Coming soon

A300/A310 FAMILY TECHNICAL SYMPOSIUM
IN LISBON, PORTUGAL, 14-16 NOVEMBER
Preparation for this technical symposium is already in progress. There will be presentations on actual in-service issues affecting the A300/A310 Family programme as well as subjects of more general interest. For information, contact your local resident customer support manager. Agenda and participation forms will be sent out in September.

HUMAN FACTORS SYMPOSIUM
IN MADRID, SPAIN, 22-24 NOVEMBER
Airbus will continue the dialogue with its operators at this symposium, discussing human factors aspects with practical and operational perspectives on:
- Flight operations (environmental, safety, pure ops e.g. procedures, philosophy, systems)
- Cabin operations (safety, CRM, organization, procedures, manuals)
- Training (to flight operations, maintenance, cabin-operations, to human factors)
- ATC (environmental, safety, pure operations e.g. procedures, philosophy, systems)
- Traffic Management, our concept and new tools for operating.

TECHNICAL DATA SUPPORT & SERVICES
SYMPOSIUM IN ATHENS, GREECE, 25-29 APRIL
The modular concept of our advanced consultation tool ‘AirNAV’ was announced at this symposium. The concept will give seamless one-stop-access to aircraft documentation and significant gains in efficiency. It will also support our move to delivering ‘Service-Oriented Data’ in the coming years. There will be no rupture in the use of standards and delivery of data, as this will be totally transparent to technical data end-users. It was also announced that as line with Airbus’ policy of applying new technology applications for existing aircraft programmes, Airbus has launched AirNAV for all A330 and A300-600 fleet customers.

The symposium was much appreciated and customers fully endorsed Airbus migration from outdated media to full digital data application.

A320 FAMILY SYMPOSIUM
IN RHODES, GREECE, 23-27 MAY
This had a record participation of 345: 167 from 91 airlines, 47 from 16 vendors and representatives of the Maintenance Repair and Overhaul Network. Evaluation forms gave a very high satisfaction level and, overall, we saw customers satisfied with A320 Family performance.

The symposium gave an opportunity to exchange views and allowed Airbus to optimize its focus on operators’ main issues. Customers acknowledged our improvements of their main concerns with projects such as Forum for Airlines Issues Resolution (FAIR), New Service Bulletin Concept, maintenance costs, Time To Get a Fix and also appreciated demonstrations of the latest A320 Family enhancements and the ongoing product evolution.

Just happened

PERFORMANCE AND OPERATIONS CONFERENCE IN BANGKOK, THAILAND, 4-8 APRIL
Our vision for the EFB (Electronic Flight Bag) and its support, how to deal with Required Navigation Performance and the way to fly RNAV approaches were announced and discussed at this symposium. Other topics included: our legacy document project, the first A380 Flight Crew Operating Manual delivery, the A350 status, our vision on CNS/ATM (Communication Navigation Surveillance/Air Traffic Management), our concept and new tools for operational cost management and our vision of safety related equipment that will be fitted on our future aircraft.

300 Flight operations specialists from 86 airlines and about 50 representatives from 19 vendors, associations and authorities participated in this very well appreciated event.

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Customer Services
The Auto Fuel Feed Controller

Replacing all the relays of the current system, except for six essential for supply of power to the pumps, the AFFC is a line replaceable digital computer. It controls the inner and center fuel tank boost pumps, and the water scavenge pumps. As with the current system, the outer tank pumps are controlled independently of the AFFC.

In order to provide automatic control, the AFFC takes inputs from the aircraft power circuits, flight deck push button switches and the refuel panel. System inputs also come from the inner and center tank level sensors, the fuel quantity computer and pump feedback signals.

The AFFC has been designed to interface with the existing aircraft signals, and does not require any changes to the flight crew interface for its operation. When crew select auto-mode on the overhead fuel panel, the AFFC will operate to automatically control the fuel feed.

Improved system maintainability through added functionality

The AFFC brings added functionality to the fuel feed system in order to greatly reduce troubleshooting workload. It achieves this by both reducing the number of autofeed faults seen on the aircraft and by providing efficient troubleshooting tools.

The amount of logic the current autofeed system can apply to the monitored system inputs is limited by the number of relays. Experience with the current system has shown that a number of indicated autofeed faults could be prevented by adding additional logic within the system to take account of transient aircraft conditions. Airbus and Goodrich Fuel and Utility Systems have therefore incorporated additional and improved logic within the AFFCs software. The result is a reduction in the number of indicated autofeed failures, and a subsequent decrease in maintenance workload.

When genuine autofeed system failures are indicated, the AFFCs BITE (Built In Test Equipment) function provides vastly improved assistance to maintenance crews to troubleshoot the fault. The AFFCs BITE has two levels of status indication, one for line maintenance and one for base maintenance personnel.

At line maintenance level, LEDs (Light Emitting Diodes) on the front panel of the AFFC provide fault codes, which indicate the status of the autofeed system, both internally and externally to the AFFC. The codes can be easily read from the AFFC and cross-checked with troubleshooting documentation to identify which components should be targeted by maintenance crews. This allows for rapid troubleshooting and helps dispatch of the aircraft. At the base maintenance level, an ARINC429 transmitter can be interrogated in order to provide system data for the past 20 flights. This transmitter can also be interrogated to obtain the current status of all discrete AFFC inputs and outputs.

Both the BITE and the ARINC429 transmitter are autofeed system improvements, enabling trouble shooting that is not feasible with the current system.

AFFC installation

It is possible to install the AFFC on all A300-600 and A310 aircraft types, which do not already have it selected as an option. The installation is completed in two stages: Provisioning and installation. Both of these stages are covered
AFFC - UPGRADING YOUR AIRBUS FLEET FOR ADDITIONAL MAINTAINABILITY

Troubleshooting of faults on relay based automated aircraft systems requires a good level of system knowledge and generally needs longer time periods when compared to the functionality provided by the BITE of digital systems. For A300-600 and A310 aircraft autofeed system relays that are ageing and may be experiencing an increase in unscheduled maintenance, the AFFC offers the opportunity to enhance fleet reliability and limit the risk of dispatch delays.

The installation stage reconfigures the aircraft wiring to connect the provisioned harness to the fuel system electronics and then remove the current relays. Once this is completed, the AFFC is installed in the mounting cage, and the harness plugged in to the AFFCs connectors to complete the new system. Finally, some cleanup work is completed in order to remove cables made redundant by installation of the AFFC.

