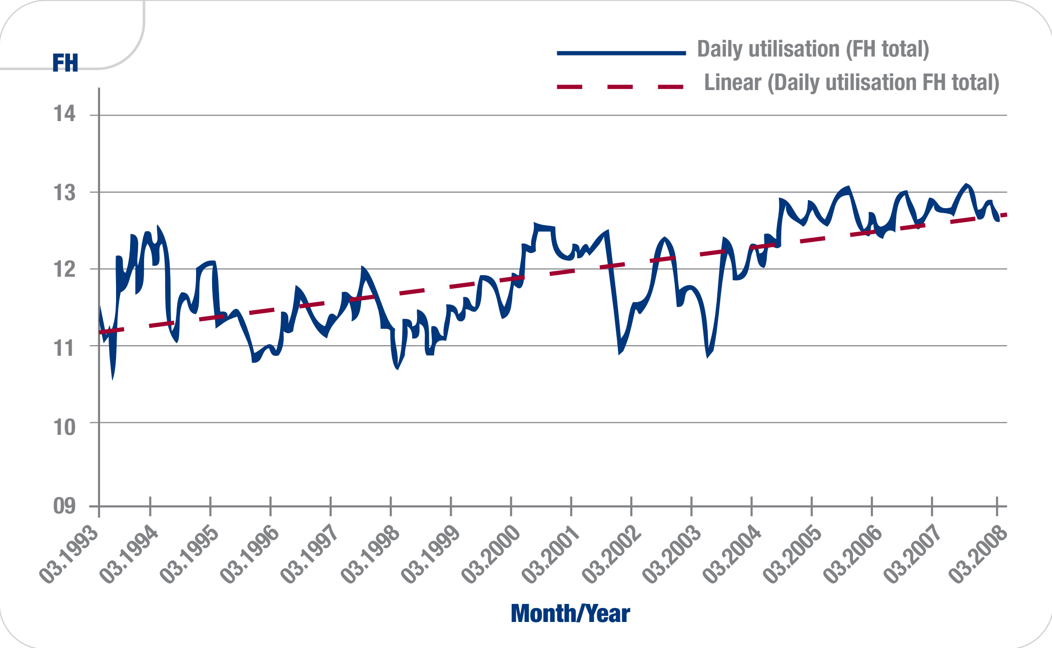
AIRBUS

Fuel system water management
A330/A340 enhancements

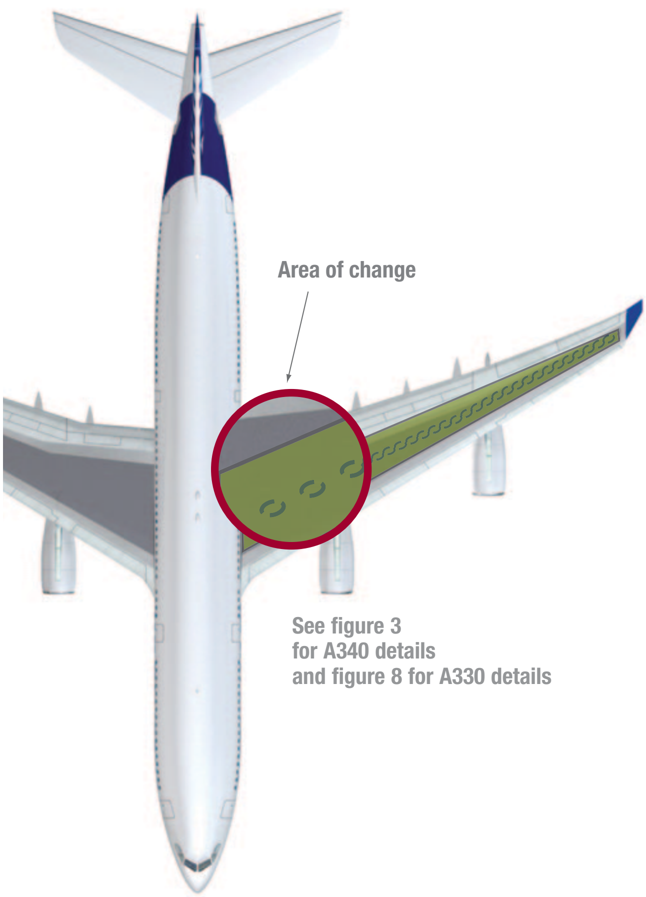
Since the entry into service of the A330 and A340 aircraft in the early 90's the aircraft utilization rate has increased by over 10%, reducing the time available for maintenance activities (refer to aircraft utilization rate chart on next page). The Maintenance Planning Document for the aircraft has a minimum interval of weekly for draining the A330/A340 aircraft fuel tanks of settled water, which can be difficult to achieve in the reduced maintenance time and can lead to accumulation of water in the tanks causing problems and aircraft delays. In the frame of the continuous improvement programme, Airbus is focused on optimizing aircraft availability and reducing maintenance costs for airlines. A key enabler for aircraft dispatch is the availability of the aircraft Fuel Quantity Indication System (FQIS). Industry-wide, the major threat to FQIS availability is microbiological contamination of the fuel (see FAST 38) and water in the fuel tanks. Settled water in the fuel tanks may affect FQIS indications, typically driving FQIS probe readings out of limits and leading to aircraft delays for tank draining. Therefore, a regular water drain task is essential for smooth aircraft operations. Responding to airline needs for increased aircraft utilization and regular maintenance actions Airbus has developed solutions, which will help to extend the water drain task interval on A330/A340 Family aircraft. This article explains the issues and solutions for fuel system water management enhancement.

