The A350's on-board fault detection & management systems are advanced compared to earlier Airbus types. This automates most of the process of providing line mechanics the information and resources they need to diagnose and rectify defects, and so maintain high dispatch reliability.

The fault management process for the A350

The A350 family is set to become one of the main widebody types in the global fleet. Of the more than 900 ordered to date, about 470 have been delivered and are in operation with more than 30 airlines. The -900 and -1000 series will replace types like the A340, 777-200ER and 747.

A feature of the A350 is the advanced systems on its flightdeck. These aid the fast and efficient detection and diagnosis of technical faults, and speed their rectification, which improves the aircraft's technical dispatch reliability. The process of detecting, diagnosing, rectifying and recording technical faults that arise during aircraft operation is examined here.

This process includes the use of systems on the board the aircraft: the electronic centralised aircraft monitor (ECAM); on-board maintenance terminal (OMT); on-board information terminal (OIT) or on-board information system (OIS); aircraft condition monitoring system (ACMS); electronic technical manuals and the Airbus AIRN@V system; and electronic technical log (ETL). The manuals hosted on the OMT can also be viewed on the OIS/OIT. These include the aircraft maintenance manual (AMM), illustrated parts catalogue (IPC), schematic diagram (SD), troubleshooting manual (TSM), wiring diagram (WDM), and operator's minimum equipment list (MEL).

Process evolution

The process of dealing with technical component and system faults that arise on aircraft during their operation has evolved significantly over the past 40 years with three generations of commercial types.

The advent of the 757/767, the A320 family, and the A330/A340, saw the introduction of built-in test equipment (BITE) on aircraft systems.

BITE sensors on the aircraft's systems and components detect malfunction by sending data to a central maintenance computer (CMC). This then generates an eight-character fault code that is displayed on the multifunction control display unit (MCDU) on the flightdeck, and is used as the first stage of diagnosing a fault.

The line mechanic usually views the system fault codes when the aircraft is on the ground during turnaround.

Many other defects, however, do not generate a fault code. These include faulty window visors on the flightdeck, flight controls not responding, and leaking hydraulic fluid. This second category of faults is categorised as observations.

As well as maintenance-related defects, there are issues that can affect the progress of a flight or the dispatch of an aircraft, but are not detected by BITE. These will be related to an aircraft system, and the flightcrew need to be alerted to them. All Airbus aircraft since the A320 have been equipped with an ECAM screen displayed on the central screen on the flightdeck.

These flight progress and dispatch issues are alerted to the flightcrew as ECAM messages. They are accompanied by instructions for the crew to make a change to the systems' configuration. An example is an alert relating to an air conditioning pack not operating correctly. If these ECAM messages do not have a correlated CMC fault code then they do not get viewed by the line mechanic. The flightcrew on these older generation types would follow the procedure related to the ECAM message as described in the aircraft operations manual.

Paper tech log

Flightcrew members manually write the observed defects and possible fault codes from the MCDU, on the traditional paper tech log as they occur. Each fault is written as a separate item in the tech log. Flightcrew members also manually add brief descriptions of the problem, referred to as pilot reports (PIREPs).

The aircraft crew addressing and reporting system (ACARS) automatically transmits fault codes to the ground during flight to the airline's maintenance control centre (MCC) or maintenance operations control (MOC) centre, so that diagnosis can start as early as possible.

System fault codes have been manually diagnosed via the use of a fault isolation manual (FIM) or TSM and a fault diagnosis tree. These are large printed documents that require manual searching by engineers and mechanics. Completion of diagnosis while the flight is still in progress will save time when rectifying the fault during turnaround.

Without fault data transmission, line mechanics have to examine fault codes on the MCDU after the aircraft has landed, and enter them on the tech log before diagnosis, as part of the line maintenance process. With this type of fault, it is also the first time mechanics become aware of the observed faults recorded by the pilots.