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Conclusion
Troubleshooting of faults on relay based automated aircraft systems requires a good level of system knowledge and generally needs longer time periods when compared to the functionality provided by the BITE of digital systems. For A300-600 and A310 aircraft autofeed system relays that are aging and may be experiencing an increase in unscheduled maintenance, the AFFC offers the opportunity to enhance fleet reliability and limit the risk of dispatch delays.

LOw FUEL TEMPERATURES - BASICS, PRINCIPLES OF OPERATIONS AND A NEW SOFTWARE TOOL FOR OPERATIONAL PREDICTIONS

LOW FUEL TEMPERATURES
Basics, principles of operations and a new software tool for operational predictions

With the operation of the very long range A340-500 and -600 on polar routings, the exposure of Airbus aircraft to low fuel temperature issues has increased. This article summarizes some basics regarding the minimum fuel temperature that can be tolerated, reviews the principles of the FUEL LO TEMP procedures on the Electronic Centralized Aircraft Monitor (ECAM) and in Flight Crew Operating Manual (FCOM) 3.02.28 and describes new software now available to operators to predict fuel temperatures for a given flight at the time of dispatch.

Lars Kornstaedt
Airbus Customer Services
Group Manager A380 Performance
Flight Operations Support and Services

Minimum allowed fuel temperature

Operating the aircraft within the certified environmental envelope is not sufficient to prevent issues with cold fuel. Indeed, safe engine operation leads to two engine-specific limitations: the minimum inlet temperature and the fuel heat management system limitation. More information on fuel characteristics is given in the ‘Getting to Grips with Cold Weather Operations’ brochure available from Airbus.

FUEL FREEZING POINT

The fuel characteristic that best describes the lower limit in temperature for use in aircraft operations is not actually the fuel freezing point, but the pumpability limit. This limit is very close to the pour point, a temperature at which the fuel, cooled without stirring, will only just still pour from a standard glass cylinder. However, since the pour point is difficult to determine accurately, the fuel freezing point continues to be used as a reference for low-temperature characteristics.

Fuel is a mixture of different hydrocarbons that do not all solidify at the same temperature. When fuel is cooled, an increasing proportion of wax crystals form in the fuel. The wax crystals can block fuel lines and filters, thus causing engine instability, power loss and eventually flameout, and their formation should therefore be avoided.

The fuel freezing point is commonly measured with the ASTM automated optical test method D5901-03. ASTM International is an organization which develops standards, amongst which are the fuel freezing point tests. This test method is based on the observation of wax crystals completely disappearing from a warmed fuel sample that was previously frozen. The method is used widely except for Russian and other Eastern-European fuels, for which the GOST (Russian state standard) method gives the temperature at which solid particles first appear during the cooling process. The ASTM method therefore affords higher margins.

The specification fuel freezing point depends directly on the level of distillation aimed for in its production. The higher the distillation grade, the lower the yield of fuel from the crude oil. Fuel of different specifications is found in different parts of the world, each with a different specification fuel freezing point. The main focus is on JetA1, primarily available everywhere except the United States of America, and on JetA, which is used there (see left-hand table).

FUEL MIXTURES

When flying between areas where different fuel types are available, mixtures of fuel with different specification fuel freezing points will occur in the tanks. Experimental evidence has shown that fuel mixtures do not behave as ideal fluids and that the resulting fuel freezing point is commonly adversely affected. Airbus recommends avoiding mixtures in the outer, most exposed tanks. JetA1 can be considered as having unaltered freezing characteristics up to a content of 10% of JetA, above that fraction results become unpredictable and the fuel freezing point should be considered to be that of JetA fuel.

ACTUAL FUEL FREEZING POINT

When known, the actual fuel freezing point of the fuel carried onboard the aircraft may be retained as a criterion for cold fuel management in flight, if a monitoring process, including maintenance, dispatch, and crew procedures, has been set up in a way that is acceptable to local authorities. This process involves the retrieval of samples from the tanks through the drain holes after the refueling is completed. These are then put through jet fuel quality analysers, results can be radiated to the crew if not available before takeoff. Based on a fuel freezing point measurement survey conducted by a company involved in research in cold temperature behaviour of petroleum products at major US airports, a typical benefit of at least 3°C and up to 18°C can be expected from the implementation of such a monitoring process.

MINIMUM INLET TEMPERATURE

Engineers have an oil cooling system at their inlet, which uses the arriving fuel as a heat sink, thus warming it. Various system architectures and hardware leads to a varying specification of the minimum temperature that a given engine type can cope with. The minimum temperature is expressed as a margin versus fuel freezing point - the minimum engine inlet temperature is the actual fuel freezing point with the manufacturer’s margin added to it (see right-hand table).

FUEL HEAT MANAGEMENT SYSTEM LIMITATION

During flight, the fuel temperature quickly drops below the freezing point of water, of which a certain proportion is always contained in aviation fuels. This water can then form ice crystals, which could travel to the engine inlet filters and clog them. To avoid this, the fuel is warmed in the oil cooling system. For some engine types, a minimum fuel temperature below which takeoff and/or flight is not permitted therefore results from the engine capability to warm up a water-saturated fuel flow, unless an anti-ice additive is used.

Operational procedures

GROUND PROCEDURES

Special attention should be paid to the fuel contained in the outer tanks before a flight through forecast cold atmosphere is commenced. These tanks may remain completely or partially filled with the cold reserve fuel from the previous flight. This may have an unrelated, but undesirable, effect of leading to wing surface icing after landing in a humid environment. More importantly, if partially filled, it may lead to high-proportion mixtures of different fuel types. Both can be avoided by performing a manual transfer of the outer tank fuel inboard during the taxi-in. If the outer tanks remain full with fuel of a lower
LOW FUEL TEMPERATURES - BASICS, PRINCIPLES OF OPERATIONS AND A NEW SOFTWARE TOOL FOR OPERATIONAL PREDICTIONS

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FAST 36

LOW  FUEL TEMPERATURES - BASICS, PRINCIPLES OF OPERATIONS AND A NEW SOFTWARE TOOL FOR OPERATIONAL PREDICTIONS

tank transfer schematic

IN-FLIGHT PROCEDURES

On aircraft equipped with a fuel temperature measurement system, an ECAM warning is triggered when the fuel temperature drops below the minimum acceptable temperature in that tank. The minimum acceptable temperature is not the same for all tanks. The temperature in the feed tanks (typically, but not exclusively, the inner tanks) may not drop below the minimum acceptable temperature limited by the engine inlet and the heat management system limitation, while the fuel in the remaining tanks may be allowed to reach the freezing point. The ECAM warnings are calibrated to the specification values of JetA and JetA1 fuel and request manual fuel transfers. The crew may delay the application of the procedures appropriately, if the actual fuel freezing point of the fuel carried is known.