Laurent ARIS
Group Manager - Fuel Systems
Customer Services Engineering
Airbus Customer Services

1 Aircraft utilization rate



2 Wing plan view



Fuel Quantity Indication System

The Fuel Quantity Indication System (FQIS) measures the quantity of fuel in each of the aircraft fuel tanks. It displays this information on the flight deck, providing indication of the Fuel on Board (FOB) and, via the Electronic Centralized Aircraft Monitoring (ECAM) Systems display, the individual tank quantities. On the A330/A340 fleet the data is also used for the auto-transfer functions e.g. CG (Centre of Gravity) control.
Airbus aircraft use a capacitance Fuel Quantity Indication (FQI) system to measure the fuel level (volume) within the aircraft fuel tanks.
Vertical probes located throughout the tanks measure the fuel level in the tanks. Each probe has two concentric aluminium tubes. The open ends of the tubes allow the fuel to move freely between the tubes. The fuel/air ratio within the probe is the capacitor dielectric; as the fuel level changes, so does the probe capacitance. When the probe is dry, the capacitance value is low, but as fuel moves up the probe the capacitance value increases. Fuel density is measured using the fuel dielectric value or variations with the speed of sound. The FQIS uses the volume and density values to calculate the mass (kg or lb).

Effect of water in the fuel tanks

The FQIS system is calibrated for use with jet fuel and the probes measure from 'unusable' to full tank capacity. However, the dielectric of water is approximately eight times higher than the jet fuel dielectric. Therefore, when there is water in the proximity of the probes, the fuel measured capacitance changes. Typically, the probes will read a higher capacitance level than the actual fuel level. In some cases the measured capacitance of the probe will over-read or 'disagree' with a neighbouring reading. At an aircraft level in the cockpit, a key symptom of presence of water in fuel is degraded or failed (XXX) fuel quantity indication.
In some cases aircraft dispatch may be limited by the status of the FQI display (see the Airbus Master Minimum Equipment List or airline Minimum Equipment List).

Moreover, in cold weather operations (below 0°C), as the water drain valves are located in the lower part of the fuel tanks where water accumulates, there is a risk of frozen water around the drain valves, which would prevent the water from being drained.
Microbiological contamination may also develop at the fuel/water interface (see FAST 38) and if water is left un-drained in the fuel tanks it may contribute to an increased risk of microbiological contamination. Considering these factors in the continuous improvement programme, Airbus has developed solutions to enhance the efficiency of the fuel tank water drain and scavenge system.

Water drain and scavenge enhancements

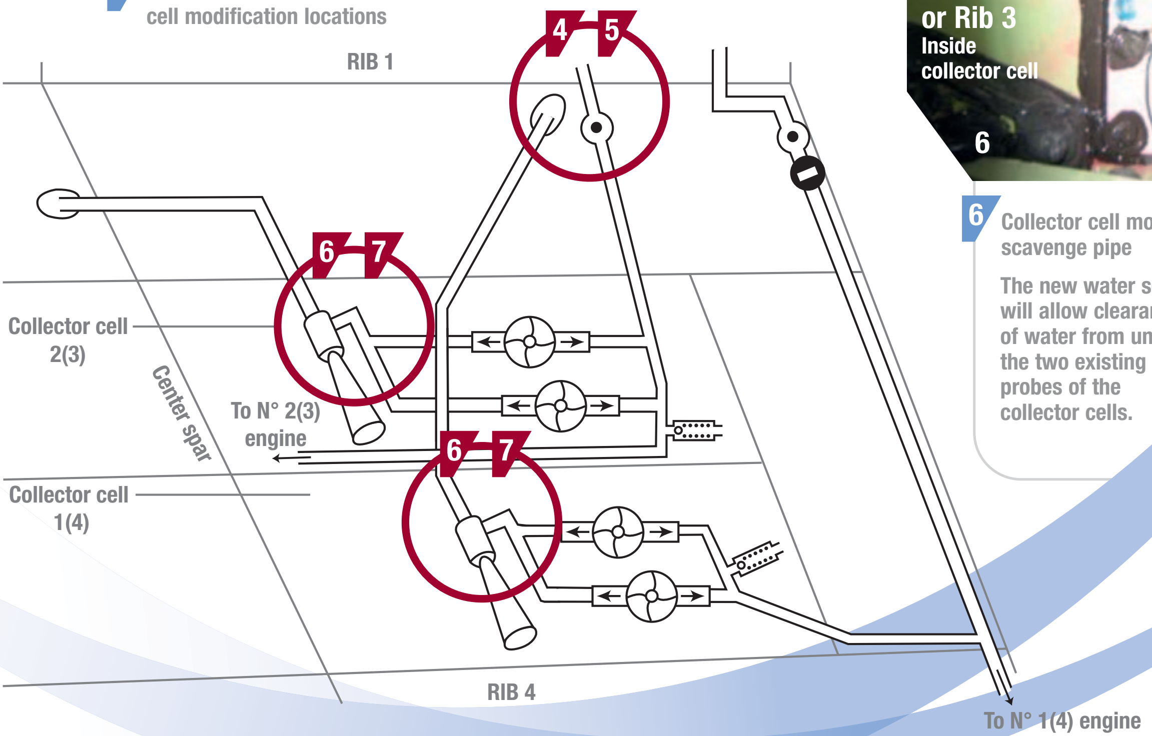
A330/A340 RIB 1 ENHANCEMENT

The modification for this consists of a new water scavenge pipe that draws water from the low point of this area. The water scavenged by this new pipe is re-circulated within the collector cells through the existing fuel transfer system. Once there, the water is blended with jet fuel and this, with the water in suspension, is then consumed by the engines via the fuel feed system, thus eliminating the water from the tank.