Faults in both categories are described on the basis of the air transport association (ATA) chapter and sub-chapter they relate to; both are pairs of digits. These are the first half of the eight characters of the fault code. Examples of ATA chapters are 27 for flight controls, 28 for the fuel system, 29 for hydraulic power, 35 for oxygen system, and 49 for the auxiliary power unit (APU).

The second set of four digits of a fault code relate to the ATA sub-chapter. The second set of four characters relate to a description of the problem. The eight-digit codes provide the information the mechanic requires to diagnose the code in the FIM or TSM manuals.

In addition to the tech log, there is a cabin log. The items entered are mainly observed defects, such as faulty seatbelts, damaged seat covers, inoperative lights, or broken equipment.

In addition to assessing faults, line mechanics at the MCC/MOC and on the flightdeck also have to consult the MEL to determine the criticality of each fault. These have cross references from the FIM

The A350 has become one of the industry's main long-haul workhorses. Cathay Pacific operates one of the largest fleets, and has already gained extensive experience with the type.

and TSM. With respect to the MEL, faults fall into three categories.

The first are 'no-go' items, and require immediate rectification before operation.

The second category are 'go' items, meaning the fault can be deferred. The MEL states the number of flight cycles (FC), flight hours (FH) or elapsed time the fault can be deferred for.

The third category are faults that the mechanic has investigated on the tech log but has found nothing evident.

In the section of the log opposite the fault entry, the mechanic specifies either a deferment or rectification. A rectification includes an AMM reference number, and the P/N removed and new P/N installed. The AMM six-digit code corresponds to the four-digit fault.

The mechanic also records the MEL reference, and the number of FC and FH or time remaining for each deferred fault.

When the defects on the tech log are cleared or deferred, the line mechanic, identified by a personal identification number (PIN), signs a certificate for release to service (CRS) form. The tech log therefore provides a constant review of the aircraft's maintenance status with respect to all outstanding faults and their remaining deferral time.

The paper tech log is a three-ply system. The top copy remains on the aircraft, and is referred to as the 'golden copy'. The second page is removed from the log each time the aircraft arrives at its home base. The content is later manually entered into the airline's maintenance and engineering (M&E) IT system, often one or two days after the log page was completed.

The third page is removed by the line mechanic examining the log and performing line maintenance at an outstation. This is held at the outstation, and is required if the departed aircraft is subsequently lost in an accident. This copy must be sent to the airline's MCC or MOC department for entry into the M&E system. This often takes several days.

Relative inefficiency

This manual process has several inherent inefficiencies.

The first is that a large set of printed manuals is required at every line station, with several other sets for the line maintenance mechanics and the MCC department at the airline's home base.

The library of technical manuals must be kept up to date, and all outstations must have the correct copies.

The use of fault codes and handwritten descriptions, manually writing the tech log, and referring to printed manuals all mean the process is time-consuming. This often causes delays, especially for defects that cannot be deferred.

Another issue is that descriptions of the defect can be vague or lack detail because line mechanics use their own phrases. Their handwriting can also be illegible.

A lack of ability to transmit any fault-related data while the flight is in progress means mechanics have to wait for the tech log and do not know about observed defects until after the aircraft has landed.

Another problem is that while the golden copy on the aircraft has the aircraft's up-to-date maintenance status, the MCC department and M&E system often have out-of-date information.

A350 advanced system

This manual process for detecting, recording, diagnosing, rectifying and reporting faults has been superseded by modern generation aircraft types that include the A380 and the A350.

The philosophy of dealing with faults and technical issues on the A350 features important differences compared to previous Airbus types. Airlines said older types provided information relating to faults and technical issues to the flightcrew did not differentiate what concerned the on-going flight and what affected the next dispatch. The aim with the A350 has been to compute a Dispatch Message (DM) to clearly indicate issues that affect the next dispatch only. DM are computed in addition to any applicable ECAM Warnings, which is similar to the concept found in previous Airbus types, indicate to A350 flight crews issues that affect the ongoing flight. However, in a major departure from previous Airbus types, the DMs of the A350 represent the main entry point for flight crews to the MEL.