The figure ‘tank transfer schematic’ shows an example for the A340-500 and -600, the FCOM 3.02.28 FUEL LO TEMP procedures request manual transfers:
• From outers to inners, when the fuel freezing point is reached in the outers
• Forward from the trim tank, when the fuel freezing point is reached in the trim tank
• From center to inner, when the minimum acceptable temperature is reached in the inners

TAT INCREASE

In addition to manual transfers, the procedure also recommends to increase the TAT (Total Air Temperature), which is the temperature measured on the structure of the aircraft. The TAT is derived from the outside or Static Air Temperature (SAT) and depends on the Mach (Ma) number:

\[ TAT = SAT \times (1 + 0.2 \times Ma) \]

There are two means of increasing the TAT: increasing speed to increase aerodynamic warming, and reducing altitude to fly in warmer air. The TAT formula highlights that speed increase only has a marginal effect, while the exchange rate SAT to TAT is one to one.

To give an impression of the effect in time, both means are shown in separate variations from a basic scenario, which considers an A340-600 taking off at Maximum Take Off Weight (MTOW) flying from the US East Coast to East Asia on a great circle routing at Long Range Cruise (LRC) speed and on an optimum altitude profile. The aircraft is using JetA fuel with a specification fuel freezing point of -40°C. A statistical outside temperature profile is considered for this example, based on a 95% reliability for January, meaning that at any point during an actual flight in that month, there is only a 5% chance of encountering lower temperatures.

The first variation consists in flying at maximum managed speed (Ma 0.845 for this type) on a fuel-optimized profile. The figure “fly faster” shows the relevant parameters plotted against the ground distance, the basic scenario always shown in shades of blue and the variation case in shades of red/orange. The speed increase leads to a shift in the optimum profile, which is mirrored by the SAT profile, but even where the aircraft flies at the same altitude, a small increase in TAT can be observed. This increase delays the moment when the temperature drops below freezing point in the outer tanks by some 300 nautical miles (nm), but does not avoid the need for the manual transfer procedure from the outers to the inners. It does, however, succeed in maintaining the inner tanks temperature above or at the freezing temperature, which is sufficient for the Rolls Royce Trent 500 engines that equip this aircraft type. This comes at a cost: fuel burn at identical takeoff weight is increased by 7.9 tonne (t).

The second variation considers flying the whole distance at Flight Level (FL) 290. The figure “fly lower” shows the large increase in SAT, which is mirrored by the TAT. The lower flight level succeeds in delaying the manual transfer by 800 nm and subsequently maintaining a comfortable margin of the fuel freezing point in the inner tanks. The cost of this variation is a fuel burn increase by 5.5t.
From this data, it determines the nominal fuel distribution and movement during the flight and simulates the effect of the various heat exchange processes, like convection, radiation, external heat sources and mass transfer. The result is a detailed output of the fuel temperatures in each tank at each waypoint, a summary that indicates whether the flight can be dispatched under the given conditions, whether any manual transfers were triggered during the simulation, and what the lowest temperature forecast in each tank is. This information allows the dispatcher to decide in an informed manner, which areas may have to be avoided on a critical flight.

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One of the design constraints for the FTP software was therefore its operability on a variety of platforms. At this time, stand-alone solutions are being developed for PC and UNIX under RS6000, in addition to the basic implementation included in the Performance Engineer’s Programs (PEP) software suite.

An important aspect lies in the large variety of flight plans to be imported. This has been tackled in the PEP environment through the definition of a standard format, which uses XML (eXtensible Markup Language) and is a subset of the standard defined for the A380 Onboard Information System (OIS). The translation of the airline pilot log to XML requires the development of a customized tool. All the relevant information for this task is provided in the Performance Programs Manual (PPM), but assistance and even the development of such a tool is available as an Airbus service.

The FTP can be used in two ways depending on the original source of the navigation, weather and performance data: the Flight Plan Analysis and the Sector Analysis.

The Flight Plan Analysis uses an airline operational flight plan or pilot log as a basis for the computation. Operational flight plans are generated with Computerized Flight Planning (CFP) systems available from a number of providers. They run on different hardware, like PCs, UNIX or mainframe computers, or even remotely over Internet or similar connections, and they produce a document, which is highly customized by the operators to their specific needs.

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The FTP software is available for all A330/A340 Family aircraft and will be released for entry into service of the A380 and the A350.
In the past, maintenance training mainly focused on theoretical knowledge acquisition. As part of Airbus policy of continually improving training courses, the maintenance training courses began to evolve, starting with the implementation of the MTD (Maintenance Training Device) in the course flow a few years ago. The MTD allowed trainees to gain practical skills before having real practice on an aircraft.

A further step in this process sees the AACT (Airbus Active learning and Competence focused Training) course being introduced. The AACT course is a new approach developed by Airbus for training maintenance technicians. The main innovation in this new approach is the intensive use of new Airbus simulation tools, like the M/FTD (Maintenance/Flight Training Device) and the virtual aircraft, which enable maintenance tasks to be performed throughout all their steps.

**AACT objectives**

The AACT innovations focus on two central aspects:

**ACTIVE LEARNING**

Training experts generally agree that, whatever the subject is, most people learn better when they are actively involved during training. With AACT, aircraft maintenance technician trainees will participate more actively in the course, and will not be passive recipients of theoretical knowledge only. This active participation in the classroom is especially important for technicians accustomed to involvement in the actual operation of aircraft.

**OPERATIONALLY ORIENTED TRAINING**

The obvious objective of any maintenance training course is to train people to be competent in their job, that is: maintaining and operating aircraft safely and efficiently. Adaptation and evolution of such training is always necessary to handle the latest aircraft technologies and maintenance practices. In the newest Airbus aircraft, especially the A380, the aircraft systems are more integrated and sophisticated maintenance tools are provided for maintenance technicians. To follow these aircraft evolutions, AACT training will be more operationally oriented than before and not only focused on aircraft system knowledge.