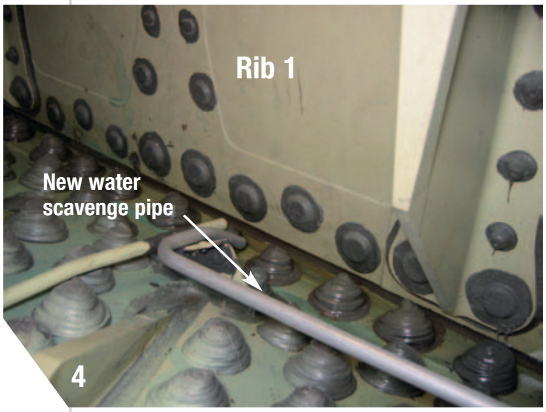
A330/A340 COLLECTOR CELL ENHANCEMENT

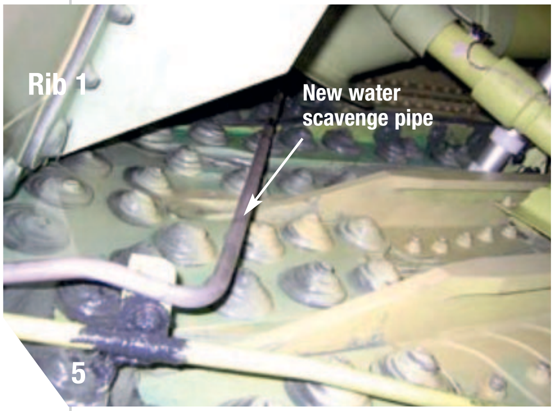
The A330 and A340 collector cell is a local fuel reservoir inside the wing tank that ensures the fuel pumps are always immersed in fuel in any flight conditions. The modification for this extends the current water scavenge pipe and adds a new remote pick-up pipe for the water drain valve. Similar to the Rib 1 modification, the collector cell water scavenge pipe will draw water from the collector cell low-point. The water scavenged by this new pipe is re-circulated within the collector cells where the water is blended with jet fuel and then consumed by the engines via the fuel feed system.

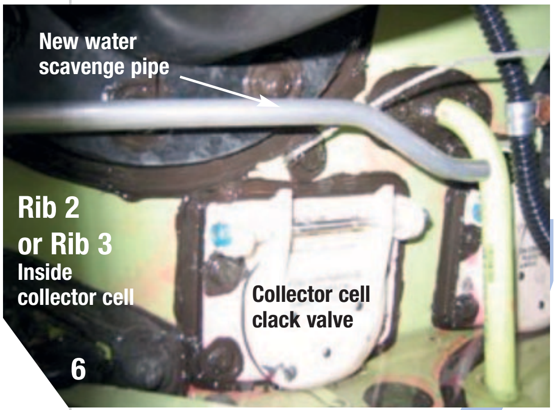
3 A340 rib 1 and collector cell modification locations



4 5 Rib 1 modification





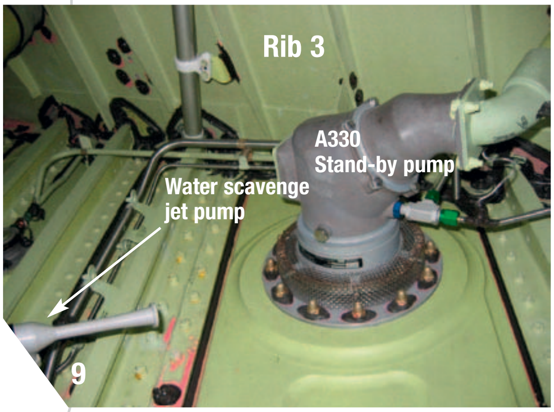


6 Collector cell modification scavenge pipe

The new water scavenge pipe will allow clearance of water from under the two existing FQI probes of the collector cells.

7 Collector cell modification
Water drain remote pickup pipe

9 A330 Rib 3
Water scavenge jet pump

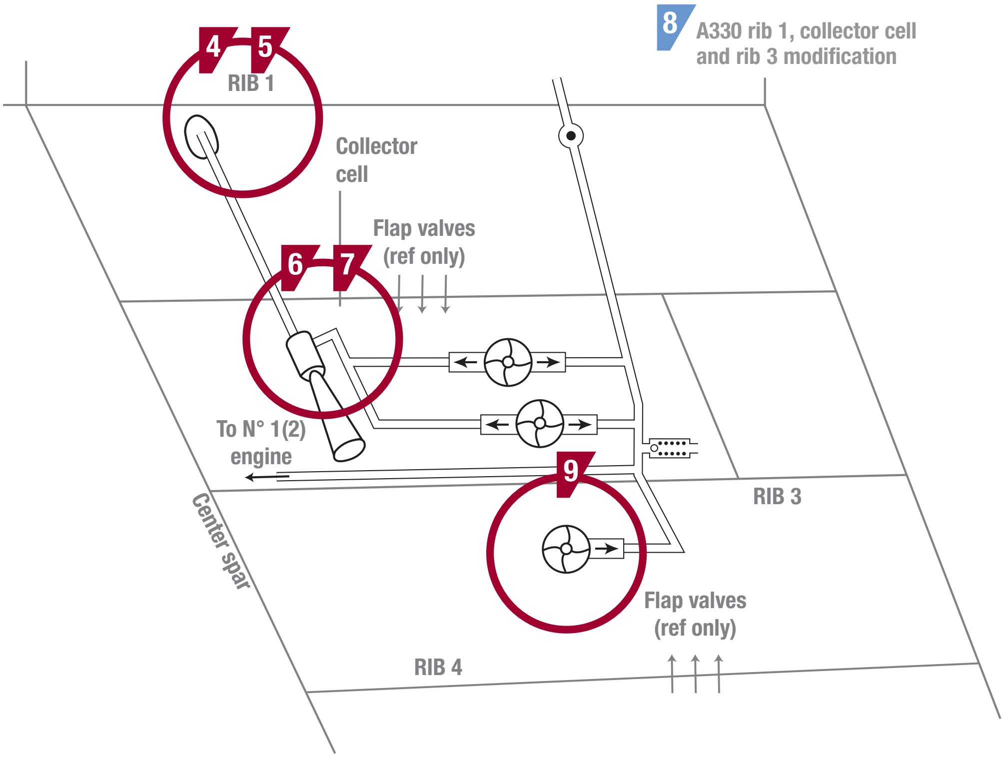


A330 RIB 3 ENHANCEMENT

Additional modifications have been developed for the A330 Rib 3 area. These introduce a water scavenge jet pump, with an induced flow line to the rib bay 3-4 tank sump. The water scavenge jet pump receives motive flow from the standby feed pump.