The types of messages that are generated for the attention of the flightcrew and the line mechanics are affected by the nature of the faults and technical issues. Some faults and defects are generally associated with eight-character fault codes. Faults and defects can be regarded in four categories.

First there are issues that only affect the flightcrew and the aircraft's on-going flight with no effect on maintenance. These typically generate an ECAM Warning, as well as other associated cockpit effects and relate to aircraft configuration issues. Examples are configuration alerts that the flight crew correct, such as CONFIG FLAPS NOT IN T/O CONFIG); and Alerts that result from a flight crew action, such as AIR PACK 2 OFF.

The second type of fault typically generates an ECAM Warning. This is because of an impact on the ongoing flight, as well as the next dispatch. This means that a DM is also computed.

These flightcrew indications are accompanied by correlated eight-character and the associated Maintenance Messages (BITE messages) that are intended for the maintenance crew and facilitate the troubleshooting of the associated faults.

Examples of such faults are a problem with the flap lowering mechanism, or the APU air conditioning not being available.

The faults are displayed on the Post Flight Report (PFR), which can be accessed via the OMT and OIT displays. The fault code is shown in blue, and can be investigated via hyperlinks to the electronic

Aircraft Fault Isolation (AFI). On the A350, the AFI is the same manual that was referred to as the Trouble Shooting Manual (TSM) in older Airbus types.

The associated ECAM actions and possible aircraft reconfiguration limitations are managed by the flightcrew. The Dispatch Message will be assessed by the flightcrew when the aircraft on the ground to identify the impact for the next dispatch. The flightcrew log any Dispatch Messages to the aircraft's technical logbook.

On the A350, DMs are the main entry point for flight crews to the MEL via hyperlinks on the Dispatch Message using a dedicated EFB application.

Dispatch Messages, along with all of the other aircraft fault information, such as ECAM Warnings and correlated Maintenance Messages, can also be assessed by the MCC on the ground.

The third type of faults do not have an impact on the on-going flight, but do affect maintenance and also the aircraft's dispatch. These faults will be reported in the form of a Dispatch Message if applicable, in addition to the correlated fault code and Maintenance Message.

An examples of such a fault is the failure of circuit board in an avionic box. The function of this board would have been taken over by a standby circuit board in the same avionic box, and would have generated a fault code. In the meantime, the flightcrew would not have been alerted.

The second and third category of faults, and which account for the majority, are system faults that affect the on-going flight and future dispatch of the aircraft, and as well as the aircraft's maintenance.

In addition to these three groups of faults, there is a fourth group that are often referred to as 'observed faults' or 'crew observations'. Examples are items such as problems with a pilot's windscreen visor electrical seat adjustment. This group can also include cabin crew observed defects, such as seat fabric damage; or maintenance crew observed defects, such as an unserviceable illumination light in one of the ground servicing panels. None of these defects generate fault codes.

Because the fourth group of defects do not generate any fault codes they must be entered into the technical log by the flightcrew. The technical log can either be a traditional printed log, or an ETL hosted on the aircraft's electronic flightbag (EFB). The A350's EFB is a Class 2 device. This is portable and can interface with the aircraft's avionics to allow data to be transferred from the aircraft's systems and automatically populated in the ETL.

The second, third and fourth groups of technical issues can all affect the future dispatch of the aircraft.

"These three categories of maintenance faults occur to varying degrees throughout operation of a fleet type," says Scott Falkiner, technical engineer e-operations at British Airways (BA). "We operate a fleet of 10 A350s, and a typical number of outstanding deferred defects for the fleet at any one time is about 130. Most are cabin items, typically accounting for 50-75% of total faults. While these do not affect the aircraft's dispatch or airworthiness, it is important to monitor cabin defects in terms of customer goodwill and service standard, so they need to be reported in a timely manner for rectification at the earliest opportunity.