**New simulation tools**

The key elements of AACT courses are two new training tools: the M/FTD and the virtual aircraft.

- **The M/FTD** is a training tool that is common to flight and maintenance training. It replicates the real aircraft cockpit with PC (Personal Computer) screens and simulates the aircraft systems and maintenance BITE (Built In Test Equipment).

  Two versions of the M/FTD are available:
  - The 3D M/FTD, which is built with touch-screens displayed as in a real cockpit, plus some essential aircraft hardware equipment (like Flight Control Unit and Multipurpose Control & Display Unit)
  - The 2D M/FTD, which is a lighter version of the M/FTD and consists of only two screens, without the aircraft hardware equipment

- **The virtual aircraft** tool is a new Airbus application, based on virtual reality and running on a normal PC. It simulates the whole aircraft and enables trainees, in a three-dimensional on-screen environment, to walk around the aircraft and locate aircraft components or visit aircraft areas, such as the avionics bay or main landing gear bay. When linked with the M/FTD, maintenance actions can also be simulated in the virtual aircraft.

- **Both of these tools will be intensively used in the AACT programme to perform the practical sessions, as well as to support the theoretical part.**

Christèle Bertrand
Airbus Customer Services
Training Project Leader
Training & Flight Operations Support and Services
AACT training programme

For theoretical sessions, the aircraft systems will still be described using classical Computer Assisted Training (CAT) lessons, whereas the system operation, control & indications will be demonstrated with the 2D M/FTD. This use of the M/FTD in the classroom will allow the instructor to use the M/FTD simulation to demonstrate systems with more flexibility and realism for the benefit of trainees. During training the main aircraft components will be located and described in the virtual aircraft, avoiding unnecessary immobilization of an actual aircraft, which can be difficult and costly. Each trainee will also be able to use the virtual aircraft freely at any time in the training to review components and locations.

Practical sessions of servicing and troubleshooting maintenance tasks (Aircraft Maintenance Manual and Trouble Shooting Manual tasks) will be performed by trainees on the M/FTD coupled with the virtual aircraft and using the electronic aircraft documentation. This link between both tools allows simulation of the whole aircraft (inside and outside), and not only the cockpit as was the case in previous generation training devices. With these tools, trainees are able to perform a task in a more realistic way and as a whole, from cockpit actions such as post-flight report consultation and fault isolation through the Multifunction Control and Display Unit, to action on an aircraft component, like removal and installation of a suspect unit, then back to the cockpit to perform BIT tests of the installed unit.

This complete simulation environment brought by the M/FTD and virtual aircraft, coupled with the aircraft documentation access, provides an efficient and secure way to conduct major practical exercises when compared to a real aircraft where all tasks cannot be actually and completely performed by all trainees. The virtual aircraft answers the main issues encountered on real aircraft, such as difficulty to simulate faults, remove and replace components, the safety risk for trainees, time necessary to allow each trainee to perform tasks and so on.

New learning environment

The 2D M/FTD and the virtual aircraft will be installed in the classroom, directly on the trainees’ desk, to maximize training benefits from the tools. This easy access to the tools will allow a greater mix of theory and practice than was previously possible and will enable explanation of systems theory step by step, prior to practical application. Trainees will therefore become more and more active in the learning process, at every stage of the training. Furthermore, they will no longer need to wait to the end of the theoretical part to interact in the course and perform the tasks by themselves.

In the AACT course, human factors training will be integrated and will no longer be considered as separate training. Human factor issues will be integrated with technical and operational training and spread in the different types of sessions: theoretical lessons and operational scenarios.

Conclusion

The AACT approach will be progressively applied to all Airbus maintenance courses. The first course using the AACT philosophy is the A320 Family maintenance course and will be run in autumn 2005 in the Hamburg training centre. After this, AACT courses will be implemented in 2006 for the first A380 maintenance course, and then on A330 and A340 Family courses.

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Airbus aircraft have been equipped with the GPWS (Ground Proximity Warning System), which was followed by the Enhanced Ground Proximity Warning System (EGPWS) certified in 1997 to warn of terrain collision hazards. In addition, Traffic alert and Collision Avoidance System (TCAS) has been installed to warn of aircraft mid-air collision hazards. Since February 2005, Airbus is offering a solution integrating both functions: the T2CAS (Terrain and Traffic Collision Avoidance System) which combines the Terrain Awareness Warning System (TAWS) currently named EGPWS, and the TCAS in one unit.

As an alternative to the currently certified TAWS and the TCAS, the T2CAS allows maintenance cost reductions as well as a global weight decrease.

The T2CAS-TAWS part specification is a class A TAWS per TSO C151b standard. It therefore provides suitable aural and visual warnings to alert the crew of any hazardous situation with respect to the terrain ensuring the following functions:

- Mode 1: Excessive rates of descent
- Mode 2: Excessive closure rate to terrain
- Mode 3: Negative climb rate or altitude loss after take off
- Mode 4: Flight into terrain when not in landing configuration
- Mode 5: Excessive downward deviation from an ILS (Instrument Landing System) glide slope

A Forward Looking Terrain Avoidance (FLTA) function
The FLTA function looks ahead of the aircraft along and below the aircraft lateral and vertical flight path and provides suitable alerts if a potential terrain threat exists. The FLTA function on the T2CAS is based on a worldwide terrain database.

A Premature Descent Alert (PDA) function
The PDA function of the TAWS uses the aircraft’s current position and flight path information determined from a suitable navigation source and airport database, to determine if the aircraft is hazardous below the normal approach path for the nearest runway as defined by the alerting algorithm, visual and aural discrete signals for both caution and warning alerts, (a specific visual and aural discrete signal is sent to the flight crew for each type of alert, either caution or warning).
The TAWS part of the T2CAS uses the same cockpit interface as for EGPWS. In comparison to EGPWS the T2CAS-TAWS offers some significant enhancements:

- Certified FLTA (Forward Looking Terrain Avoidance) and PDA functions are ensured by the CPA (Collision Prediction and Avoidance) function in T2CAS. Based on actual aircraft climb capability, the CPA offers the following enhancements:
  - A new aural warning ‘Avoid Terrain’ alerts the flight crew that the climb capability of the aircraft may not be sufficient to clear the terrain.
  - A corresponding red and black crosshatched area on ND depicts the terrain concerned.
  - The nuisance prone mode 2 (solely based on measured radio altitude) is inhibited while FLTA function (the CPA function previously described) is operative.