This modification does not interfere with the existing standby feed pump operation and does not require modification to the existing circuitry. The additional electrical components allow the stand by feed pump to be automatically operated. The stand by pump operates when the aircraft is on the ground, both main pumps have been selected and engines are above idle. The electrical modification allows normal stand by feed pump operation (when main pumps fail) or on normal pump selection and any failure, of components introduced the scavenge cycle without interference of the normal pump control system.

8 A330 rib 1, collector cell and rib 3 modification



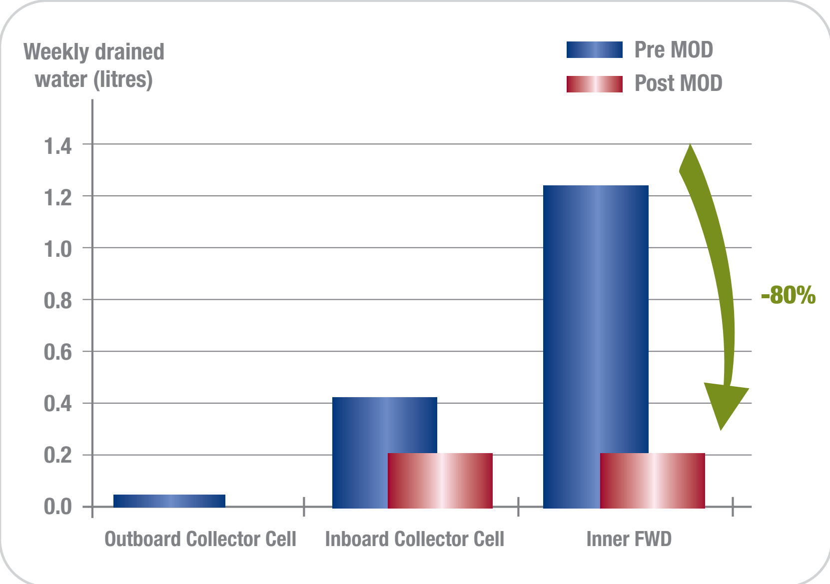
This modification improves water scavenge in the rib 3 area and reduces the quantity of settling water.

In-service evaluation and results

The A340 water scavenge modifications were installed on two in-service aircraft during summer 2007, evaluated in normal airline operations for six months and the results are now available to airlines.

The evaluation showed a reduction of up to 80% of the quantity of water drained, as shown in the chart below. Therefore, this modification has proven effective and enables escalation of the water drain task interval.

10 In-service evaluation results



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Conclusion

Water drainage has a significant impact on the maintenance burden and grounding time for airlines. Therefore, Airbus developed specific modifications for locations where the highest quantity of water has been accumulating.
Tests and an in-service evaluation have been performed and results support water drain task escalation from weekly to A-Check for aircraft with the modifications incorporated.
An additional benefit is that minimizing water content in the aircraft fuel tanks significantly reduces the risk of microbiological contamination developing within the tanks and the costly maintenance and grounding activities associated with its removal (see FAST 38).
The evaluation indicated that the cost of these modifications would be recovered in approximately 18 months for A330 aircraft and less for A340 aircraft, providing a clear benefit for airlines in reduced maintenance activities and improved operations of their aircraft.

AIRBUS

Blue-ice runway operations
Airbus ACJ to Antarctica

An Airbus Corporate Jetliner (ACJ) is now flying regularly to and from Antarctica, transporting scientists more quickly and in greater comfort than by ship. The flights are the first to Antarctica by any airliner, the first landings on ice by any Airbus aircraft, and mean that the Airbus ACJ Family is now flying on every continent, highlighting the versatility of the family. Captain Garry Studd explains operation of the aircraft in Antarctica.

David VELUPILLAI
Product Marketing Director
Executive & Private Aviation
Airbus Customer Affairs

Operations

It is approaching midnight in Australia, and Captain Garry Studd is preparing to fly a group of research scientists in Skytraders' Airbus Corporate Jetliner (ACJ) to Antarctica. The flight takes just over four and a half hours, so it means a landing in the middle of the night - albeit in daylight, be-cause of the midnight sun.

Why not during more civilised hours? The reason is to have a colder temperature on the Wilkins blue-ice runway where they will land, and it highlights the contrasts and paradoxes of the Antarctic.

We think of the Antarctic as being one of the coldest places on Earth, and indeed it is, with winter temperatures falling below – 60° Celsius. But it is summer and, in the daytime, it rarely drops below – 20° Celsius.

Landing at night when the temperatures are lower means that the ice runway will have a better surface coefficient of friction. There are about 2,500 feet of ice underneath the runway, and solid ground underneath that – unlike the Arctic, where there is only ice – but it is, of course, the ice on the surface that matters. Much about the Antarctic is impressive. Some 80 per cent of the world's fresh water is locked up in its ice, and it is one of the world's coldest, loneliest, most beautiful and most unspoiled places.

Garry Studd has wanted to be a polar explorer since the age of about seven, has been involved in the Antarctic for more than 31 years, and is probably one of the world's most experienced Antarctic pilots.

So what's it like taking an Airbus aircraft to Antarctica and landing on an ice-runway?