"Of the remaining faults, about 80% are flightdeck observations and physical damage to the aircraft that are reported by the flightcrew," continues Falkiner. "LRU, component and system faults, and which produce a fault code, account for the smallest portion of these three categories."

Fault management

As the flight progresses faults continue to be observed. Some may be shown on the ECAM display, but ECAM and system faults are summarised in the Current Flight Report (CFR) and the PFR, which can be viewed via the OIT/OIS screen. These are only the faults that generate a fault code; summarised in lines of white text.

Observed faults, that are recorded on the aircraft's tech log, can affect its

The two outboard screens on the main panel on the flightdeck provide flightcrew and mechanics access to the on-board information system (OIS) and on-board maintenance terminal (OMT). These provide a PFR, a summary of all defects and faults recorded during a flight.

dispatch. These do not have associated fault codes. Traditionally they were written on the paper tech log by flightcrew.

The A350 has improved this system by having a set of standard descriptions of observed faults on the library in the EFB. The menu allows pilots to select the correct description, such as a faulty electrical seat adjustment, by choosing the relevant ATA chapter, and then sub-chapter. These choices provide the first two pairs of a code to describe the fault. In this case it is ATA 25.

The last two digits select the particular component or item affected. In this case it would be ATA 25-11 for Furnishings and specifically the pilot's seat.

Such fault code provisions, even for observed faults not monitored by aircraft systems, allow the flightcrew to electronically record the associated defects in the aircraft technical logbook.

Faults that are monitored by aircraft systems are summarised in the PFR after each flight, and can be viewed on the aircraft by the maintenance crew on the OMT or the OIT.

If any fault has an impact on the dispatch of the aircraft, then the associated DM will automatically be shown on the screen with a 'MEL' indication hyperlink shown in blue. This indicates that the item is a minimum equipment list (MEL) issue, and so affects the dispatch of the next flight. The mechanic can enter the electronic MEL manual from this hyperlink associated with the DM The corresponding eight-character fault code is also shown in the aircraft effects summary on the PFR.

Ultimately, all faults indicated in the PFR and also reported in the aircraft technical logbook have to be managed by the maintenance crew. The PFR facilitates the identification of the relevant aircraft effect of each monitored fault by grouping them under the corresponding tab of:

- Cockpit (for detected faults with cockpit related effects),
- Cabin (for detected faults with cabin related effects),
- Maintenance (for detected faults with neither cockpit nor cabin related effects).

Each item can be associated with the eight-character fault code shown in blue in the PFR display that enables the navigation to the corresponding electronic AFI accessible via the OMT or the OIT.

The AFI can then provide a link to corresponding the Maintenance Procedure (MP) manual. On the A350, the MP is the same type of manual that was referred to as the Aircraft Maintenance Manual (AMM) in previous Airbus types. Guidance to the relevant AFI and MP tasks is also provided for crew observations with no reported fault code.

Fault diagnosis and consultation of the rectification instructions can therefore all be performed electronically by the mechanic via the OMT or it OIT after the aircraft has landed. The mechanic can also access the OMT on the aircraft via the optional portable maintenance aircraft terminal (PMAT) when connected via specific ports located around the aircraft.

Fault diagnosis and preparation can also be done on the ground, while the flight is in progress, if the aircraft has sufficient connectivity systems and an ETL.

Maintenance messages on the A350 are all aggregated and correlated with the associated aircraft effects by the Centralised Maintenance System (CMS) and are automatically transmitted, along with the reported aircraft effects to the ground in real time. Observed defects can only be sent to the ground while the flight is in progress, however, if an ETL is used.

If an ETL is not used, then flightcrew will have to enter these observed defects manually on to the paper tech log during flight. Some may also be entered by the line mechanic after landing.