The system has 3 main functions:
- Detects close aircraft (equipped with Air Traffic Control (ATC) transponders).
- Displays possible collision aircraft.
- Activates vertical orders in order to avoid collision.

The system is designed to generate safe separation between aircraft predicted to be on collision trajectories, while minimizing ATC clearance deviations or excursions.

TCAS continually surveys the airspace around the host aircraft by actively interrogating and seeking replies from the transponders of other aircraft in the vicinity. It recognizes replies from aircraft equipped with ICAO Mode-A, Mode-C, or Mode-S transponders and determines the range, relative bearing, and the relative altitude of the other aircraft. Using this information, TCAS predicts flight paths, estimates the separation at the closest point of approach (CPA), and determines if a potential conflict exists. If a conflict is detected, the system gives guidance for the optimum vertical avoidance manoeuvre.
A NEW CONCEPT FOR SERVICE BULLETINS: ADDRESSING AIRLINE EXPECTATIONS FOR SERVICE BULLETINS

A new concept for Service Bulletins addressing airline expectations for Service Bulletins

Airbus has launched a ‘Service Bulletin New Concept’ (SB New Concept) project, which has the objectives to:

- Improve SB communication
- Ease SB understanding
- Reduce airline engineering SB workload
- Match SBs with airline practices
- Minimize aircraft ground-time
- Contribute to improving vendor performance

The project arose from one core idea that led Airbus to a new approach to SBs: there is a real need to reduce airlines engineering workload generated by SBs.

Wiring provisions and installation

Installed at the same rack as the TCAS computer, this upgrade solution is easy to integrate in the avionics compartment as it uses the same peripheral computers as the EGPHS.

Airbus delivers 2 Service Bulletins and the related kits: The first is for wiring provisions and the second for T2CAS installation. As an option, the aircraft wiring provisions for T2CAS can be directly installed on the production line for all programmes.

To retrofit the aircraft with a T2CAS, the following prerequisites have to be installed if not available on the aircraft:

- EGPWS provisions and the related peripheral computers,
- TCAS Change 7.0,
- Compatible mode S ATC transponder,
- Pin programming according to the aircraft configuration,
- T2CAS computer and associated antennas.

The combination of the TCAS and TAWS into one Line Replaceable Unit (LRU) provides an innovative and flexible alternative to the two separate LRUs of the existing systems. Combining them into T2CAS gives significant enhancements over some of the functions of the existing systems, provides a weight decrease and furthermore reduces maintenance costs for operators.

Since February 2005, Airbus can provide a certified solution for all types of Airbus aircraft (except A300 B2/B4) since the first embodiment for each programme has been realized between February and April 2005. An A320 was retrofitted at the end of February, an A340 at the beginning of March and an A300-600 at the end of April.

The system item is scheduled to be available via the Upgrade Services E-catalogue at the beginning of 2006.

Conclusion

The combination of the TCAS and TAWS into one Line Replaceable Unit (LRU) provides an innovative and flexible alternative to the two separate LRUs of the existing systems. Combining them into T2CAS gives significant enhancements over some of the functions of the existing systems, provides a weight decrease and furthermore reduces maintenance costs for operators. Since February 2005, Airbus can provide a certified solution for all types of Airbus aircraft (except A300 B2/B4) since the first embodiment for each programme has been realized between February and April 2005. An A320 was retrofitted at the end of February, an A340 at the beginning of March and an A300-600 at the end of April.

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A new approach to SBs

The project is a completely new approach to SBs and was initiated by key messages from the airline community, which led Airbus to analyse what could be improved and identify a new concept for SBs. The decision to launch the project was taken with some airlines and workshops were organized in 2004 to ensure the SB New Concept will really match airlines expectations.

Working together with these airlines, Airbus identified enhancements to apply to SBs to achieve the project objectives and defined future services to be offered. This was done by a collaborative approach with the involved airlines, which allowed Airbus to understand and analyse the SB integration process on the airline’s side (Refer to figure ‘A generic view of SB processing at airlines’).

This joint analysis of airline activities resulting from the receipt of SBs allowed Airbus to understand any difficulties the airlines could face with handling SBs and determine what should be changed, what improvements should be required and what new on-line SB services could be offered to reduce airline SB activities and make them easier.

A tremendous number of ideas were generated by the analysis and services were identified that could help in several areas of the airline process, not only in the ‘engineering preparation’ area.

The future services defined will cover the different steps of the SB integration process, from receipt to embodiment and cover mainly Airbus SBs, but will also cover vendor SBs to some extent and embrace the project objectives.

Improve SB communication

Airlines would like improved communications with Airbus and are also interested in sharing experience with the general airline community. This will be achieved with a service called ‘General on-line services’, which started with the ‘Event Notification’ service available on Airbus On-Line Services since September 2004. Airlines registering to the ‘notification subscription’ are then notified by e-mail whenever SBs are made available on Airbus On-Line Services (Refer to figure ‘How to access event notification services’ on the following page).

The next step, by the beginning of 2006, will be an SB on-line reporting service to make the SB accomplishment reporting activity easier for airlines.

After this, an SB FAQ (Frequently Asked Questions) and forum will be introduced. This will be done as a second step of the Airbus FAIR (Forum for Airline Issues Resolution) project in the third quarter of 2006. This service will offer a forum for discussion, so that airlines can share experience with other airlines on SB embodiment. It will also provide an area where Airbus will inform airlines of queries received and their associated answers, to proactively anticipate similar queries from other airlines.
Ease SB understanding

SB implementation can be sometimes time consuming and airlines would like Airbus to make SBs easier to understand to reduce this.

For some complex SBs an additional document called an ‘SB booklet’ has been already introduced. This booklet describes a complete modification in photos taken during an SB validation on in-service aircraft (Refer to figure “Extracts from SB booklets available on Airbus On-Line Services”).

These are available now on Airbus On-line Services and are accessible from the ‘Service Bulletin Information’ area of the ‘General Information’ service (Refer to figure ‘How to access SB booklets on Airbus On-Line Services’ on the following page).