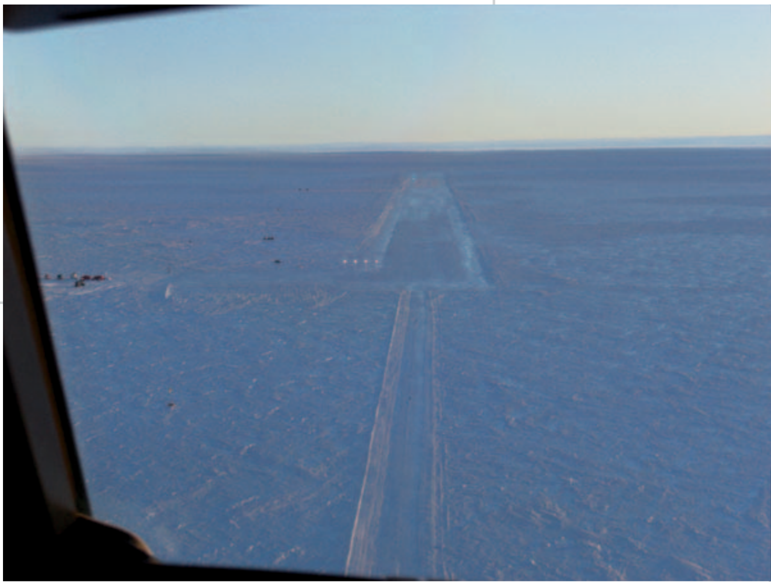
Midnight sun:
the Earth's tilt means 24 hours a day of sunlight in summer in the southern polar region.

Garry Studd says: ‘The landing and stopping are not a problem – braking action is only slightly worse than landing on a wet runway - our biggest challenge is lateral control and handling the aircraft on the ground, especially in strong winds, when there is risk of the whole aircraft trying to ‘weathercock’ (point its nose into wind)’. He continues – ‘The team on the ground measures the friction coefficient every 500 metres along the runway before we land and reports to us by radio – if it is okay we land, and if not we turn around.’ In practice, the Airbus ACJ pilots are looking for a runway friction coefficient of around 0.20 or better, before they will commit to a landing.

‘Blue-ice’ simply means a runway surface that is kept clear of snow by the wind and, at Wilkins, a 30 knots wind is typically what you get. Meteorological measurements, made before the runway was built, allowed its centreline to be aligned with this wind.

‘The challenge comes when you try to turn the aircraft around at the end of the landing roll,’ continues Studd, ‘so we deliberately restrict the Airbus ACJ’s centre-of-gravity when landing on ice to keep a better distribution of weight on all three landing gear to optimize the bearing strength of the ice and also assist us to make a 180 degree turn on the blue-ice runway in winds of up to about 50 knots.’

Skytraders operates its Airbus ACJ with four additional centre tanks (ACTs) in its cargo-hold – there is room for a maximum of six – and appreciates the aircraft’s outward-opening cargo doors, which maximizes the remaining cargo space. The extra fuel carried in these tanks allows Skytraders to fly its Airbus ACJ to Antarctica and back without refuelling, which brings several important benefits. ‘First, it means that if the weather is not good enough for a landing, we can always turn around and fly back to Australia, which is pretty important when you recognize that there is no nearby alternate,’ comments Studd. ‘Secondly, the Antarctic is very much a pristine, unspoiled place – one of the reasons it is so valuable to scientists – so avoiding refuelling means that there is no risk of contamination from a fuel spill. And thirdly, transporting fuel to the Wilkins runway would make it very costly – perhaps as much as $25 a gallon.’



Approach to the Wilkins runway, note PAPI lights on the left of the runway

Landing on the Wilkins runway

Skytraders looked at a range of aircraft ranging from small to large before choosing the Airbus ACJ for its Antarctic operations. 'We wanted an aircraft without a point-of-no-return for the mission," says Studd, and the Airbus ACJ's very long range and modest size and weight make it great for the job.'

It operates the flights to and from the Antarctic on behalf of the Australian Antarctic Division, and the big benefit it brings is a reduction in the time it takes to get scientists and their equipment to and from the region. 'Under the best conditions, it takes about ten days to go by ship from Hobart to the base at Casey, but it can take three or four weeks if you get stuck in the ice,' points out Studd. 'The Airbus ACJ also costs less a day to run than a ship, says Studd, 'and freeing one up is helpful for marine research.' The rapid flight time is also of direct benefit to some scientists. He cites the example of one researcher that makes measurements of an isotope buried in 1,000 metre long ice cores that are drilled out of the ice. The isotope breaks down in about 24 hours so, until the flights began, it was not possible to get them back to the laboratory in time for meaningful research. Some of the ice in these cores dates from a million years ago, making it a very special and unique insight into the Earth's past. Other Antarctic research covers many other fields – such as atmospheric measurements, geology, glaciology and work involving plants and animals.

Runway flyover

On the way

Skytraders' Airbus ACJ flights also make research more accessible to scientists – who might not be able to afford to devote the month or two that travel by ship would demand, but would be able to spare a week or two. It also makes emergency evacuation flights possible and, if equipment breaks or something needs replacing, then it can easily be flown out very quickly.

Skytraders' Airbus ACJ features an airline-style layout, with 28 seats in business class, and 54 in economy. Flights to the Antarctic typically carry around 20-25 passengers, however, which is well within the 40 or so persons that can be accommodated in the emergency shelter at the Wilkins runway (the main Australian research base is at Casey, about 60 kilometres away).

The Antarctic flights leave from Hobart in Tasmania, and are run as a full public transport operation – one of the benefits of the Airbus ACJ is that it is fully certificated for such operations – under the company's own Air Operator Certificate (AOC). They are flown during the Antarctic summer, which typically runs from end-October to early-March. Because the routing takes the Airbus ACJ far from nearby airports, the flights are flown under 180 min Extended Time Diversion Operations, which are like ETOPS (Extended Twin-engine Operations), but with some additional requirements. Based on experience to date, Skytraders' Airbus ACJ typically does two or three trips a week at the start and end of the season, when there is the most need for getting people and equipment to and from the site, and an average of about one trip a week during the rest of it.