Flightdeck connectivity

The transmission of fault codes and data during flight for diagnosis and preparation on the ground requires the aircraft to have a connectivity system. The first standard system is 'plain old ACARS', sometimes referred to as POA ACARS. This only operates when the aircraft is over the ground, since it operates through very high frequency (VHF) radio transmitters, with a range of up to 200nm.

Other connectivity options on the A350 include ACARS via high-frequency (HF) radio over long distances, transmissions via Classic Iridium or Inmarsat satellite communication (Satcom), the Swift Broadband (SBB) system for transmissions via internet protocol (I.P.) via satellite, and hybrid systems such as the European Aviation Network (EAN), which combines Satcom and air-to-ground I.P. transmissions.

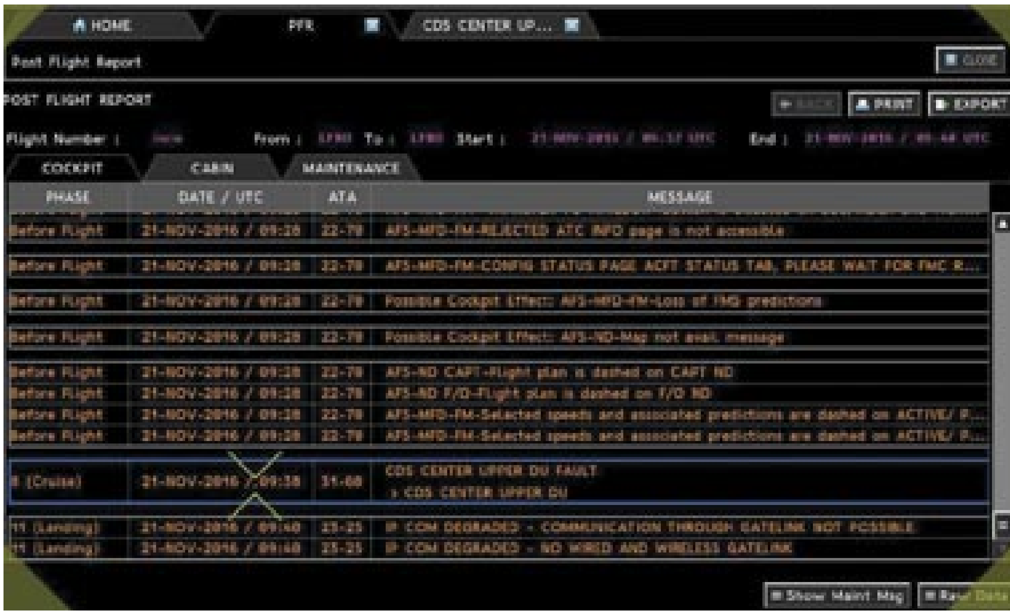
The use of both short- and long-range connectivity systems makes it possible to transmit data in real time or at regular intervals to an airline's MCC or MOC, line maintenance and engineering departments, and line mechanics' offices at outstations. The aircraft's avionics systems will select the most suitable and cheapest connectivity system depending on the aircraft's location.

"BA uses POA ACARS over VHF and HF radio, and via Classic Satcom," says Falkiner. "We also have Inmarsat SBB on the A350, which allows large data transmissions. These systems send messages automatically to our maintenance control department at London Heathrow, which manages BA's entire operation."

Electronic tech log

With a variety of connectivity systems available, all types of faults can be entered on an ETL, and transmitted to the ground.

The majority of A350 operations are medium- and long-haul flights, so most faults can be transmitted with sufficient time remaining for the MCC, line maintenance department, or line mechanic at an outstation, to diagnose and prepare



The post-flight report (PFR) of all defects recorded during a flight include the listing of an eight-character fault code where relevant, and access to electronic versions of the technical manuals.

rectifications in advance of the aircraft's arrival.