This approach will be further enhanced in 2006 with the integration of photos into SBs to complement the current illustrations. The advantage of photo integration is to better show the area concerned by a modification or inspection.

The possibility of using a digital mock-up to build movies showing part of the modification for complex SBs is also under study. This is feasible because Airbus designs new aircraft models using 3D computer aided design, so the 3D views could be used to implement a library of movies. This will be applicable only for new aircraft programmes.

Reduce airline engineering SB workload

This area is the major one of interest for airlines and will be covered by an enhancement known as ‘fully engineered SB’. SBs are sometimes quite complex and can also cover several different aircraft configurations. As a result, airline engineers may spend a significant amount of time identifying what impacts a specific aircraft and reworking an SB into smaller tasks for engineering orders to enable accomplishment on that aircraft. Man-hours can be saved by providing airlines with a document in line with their working practices in the shape of a ‘fully engineered SB’ – meaning an SB ready for an airline to use and designed in accordance with engineering orders.

The ‘fully engineered SB’ objective is to adapt SBs to the airlines way of working and will be addressed by Airbus in three ways:

• Configuration management
• Detailed task breakdown
• Introduction of hyperlinks

CONFIGURATION MANAGEMENT

This will ease access to SB data by introducing management by configuration, which will harmonize SB contents and allow data filtering. Using it, airlines can easily select, consult, extract and download data concerning their own fleet or individual aircraft.
Continuous improvement is one of the key objectives of Airbus Customer Services and the SB New Concept is a concrete example of this. The concept has been defined and implemented in partnership with airlines to ensure SB and associated services enhancements fully match airline expectations.

Improved supplier performance

The airline community expects Airbus to be more involved in supplier activities and contribute to a good supplier performance. Online access to Vendor Service Bulletins (VSBs) covered by an Airbus SB has been operational on Airbus On-Line Services since April 2005, giving a more efficient, easier access to VSBs via a single point of contact (Refer to figure ‘How to access VSB on Airbus On-Line Services).

Minimize aircraft ground-time

The ‘fully engineered SB’ will minimize aircraft ground-time to some extent and it will also be enhanced by other innovative services, such as one known as ‘other applicable SBs’. This will enable retrieval of SBs that could be embodied at the same time as a given SB as they involve the same zones or access. This offers the opportunity to reduce the global time required for accomplishment of these other SBs if they were performed separately.

Other enhancements, related to Airbus internal processes, are also planned with a VSB on-line scrutiny to improve VSB timeliness and accuracy. Airbus is also working with suppliers to make available by the end of 2007 all VSBs on Airbus On-Line Services and not only those covered by an Airbus SB.

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Implementation of the ‘fully engineered SB’ is foreseen in several waves, with three major steps, to give initial benefits immediately.

The first step introduces management by configuration. SB accomplishment instructions are structured by configuration to ease access to data applicable to a specific configuration (Refer to figure ‘Management of accomplishment instruction per configuration’) and will be broken down according to the type of work and the work area. Whenever possible, breakdown will be in tasks of about 3 to 4 hours to enable planning of work to fit into shift patterns. This breakdown approach is now being applied for any new Airbus SB. For very complex SBs it allows drastic reduction of the time required to prepare work instructions.

The second step, planned for the first half of 2006, will give access to customized SB data, filterable in accordance with fleet configurations.

The third step, based on a new SB product structure, will further enhance access to airline data and will enable navigability with other technical manuals through new on-line services. This service is planned to be operational beginning 2007.

Segmenting accomplishment instructions into smaller tasks will accommodate shift work organization and improve flexibility at embodiment level. Tasks will be also enriched with information such as associated kits, location, man-hours and skills as this type of information is necessary to organize work on an aircraft.

HYPERLINKS

Hyperlinks will allow navigability between SBs and referenced documents, such as the Aircraft Maintenance Manual.

How to access VSB on Airbus On-Line Services
RFID - Supporting the Aircraft Supply Chain

Radio Frequency Identification
Supporting the aircraft supply chain

Around the world, organizations mandate their business partners to tag their goods with Radio Frequency Identification (RFID) devices. For example, one of the biggest US supermarket chains insists that its top suppliers tag their crates with RFID from 2005 onwards. RFID is an automated identification system, which allows touch-free identification of goods or shipments within process control, tracking and tracing as well as functions in many other areas of the supply chain.

RFID is used today in many aspects of daily life, such as access passes to security areas, toll payment stations, logistics and anti-theft protection. However, the technological basis applied for such purposes is different from the one needed for the aviation industry.

This article provides an update on Airbus RFID activities subsequent to the article published in FAST 30. It gives an overview of Airbus RFID activities and achievements and the positive effect of RFID on the aircraft spare parts supply chain.

The article further describes the individual steps taken towards a total integration of RFID into a company’s ERP (Enterprise Resource Planning) environment and gives information on Airbus leading industry activities to define RFID standards.

RFID tags are essentially micro-chips, and mostly referred to as transponders, tags or RFID chips. The RFID tags always listen for radio signals sent by RFID readers. When a tag receives a radio query, it responds by transmitting its unique identification frequency code and data back to the source of the radio signal. Depending on the required range, the RFID tag works either without its own energy source (passive system) or with its own energy source (active system). Passive RFID tags are powered by the radio signal that wakes them up and triggers an answer.

Today’s conventional use of RFID identification requirements are mostly of low data density, while the benefit for the aviation industry lies in the high data density that is needed for tracing.

Data density types
Which type of data density is applied depends on the actual task requirements.

LOW DATA DENSITY
Low data density is mostly used for simple information listing, i.e. informing the RFID reader of the number of identical items within one package. Long distance reading for total data capture is possible. Communication with several tags simultaneously under an anti-collision system is also possible. The anti-collision system enables the reader to receive data from each tag on a one-by-one basis. When multiple tags are in the same radio frequency and transmit data together, the reader communicates with the tags to prevent the collision of data. This is, for example, accomplished by transmitting a gap pulse.

HIGH DATA DENSITY
High data density is used for tracing of goods when a complete, unambiguous part history is needed, as in the aviation industry. Each component that is traced has a unique identification and history. It is not sufficient to know the number of units received, but more specifically: where did the part come from, where was it installed, how many hours was it operated, who repaired it, who installed what type of software last and so on. It requires short distance reading to ensure accurate readings, with communication taking place exclusively with a single tag at a reading distance within centimetres.