The blue-ice runway at Wilkins is certificated to the same high standards as other Australian airports, including Sydney. It took four years to build, and is the largest certificated aerodrome in Australian territory. Situated 70 kilometres inland, and at a height of 2,500 feet, the Wilkins runway is 4,000 metres long and 100 metres wide. It comprises levelled blue-ice, and has to meet the same stringent standards required of other Australian airports – including no bumps above a certain height and other conditions. Creating and maintaining a surface of compacted snow, which offers better braking action, is a constant challenge, and the surface can easily be destroyed by a blizzard. Fortunately, the blue-ice runway underneath can still be used for landings, albeit with some limitations.

Skytraders made its first Airbus ACJ landing in the Antarctic on 19th November 2007, at the US base in McMurdo Sound, where the facilities are much larger and longer established. This was followed by a first landing at Wilkins on 9th December, and full operations were certificated by Australia's Civil Aviation Safety Authority (CASA) in January 2008. 'We very much appreciated the support from Airbus for these pioneering flights, especially that of Airbus pilot John Quinnell, who has been the life and soul of our operation in the Antarctic, and that of retired Vice President Flight Division Pierre Baud, who was with us on our very first landing at Wilkins Runway,' says Studd.

One of the big challenges of regular Antarctic flights is, of course, the risk of an aircraft becoming unserviceable on the ground. Skytraders works actively to minimize the risk, by keeping the aircraft well maintained and only committing to landings when everything is in good working order. Like other corporate jet operators around the world, it also flies with an engineer on board. The Auxiliary Power Unit (APU) is started at top-of-descent, for example, to ensure that there are at least two sources of air for an engine start on the ground (the APU and the ground power unit). 'We also tend to avoid changes to the aircraft configuration until we are sure that we can land', says Studd.

But what happens if the worst happens, and the aircraft becomes unserviceable on the ground? 'It might take time, but we would find a way to fix it,' says Studd. 'The Antarctic is a very special place, and people help each other,' he adds. 'We tend to go only when the weather is good', says Studd, 'and in the Antarctic the weather is usually either very, very good, or very, very bad.'

'In practical terms, we are looking for a cloud base of 2,000 feet or more, and a visibility of at least 10 kilometres, before we will commit to a landing', he adds. 'In weather terms, one of the biggest dangers is the lack of surface definition in the landscape, making it hard to judge how far away things are, and how high you are above them', points out Studd. 'This is exacerbated by a phenomenon known as whiteout, which can occur even when there is a high cloud-base and, sometimes, unlimited visibility.'

An established Global Positioning System (GPS) approach is used when flying into Wilkins, and all of the bearings are 'true' rather than magnetic.
'We operate in 'true' or grid-based navigation below a latitude of 60° south', says Studd, 'and making the transition is very easy in the Airbus ACJ – everything goes to 'true' on the push of a button'. Precision Approach Path Indicators (PAPI) provide the final guidance in the final phases.

'We will only land if there is less than 5 knots of cross-wind, we have 'primary' GPS navigation and if the runway friction coefficient is 0.2 or better', explains Studd. 'We fly a fully managed approach and will typically use medium autobrake for the landing', adds Studd.

True VS magnetic:
Magnetic compasses behave erratically close to the poles, and navigation based on a true or grid reference is used in the polar regions.

'Once on the ground, we minimize use of the nosewheel steering to avoid skidding', he adds.

The edges of the runway are marked by canvas markers on canes, which have to be put out for each aircraft arrival and departure, or they would blow away. Eight full time staff are responsible for weather reporting, and for clearing and preparing the runway for each landing.

'Ice is dynamic, and one of the peculiarities of the Wilkins runway is that its threshold moves at about 12-15 metres a year, significant, but not enough to affect our day-to-day operations', points out Studd.

After landing, we leave the slats and flaps in the '1 + F' configuration, which allows easier detection of any trapped ice and snow and is also the setting that we will use for takeoff.

Once the Airbus ACJ has landed, it usually stays just long enough to unload and reload passengers and equipment. This usually takes about one and a half to two hours, during which the engines are shut down but the APU is kept running. 'When it is –20° Celsius and blowing 50 knots, however, things take a bit longer', points out Studd. 'We operate with three pilots on board', says Studd, 'which gives us some reserve for the unexpected, such as one of us being incapacitated by slipping and falling on the ice. With the engineer and a flight attendant that makes a crew of five', he adds. 'We are sometimes faced with snow blowing along the surface and, in such conditions, the good clearance between the Airbus ACJ's engines and the ground are a further plus', he adds. 'When it is time to leave, we do a wing anti-ice check, then we start the engines and it is back to Australia for the Skytraders Airbus ACJ - until the

next mission'. 'During the past season we flew a total of 12 flights, turned back twice for weather reasons, and achieved 100 per cent reliability', says Studd.

The Antarctic flights are only one part of Skytraders' use of the Airbus ACJ, however. Studd points out that the aircraft is the first of its kind in Australia that it is available for charter, and that it has already done many flights of this kind. 'We're expecting to fly about 300-400 hours a season, and are very pleased with what we have already achieved with our Airbus ACJ operations', says Studd. 'The Airbus ACJ has more than demonstrated its versatility and reliability in operations to one of the most hostile places on Earth, and we are glad to have it in our fleet', he concludes.

'Antarctica in brief'

Antarctica comprises some 13 million square kilometres - more than the whole of Canada and the United States put together, and about twice the size of Australia. Paradoxically, for a land that has so much of the world's freshwater locked up in its ice cap, Antarctica is a very dry place. Parts of the ice cap are more than 14,000 feet high, and even the South Pole is some 9,250 feet high. Nobody owns Antarctica although several countries, including Australia, have territorial claims. Some 45 countries are signatories to the Antarctic Treaty, which currently ensures the future of Antarctica for scientific, non-commercial and peaceful purposes. Australia has the largest claim to Antarctica – just over 40 per cent – and runs three scientific research bases, at Casey, Mawson and Davis. Turboprop CASA 212s - equipped with skis – and operated by Skytraders are also used for flights within Antarctica on behalf of the Australian Antarctic Division.