The use of an ETL is up to the operator. Since the EFB/ETL can be interfaced with the aircraft's systems, Airbus has an approved list of ETLs for operators to choose from, including the Conduce system, selected by Spanish operator World2fly and Middle Eastern operator Etihad Airways. Conduce is also used by Airbus for its Beluga aircraft.

Other choices include the Ultramain system, which is used by BA and Cathay Pacific; and the Nvable ETL system.

Nvable has recently formed a partnership with M&E system vendor Commsoft to interface the OASES system with its ETL. "The basis of the ETL is that it captures fault data, and requires authorisations on each section. Each section is shown as a tab, and there is a traffic light colour code to indicate if each section is complete," says Cameron Hood, chief executive officer at Nvable.

Sections include a page for recording arrival details; a page for recording new defects; a page that captures the deferment or clearing of a defect; a page that records fuel on the aircraft at arrival and the amount uplifted during turnaround; a page that lists the line maintenance checks and out-of-phase (OOP) maintenance tasks coming due, and the routine tasks due in each one; and a page where the captain signs before the aircraft departs.

"An ETL is part of the solution for an e-enabled aircraft and the overall transition to a digitised system for managing a fleet," says John Brownen, head of Hong Kong operations, engineering department at Cathay Pacific. "The ETL application allows real-time fault reporting, provides enhanced data, and allows photographs to be attached to a defect report.

"The ETL has user profiles for flight and cabin crew, and engineers and mechanics. Defects can be raised in either profile," continues Brownen. "A customised fault tree facilitates easy location of the correct fault description and its reporting. The fault tree works on the basis of ATA chapter number, and text descriptions of observed faults."

On-ground response

If an ETL is used, then all three categories of faults that concern MCC and line maintenance can be managed while in flight. Fault data is usually first sent to an operator's MCC or MOC department.

The first stage of management is to summarise the faults arising on each aircraft as they arise, and monitor faults arising on the operating fleet as a whole.

In the early 2000s, AIRMAN was the first product offered by Airbus to interface with the fault codes sent from the aircraft. Used by an airline's MCC department, the AIRMAN software was hosted on a computer to summarise the faults occurring on aircraft in flight as they come in. A visual display showed each aircraft, identified with its registration and flight number, together with a summary list of outstanding faults. These were colour-coded to indicate their severity. Red indicated the highest level, amber indicated medium, while yellow signalled a low priority for rectification.

This evolved into AIRMAN web, a web-based application.

"The AIRMAN dashboard provides links to the MEL so that quick diagnosis can be made with reference to the dispatch of the next flight," says Falkiner. This is presented visually on the dashboard screen. AIRMAN can also have the airline's own documents.

"We have a section on AIRMAN for each fleet type at BA, and use the system to watch defects as they come in," adds Falkiner. "System defects which produce fault codes occur in limited numbers. We get an average of one or two per day for the entire BA fleet. We may start analysing these as soon as possible, depending on the defect. A few false messages can occur, however, as well as error messages."

AIRMAN web is currently being replaced by Skywise Health Monitoring, which has multiple pages. Besides the page summarising the fleet, it can also show a fault page for each aircraft and the PFR page for each aircraft and the CFR (for in-flight fault display) as well as PFR (for post-flight fault display) for each aircraft. Further to that, Skywise Health Monitoring can leverage the power of the Skywise data platform by integrating with the airline's M&E system, and so offer a seamless experience for maintenance operators in navigating the various aircraft information repositories.

The faults and defects coming into the MOC or MCC, and possibly passing through AIRMAN or Skywise, are also automatically entered into the airline's M&E system if they are transmitted to the ground from the aircraft and the ETL. "This has the benefit of keeping the M&E system and each aircraft's maintenance status up to date," says Falkiner.