The chips used in Airbus applications are set today at a capacity of 4 kilobytes with dimensions of just 8 millimetres (0.31 in.) in diameter and can be flush metal mounted.

RFID benefits
The aviation industry is similar to other organizations in looking for efficiency enhancements and cost savings and the supply chain for spare parts, tools and similar goods is recognised as an area offering potential. Interfaces within supply chains and the associated administration and information flow are areas where efficiency can be significantly improved through using RFID functionality.

Among the many advantages of RFID over the widely used bar-coding is its ability to read the data contained in the chip, without line of sight, with the data instantly transferred by radio waves. This allows, for example, reading of periodical check information of oxygen masks installed in an aircraft without the need to take them out from behind ceiling panels.

Suppliers can use RFID to ensure parts are genuine, reducing the risk of unapproved parts entering the supply chain.

Data recorded, such as repair history or cycle time information, are shared so that the integrity and dynamic history can be established, leading to increased maintenance reliability and aircraft safety.

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Radio frequency applications for RFID

High Frequency (HF):
- 13.56MHz
Today’s sole worldwide standard RFID frequency

Ultra High Frequency (UHF):
- 862 - 960MHz
Standard frequency range usable for RFID, but currently not commonly applied worldwide.
  - USA 902-928MHz
  - Europe 865-868MHz
  - Japan 950 - 956MHz
  - Korea 910 - 914MHz
  - Australia 923 - 926MHz
  - China approx. 900MHz

Airbus’ RFID chronology
1997 - RFID deployment on Airbus tools for loan service business
1998 - Development of RFID infrastructure and application
1999 - Further gain of practical experience with operation under RFID
2002 - Airbus initiates global standardization activity on RFID in aviation
2003 - Airbus developed book of technical requirements for RFID
2003 - ATA Spec 2000 chapter 9 was renamed “Automatic Identification & Capturing”
2003 - Successful onboard aircraft test of RFID with resulting unlimited approval by German National Airworthiness Authorities (LBA)
2004 - ATA Spec 2000: First RFID section with basic requirements embodied
2005 - ATA Spec 2000: Mandatory data elements are defined
2006 - Airbus Singapore warehouse to operate under RFID

While marking, tracking and sharing is common in many industries, the really important aspect for the aviation industry lies in RFIDs potential to trace - addressing essential safety aspects of parts originality. Tracing means capturing the current status of the part and creating its history records.

Typical traceable information includes:
- Part history and status, i.e. modifications, software versions
- Calibration
- Certification
- Authorized documents
- Updated information
- Unambiguous part identification

The advantages of tracing have led to RFID being widely introduced to manage supply chains from manufacturing, to shipping, to stocking store shelves.

The Air Transport Association (ATA) has also added an RFID standard to its Spec 2000 e-business applications for the aviation parts industry.

Airbus vision for RFID
Airbus recognized the potential of RFID early on (see “Airbus’ RFID chronology”) and since then has actively led RFID activities in the aviation industry.

The necessity for permanent parts marking for safety and authenticity reasons is recognized, though these can depend on the part and its environment. Therefore, permanent parts marking must be applied according to the differing needs, Airbus actively promotes available technologies such as text nameplates, and barcodes and is researching the possibilities of the RFID technology.

The benefits of RFID described previously mean that the whole process can be made quicker, more efficient and less costly. Therefore, Airbus is investigating the possibilities of deploying RFID on future aircraft programmes and will continue to lead industry activities to standardize RFID, develop new projects and finally promote widespread application of RFID technology where it is applicable under security and cost effective aspects.

SOFTWARE ASPECTS of RFID

Special read/write software for RFID applications was created to read, write, and add data on the chip. As the software is independent, it can be used with any system allowing integration into all existing data processing systems.

Airbus main objectives are:
- Define harmonized identification information
- Develop tag data standards
- Define passive and active RFID usage in close cooperation with regulation authorities
- Develop an agreed standard for data exchange between different parties while considering existing aviation standards such as ISO (International Standards Organization) standards for RFID systems that cover identification cards and smart labels and ATA Spec 2000 for definition of data structure

The integration is fully applied and transferable to other RFID users that want to link RFID to ERP systems.

AIRBUS INITIATIVES FOR RFID STANDARDIZATION AND DEPLOYMENT

The most important objective for RFID use is to define an international standard for the data fields and frequencies.

Airbus leads the international standardization activities through active participation at steering boards and regular industry conferences.

Airbus also participates in the IATA Spec 2000 Chapter 9 Task Force, Permanent Bar Code Parts Identification and actively pursues a continuous dialogue with customers, suppliers and other aircraft manufacturers.

Airbus is investigating the possibilities of the RFID technology, but currently not commonly applied worldwide.

Radio frequency stable.

Component moisture absorption can influence the moisture levels in the component and therefore the performance and reliability of the RFID system. The component moisture levels should be controlled to ensure that the RFID devices perform as expected.

Safety in flight aboard commercial aircraft
In cooperation with a European charter airline, Airbus has performed in-flight tests of RFID tags carried on Airbus A320 aircraft. During over 6,000 documented flight hours in 12 aircraft, tests were conducted with zero defects. The tags received unlimited approval from the German Airworthiness Authorities (LBA) after this successful test, paving the way for future airworthiness approval of the technology.

Safety for tag Resistance to physical impact
Together with EADS Astrium in Bremen, Airbus performed safety tests with RFID tags to identify any risk of defect or interference in the hostile environments common in commercial aircraft operation. Tags were exposed to severe conditions followed by read and write experiments. Safety tests included temperature changes, chemical liquid exposure, humidity, lightning induced transient susceptibility, electrostatic discharge, shock and vibration as well as fire impact. None of the physical impacts had negative effects on the read write functionality or data integrity. Neither did the hostile test environment cause defects in the tags. The tag is resistant against a temperature range from minus 50°C to plus 70°C, safe against aggressive liquids and safe from electromagnetic interference (EMI). Certification of conformity to RTCA D0-160 was received from EADS laboratory Astrium Bremen.

Safety for data access
An important aspect is authorized password protection for data access and modification and also to back-up data on the ERP system.