'Airbus ACJ Family'

Airbus has created corporate jet versions of its aircraft from time to time since its early days, but it was not until 1997 that it entered the market in a more comprehensive way, with the launch of an A319 derivative called the Airbus Corporate Jetliner (ACJ). Featuring a VIP or other cabin chosen by the customer, extra fuel-tanks in the cargo-hold for intercontinental range, high-thrust engines for good takeoff performance, built-in airstairs and a richer specification, it has established itself as the new top-of-the-line in corporate jets, delivering more comfort and space than traditional business jets. The Airbus ACJ Family, which now comprises the A318 Elite, ACJ and A320 Prestige, has won more than 100 sales, worth more than $5.5 billion since its inception, and continues to win new business from private clients, companies and governments. It is complemented by VIP widebodies ranging from the A330/A340 through the A350 and all the way up to the A380, for customers that want even more comfort and space, as well as the range to fly 'non-stop to the world'.

Garry Studd
has wanted to be a polar explorer since he was seven years old and, when he was just 16, led an expedition to Spitzbergen, within the arctic circle. He originally attempted to qualify as a doctor, but became a pilot instead when this did not work out.
He began flying in Antarctica in 1977, where he was Chief Pilot for the British Antarctic Survey, flying Twin Otters, until 1984.
He has continued his involvement with Antarctic flight operations for various organizations to date.
His passion was development flying and, from 1984-1988, he ran the flight test department of Decca Navigator in the UK (later Racal Avionics and THALES).
From 1990 he was Chief Pilot of a major UK executive jet charter company and latterly ran his own company specialising in training Falcon 900 business jet pilots and, for part of this time, he also flew Falcons for a private customer.
In 2004, Garry went to Australia to become Deputy Chief Pilot for Skytraders.
He has flown some 17,000 hours, of which about 6,000 are in the Antarctic.
His interests include skiing and woodworking.

CAPTAIN GARRY STUDD ACCEPTS AIRBUS AWARD ON BEHALF OF SKYTRADERS - AIRBUS ACJ FORUM IN PARIS, 2ND APRIL 2008

Captain Garry Studd, Skytraders' Deputy Chief Pilot (centre), accepts the Airbus award for Skytraders' pioneering of the first flights to the Antarctic by any airliner, the first landings on an ice-runway by any Airbus aircraft, and the first operations on the continent by an Airbus Corporate Jetliner.
The award was presented by Charles Champion, Airbus EVP Customer Services (left) with Antoine Vieillard (right), Airbus VP A320 Family and CJ/VIP Programme within Customer Services.

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Conclusion

Antarctica, once the preserve of polar explorers, is now regularly accessible to scientists through regular flights by the Airbus ACJ, helping us to understand more about our planet. Conscious of the need to preserve this pristine wilderness for generations to come, the flights are made in an environmentally responsible way, with careful preparation and operation helping to ensure safety in challenging surroundings.
The Airbus ACJ's ability to handle a wide range of climatic conditions means that it takes these demanding operations in its stride, highlighting once again the versatility and operational flexibility of the modern Airbus family.

AIRBUS

Fuel system water management
Part II

In the good old days refuelling aircraft was not as organized and efficient as it is today, with the consequent higher probability of water or contamination in fuel.

However, aircraft in those days flew far less hours and distance and fuel tanks were easier to drain and clean. The advances in aircraft operations since these days have brought new issues in aircraft fuel and solutions for them as described in the article on page 21.

Customer Services
events

Just happened

A330/A340 Technical Symposium, Dubai, 11-15 May

The symposium was attended by 57 airlines. During the airline caucus operators expressed their satisfaction and requested Airbus to concentrate on the following issues in the coming months:

- Landing gear overhaul requirements and life limitations
- Landing gear corrosion and findings at first overhaul
- Fuel tank contamination, water drainage modifications and validation of a new biocide
- Engine bleed system reliability
- APU (Auxiliary Power Unit) generator burst.

Operators also strongly requested Airbus to develop fuel saving initiatives, e.g. weight reduction or performance improvement packages.

Operational excellence awards were presented:

- Emirates were awarded for operational excellence for the A340-500/600 fleet,
- Korean Airlines were awarded for operational excellence for the A330 fleet of more than 10 aircraft,
- Asiana were awarded for operational excellence for the A330 fleet of less than 10 aircraft,
- Cathay Pacific were awarded for operational excellence for the A340 fleet of more than 10 aircraft,
- Sri Lankan were awarded for operational excellence for the A340 fleet of less than 10 aircraft.

Material, Suppliers and Warranty Symposium, Cancun, Mexico 2-5 June 2008

We concluded a successful symposium, which brought together 150 people from customers and major suppliers organizations. The key theme of this event was to 'Materialize our future together' with keynote speeches dedicated to:

- Reveal of the Supplier Support Rating awards,
- Airbus Material Management strategy,
- The new Supplier Support Conditions (SSC),
- Supplier improvement process,
- Airbus BFE and powerplant supplier policies and support,
- Optimization of the supply chain,
- What's new in warranty,
- Warranty tool developments,

To compliment the speeches, plenary sessions and workshops were held to share greater detail on specific developments and to openly exchange ideas together with customers and suppliers. The customer caucus highlighted that we delivered on our previous commitments and our ongoing initiatives were highly appreciated.