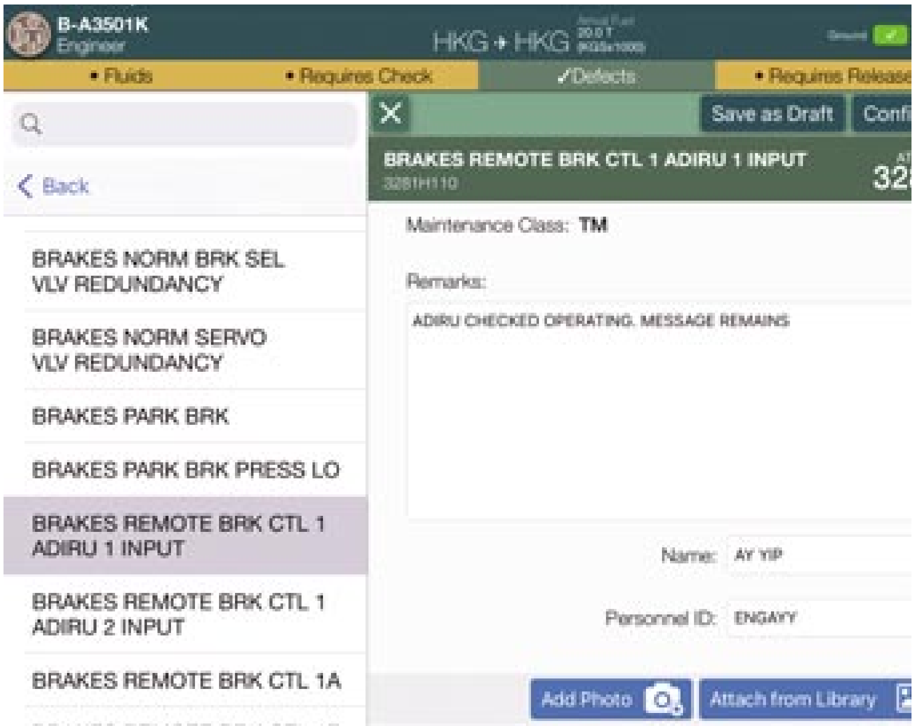
The AIRMAN and Skywise systems also offer direct interface via hyperlinks airn@vX. This is a library of all the electronic aircraft manuals that replaced the previous legacy solution called AirN@v. These are the manuals hosted on the OIT and OMT on the aircraft.

The mechanics and MCC personnel can consult the electronic versions of the technical manuals while a flight is in progress. The mechanic can start from the fault code highlighted in blue on the CFR/PFR, and navigate all the way through to the AFI and MP. In addition, experienced mechanics have the intuition to determine causes of faults themselves.

Besides the Airbus systems, the Nvable ETL system collates all defect and related information for each aircraft in the user's fleet. This is displayed as a summary box for each aircraft, with essential outstanding defect information shown in simple icons. This includes the number of open defects, and their remaining time restrictions. The box for each aircraft can be expanded to a full page to view more detail.

Mechanic reaction

The mechanic will receive all information relating to all types of fault if an ETL is used on the aircraft. In this case, the mechanic can prepare rectification maintenance before the aircraft's arrival.



Cathay Pacific and British Airways are two A350 operators that have selected the Ultramain Electronic Logbook (ELB), or ETL. This can be used to examine Dispatch Messages, and report and analyse fault codes. The ELB report can be viewed on the device, and via a desktop in MOC/MCC.

If, however, a paper tech log is used the mechanic will only be notified of the CMC system fault codes ahead of the aircraft landing, since the airline's MCC will have been able to transmit the relevant information to the outstation.

The mechanic will only be able to read the paper tech log, written by the flightcrew, after the aircraft has arrived. "The mechanic often starts after the pilots have left the flightdeck," says Falkiner. "The mechanic will examine the log for system fault messages and codes, and look through the PFR on the PMT or the OIT. The mechanic can also access AIRMAN or Skywise at an outstation to search for these, in which case they can look at electronic versions of all the manuals. The Airbus systems will create a sub-set of dispatch messages that have originated from defects with MEL alerts on the PFR. The system is also configured to produce a process to rectify each fault.