Safety for part security
The destruction of a tag needs to be ensured if removed from a part or lost. It is essential to prevent counterfeit parts equipped with tags from scrapped components. Each tag must have a valid serial number. Manufacturers can use the chip to prevent unapproved parts entering the supply chain.
RFID/ERP integration at Airbus tools for loan service

In 1997 Airbus started to deploy RFID in its tools business. The motivation for this innovative step was the intention to provide a better, quicker service to customers by improving the efficiency of administration in the tool loan business.

By introducing RFID, Airbus was able to reduce the Turn around Time (TAT) by over 25% and processes throughout the supply chain were accelerated, among them for good data entries and quality inspection due to faster and more accurate data availability.

As a result, tools managed with RFID had a higher effective availability, in addition reduced paperwork and error rates led to significantly reduced administration.

Some of the other significant results included:
- Higher data accuracy due to automatic data capture and avoidance of carry forward and multiplying data entry mistakes
- Easier, faster and improved flow of information between all participants in the supply chain
- Faster loan tool re-availability due to streamlined process and thus reduced stock levels
- Possibility to completely trace the part’s history from cradle to grave
- Faster and more accurate loan invoicing

**HOW IT WORKS**

The Airbus supply chain management activities for tools are based on an ERP Supply Chain Event Manager (SCEM), which is the central system, functioning between the Airbus back office ERP system and the RFID infrastructure consisting of tag, RFID reader and middleware. The middleware is a software specifically developed for Airbus to ensure communication between the RFID reader and the SCEM. The SCEM is linked to the ERP system via an ERP application interface. Using an ERP exchange infrastructure, the management console communicates with the RFID middleware via an XML, (eXtensible Markup Language) interface. The data is then written to or read from the tag via the RFID server. The interface is open to allow incorporation of bar code scanning or other SCEM or ERP standard interfaces at a later date. The SCEM triggers the process and workflows, both internally and externally.

1. **The cycle starts in the ERP system with a customer order, which triggers an event in the SCEM, starting the process**. The ordered tool is then prepared for delivery to the customer.

2. **The forwarder collects the tool and updates the transportation data in the ERP system, resulting in a message that creates an event in the SCEM. The message is then passed via the middleware to the RFID reader and written on the shipments tag and tool box.**

3. **The data is now available electronically and online, both on the RFID tags and via the SCEM capability on the Internet and can be accessed by the authorized supply chain parties.**

4. **When the tool is delivered to the customer by the forwarder, the delivery is acknowledged through a mobile device via the Internet signalling the SCEM that the delivery is complete.** The tool data and status is available in the SCEM and online at every stage in the process enabling efficient shipment tracking and routing between customers, repair shop and Airbus warehouses.

5. **Once the customer returns the tool, the tag on the tool is read and the SCEM automatically notifies quality inspection by email, avoiding any delay in the internal process. After this a quality inspection and packing is carried out. Once this is notified, the tool is registered as quality inspected and ready for delivery again.**

Processes possible today include the return of tools to the tool shop by customers, transfer of tools from warehouse to repair shop, and return of tools from repair shop to the warehouse.
Airbus promotion of RFID applications

Airbus is actively promoting RFID through various projects of the RFID application, for example in cargo and baggage handling and also facilitates knowledge transfer on these applications to customers through regular conferences. For this purpose, Airbus is creating a knowledge database for future customer access.

The most important next step is the revision of the ATA Spec 2000 and general agreement from the FAA and EASA.

Airbus has started several projects to further test RFID technology in the aerospace environment. The selection process for the solution providers has already started.

CERTIFICATION OF RFID TAGS AS REPLACEMENT OF YELLOW TAGS

Airbus puts great emphasis on the elimination of paper documents for supplier parts. By application of RFID, the so-called Yellow Tags identifying the quality control status of a part will no longer be required.

AIRCRAFT WAREHOUSE TO OPERATE FULLY WITH RFID

Airbus is evaluating the launch of a pilot project for an all RFID warehouse. Once a go-ahead decision has been taken, RFID can be introduced in three steps:

• Tools & ground support equipment will be equipped with RFID
• Repair management and quality inspection will be managed via RFID
• RFID will be extended to all spares stored in this warehouse

UNAPPROVED PARTS IDENTIFICATION PROJECT

Airbus has launched a project with a university to provide a means for the identification of unapproved parts in aircraft engines through RFID.

RFID IN LOGISTICS FOR MANUFACTURING

Airbus has launched a project with a university to investigate and deploy the use of RFID in the logistics of manufacturing.

SPARES CENTERS IN AIRBUS WAREHOUSE TO OPERATE FULLY WITH RFID

Airbus operates 24 hours a day every day. AOG Technical and Spares calls.

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Customer support
The first flight of the A380 in April 2005 generated unprecedented worldwide publicity and caught the attention of the general public concerning large double-deck aircraft.

However, the A380 is not the first double-deck aircraft; there have been a number of them over the years, one of which was the Breguet 763 airliner.

Design work on this aircraft started in 1936 with the Breguet 730 prototype, but was postponed due to the Second World War. In 1946, work started again and the prototype, designated Breguet 761, made its first flight at Villacoublay in France on 15 February 1949.

A heavier version was then introduced, designated the 763 Provence, which was destined for Air France and flew mainly on the route from Paris to Algiers from 1953 to 1971.

A final version of the aircraft, the 765 Sahara, was built for the French Air Force and flew for the first time in July 1958. This version was heavier, modified for military use, and had longer range. It remained in service until 1969 when the Transall replaced it.

In its day, it was an impressive aircraft, but a comparison of its characteristics with the state-of-the-art A380 shows just how far the aviation industry has come in the fifty-six years since this double-decker first flew.

The Breguet 765 characteristics were:
- Wingspan: 45.5m (149ft)
- Length: 29m (95ft)
- Height: 10.15m (33ft)
- Speed: 400km/h (250 miles/hour)
- Range: 4000km (2,500 miles)
- Payload: 17t freight or 130 passengers
- Flight crew: 5
AIRMAN AIRcraft Maintenance ANalysis.

He’s flexible and adaptable. He can’t leap tall buildings in a single bound but he can run a fleet of aircraft. He’s AIRMAN: A unique software tool designed to optimise the maintenance of your fleet. Always handy to have around, AIRMAN can reduce aircraft turnaround time. He can provide millions of in-service live data checks. He can provide analysis of available data and access to all relevant information. He can save millions. For more contact Airbus Customer Services.