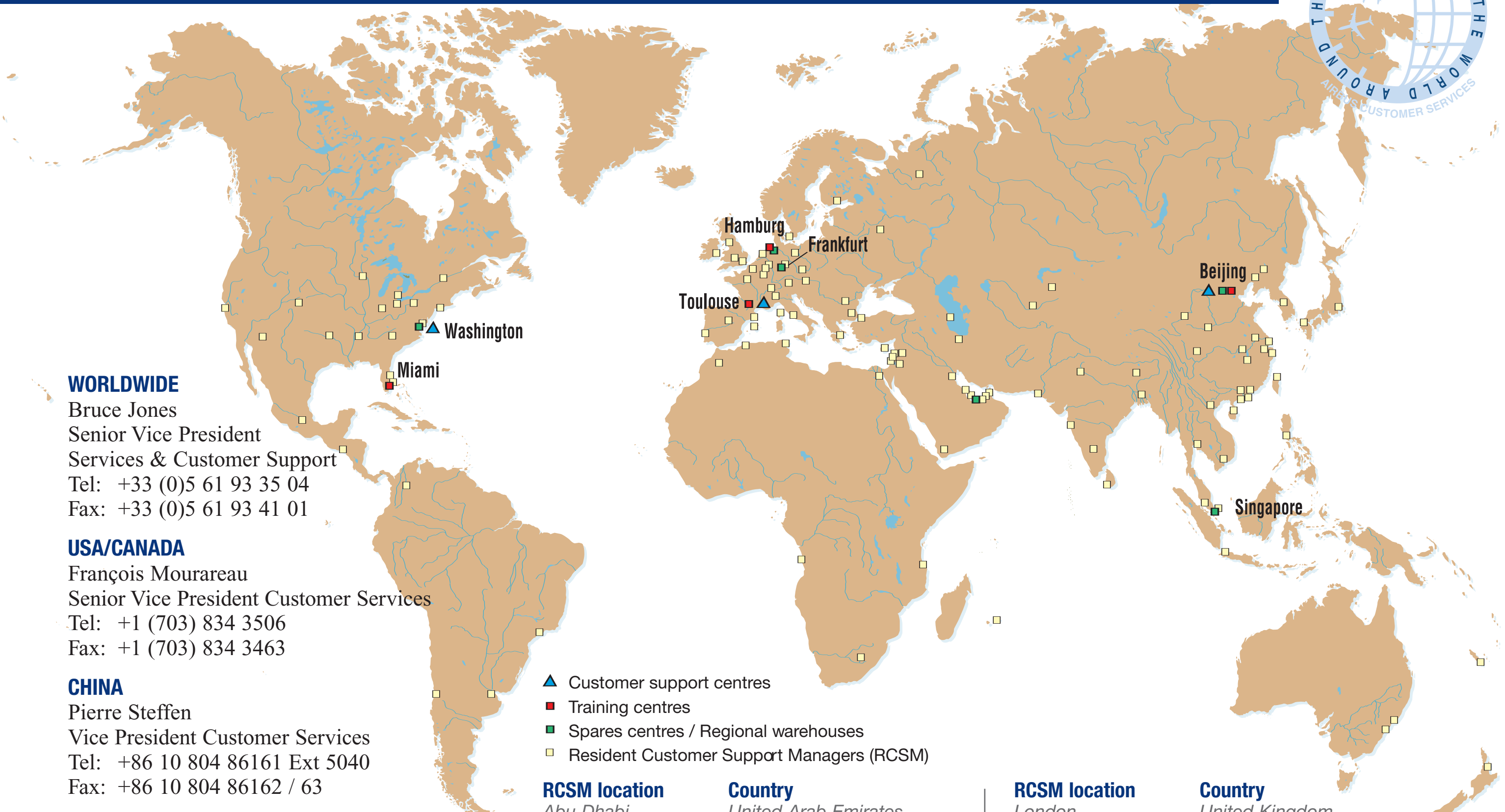
Coming soon

Airbus Training symposium, Paris, 1- 4 December 2008

After an outstanding event in San Francisco in October 2006, the ninth of these dynamic and highly informative forums dedicated to the Airbus international training scene will take place at the Marriott Rive Gauche Hotel in Paris, France. This biennial event provides airline training professionals with a unique opportunity: whether the focus is on flying, cabin safety or aircraft maintenance, participants will get the latest status of all Airbus training programmes, technologies, techniques and perspectives and can share their Airbus training experience with the industry's most senior players.

Four separate but integrated conference streams covering pilot training, cabin crew training, maintenance training and training simulation support, will complement an exhibition featuring the latest developments in simulation and training technology.

The Airbus Training Symposium is the best forum for Airbus training information and industry networking and Airbus will be pleased to welcome its customers, aviation authorities and the major training media vendors.



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RCSM location	Country
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Al-Manamah	Bahrain
Almaty	Kazakhstan
Amman	Jordan
Amsterdam	Netherlands
Athens	Greece
Auckland	New Zealand
Baku	Azerbaijan
Bangalore	India
Bangkok	Thailand
Barcelona	Spain
Beijing	China
Beirut	Lebanon
Berlin	Germany
Bogota	Colombia
Brussels	Belgium
Bucharest	Romania
Budapest	Hungary
Buenos Aires	Argentina
Cairo	Egypt
Changchun	China
Charlotte	United States of America
Chengdu	China
Cologne	Germany
Colombo	Sri Lanka
Copenhagen	Denmark
Damascus	Syria
Dar Es Salaam	Tanzania
Delhi	India
Denver	United States of America
Detroit	United States of America
Dhaka	Bangladesh
Doha	Qatar
Dubai	United Arab Emirates
Dublin	Ireland
Dusseldorf	Germany
Ekaterinburg	Russia
Fort Lauderdale	United States of America
Frankfurt	Germany
Guangzhou	China
Haikou	China
Hamburg	Germany
Hangzhou	China
Hanoi	Vietnam
Helsinki	Finland
Ho Chi Minh City	Vietnam
Hong Kong	S.A.R. China
Indianapolis	United States of America
Istanbul	Turkey
Jakarta	Indonesia
Johannesburg	South Africa
Karachi	Pakistan
Kita-Kyushu	Japan
Kuala Lumpur	Malaysia
Kuwait City	Kuwait
Lanzhou	China
Larnaca	Cyprus
Lisbon	Portugal

RCSM location	Country
London	United Kingdom
Louisville	United States of America
Luton	United Kingdom
Luxembourg	Luxembourg
Macau	S.A.R. China
Madrid	Spain
Manchester	United Kingdom
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Nanjing	China
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