"BA uses the Ultramain ETL system via an iPad on its A350," continues Falkiner. 'There is a similar system on the 787. Ultramain covers every possible fault, with and without CMC fault codes, entered by the flightcrew or cabin crew. Entries can be a fault code, a standard set of text selected from the menu, or a set of text that is found in the system after an ATA chapter or sub-chapter is chosen. This avoids the problem of crew members manually entering their own description, leading to difficulties with accurately identifying the fault."

BA had the Ultramain techlog built into the 787 with the use of a Class 3 EFB. This caused problems, for example with false alerts from the CMC. "We chose a system of manual entry for the techlog on a Class 2 EFB to avoid these problems," says Falkiner. "The advantage of using a tech log is that it reduces many aircraft dispatch reliability issues, because the line maintenance department can start work during the flight. The timeliness of transmitting faults and automatically entering them into the M&E system means it has a more up-to-date representation of each aircraft's maintenance status. Mechanics can also take pictures of a defect with an electronic device, and add these to the related fault."

With all the faults present on the log, whether entered manually or fed through to the OMT or OIT automatically, the mechanic can view the summary page of the PFR. Preparation of fault rectification starts at this stage, and each one is hyperlinked to the relevant electronic manuals held in the OMT. "The AFI, MP and illustrated parts catalogue (IPC) are the most important manuals, and all are held in one group within AIRN@V, on the OMT," says Kelvin To, lead technical services engineer Airbus, at Cathay Pacific. "The manuals have all the defects, related IPC pages and MP pages for rectification to reduce the time spent by the mechanic.

"All the issues that affect line maintenance are integrated within the A350's system," continues To. "For example, there may be an instruction in a rectification task for the mechanic to pull a particular circuit-breaker. This can now be done electronically within the OMT, although there are still some circuit-breakers that have to be manually pulled."

Kelvin To adds that another attractive feature of the A350's system is that the FIM instructs the mechanic to pressurise a hydraulic pump, and the OMT states the correct pressure level and the position of the switches that the mechanic needs to set. Another feature is that after the mechanic has finished troubleshooting, the OMT will list any components that need replacing.

An ETL can be configured to provide a lot of useful information to the line mechanic. "The defect page on the Nvable ETL can, for example, change the status of a defect that has been recorded," says Hood. "The page will also include the type of action taken to change the status, and details of any component and P/N changes. This page can only be signed by a mechanic, who identifies themselves with a PIN number. The CRS cannot be produced without this mechanic's sign off. At this point the colour for the defects tab turns green if all outstanding defects have sufficient deferral time remaining."

Brownen at Cathay Pacific says that the key elements of defect control in the A350's overall system are: the positive identification, verification and rectification of defects; the history of each defect on the aircraft and the previous actions taken, which is useful in the case of repetitive faults; and awareness of the effects of a fault on aircraft dispatch in terms of flight time and sector limitations, and on an aircraft's ability to conduct extended-range twin-engine operational performance standards (ETOPs) missions.

"Once the mechanic has completed all required defects, the Ultramain ETL will confirm they have been dealt with, but it will prevent the mechanic from signing the electronic CRS in the case of a 'no-go' item, or a 'go' defect that has run out of deferral time or has insufficient deferral time for the next mission," explains To. "The ETL has made a lot of difference because of the instant flow of information, and the ability to attach photographs, search through manuals, and prevent the incorrect release of an aircraft."

Cathay Pacific continues to transform its digitisation process, including the design and development of electronic maintenance task cards. These will be delivered in XML format to provide an intelligent task card with information specific to the particular aircraft being worked on, such as only the component part numbers and instructions that apply to it. This will provide an interactive task card system that speeds up the preparation of rectification and non-routine task cards, automatically records the man-hours, materials and parts used, and updates the aircraft's maintenance status in the M&E system in real time. AC