The processes of line maintenance, maintenance control & flight operations are managed manually. Technologies have evolved which now makes communication and coordination between these three functions completely electronic, and streamline the process.

Configuring IT systems to combine flight operations & line maintenance

Line maintenance, maintenance control, and flight operations departments have traditionally managed their tasks manually.

Several key functions are performed simultaneously by all these departments. Coordinating these functions, and maintaining communication between all the three departments, so that all of them are aware of the maintenance and operational status of every aircraft in the fleet requires a lot of data to be communicated at the fastest speed and in the shortest time possible.

It has now become possible to configure an IT system to remove almost all manual tasks, and paper manuals and documents. The maintenance & engineering (M&E) IT system is at the core of this.

Flight-schedule coordination

Flight-schedule planning starts several years in advance. "We prepare a flight schedule five and two years in advance of actual operation," says Guy Amary, information management office exploitation manager, at Air France. "The flight-scheduling group discusses the plan with the engineering department, to determine which aircraft type will be used for which flights, so we can predict the flight hours (FH) and flight cycles (FC) generated by each aircraft.

"In the short term, planning a flight schedule and assigning individual aircraft to particular flight numbers on each day over an extended period is re-planned and optimised daily," continues Amary. "We do this for a 15-day period for our long-haul fleet, and for a 10-day period for our short-haul fleet."

Flight operations and scheduling systems are offered by Lufthansa Systems (NetLine), SITA (Fleetwatch), AIMS (AIMS), Sabre (RM and Flightwatch).

Before a draft flight schedule can be formulated, some basic data are needed on required downtime and frequency for each type of planned line and base maintenance check. The M&E system has to feed the flight-scheduling system data on aircraft operational restrictions. This will include information relating to open defects; minimum equipment list (MEL) items; and the required location for some of the maintenance events coming due, such as an engine change, or the rectification of more complex defects.

"Coordinating a flight schedule with a fleet's maintenance requirements starts with the M&E system feeding data to the flight schedule system," says Chris Reed, managing director at Trax. "The M&E system interfaces with the flight-scheduling system, normally through web services, using XML data. The data in either system will not always be in XML format, but most Trax users will convert the data to XML, transmit them, and then convert the data back to the required format after arriving at the next system."

Many M&E system providers provide application programming interfaces (APIs). "Mxi Technologies now has a range of standard APIs that interface our Maintenix M&E system with various other systems," says James Elliott, production marketing manager at Mxi Technologies.

As the actual date of the planned flight schedule approaches, the FH, FC, maintenance checks performed, and maintenance status of each aircraft change constantly. A basic function of the M&E system is to constantly update a timeline of maintenance events coming due for each aircraft, on a calendar basis, in relation to the flight schedule planned for the fleet. This is done as actual maintenance events are performed, the aircraft's maintenance status changes, and accumulated FH and FC data are fed into the M&E system.

Aircraft in operation

The flight-schedule system is usually updated overnight every 24 hours in respect of each aircraft's current geographical position, its maintenance and operational status, and the flights planned for the next 24 hours.

As aircraft perform their planned operations, actual out, off, on and in (OOOI) times that provide data on the actual start and end of flight and block times, are transmitted from the aircraft to the flight scheduling system via the aircraft communications addressing and reporting system (ACARS). This automated transmission replaces the manual-entry in-flight technical logs, which had to be manually keyed into the operations and M&E systems. "Once OOOI times have been received by the various systems in the flight operations department, the data are passed on to the M&E system," explains Elliott. "Feeding actual OOOI times into the M&E system automatically as each flight takes place allows the M&E system to update the timeline of maintenance events coming due. This is fed periodically into the flight-scheduling system so that the flight schedule planned for a fleet or sub-fleet can be accurately updated. The information and data flows, and maintenance events and flight schedules are all done automatically. This is important for coordinating flight operations, maintenance control, and line maintenance activities."

There are several other methods for transferring OOOI times from the aircraft to the flight operations and M&E

Modern connectivity systems mean that airline maintenance control centres and line maintenance departments can now be informed of both CMC and non-CMC faults while the aircraft is in the air.

systems. "One is for the data to come into the M&E system through a web service interface," says Reed. "The systems can update operating schedules and the timeline of maintenance events either overnight or in real-time."

Technical fault reporting

The second main aspect of on-going flight operations is the occurrence of technical faults on the aircraft. These can broadly be sub-divided between faults that are automatically generated by the aircraft's central maintenance computer (CMC), and those that are not.

Aircraft systems and system components have built-in test equipment (BITE), which will result in the CMC generating a fault code when components and systems start to malfunction and develop problems. These fault codes can be transmitted from the CMC to the ground using ACARS. Standard ACARS messages conform to ARINC protocols.

Not all aircraft types are fitted with ACARS equipment, however, installation of which can cost $100,000. Instead, some airlines still have their flightcrews manually recording CMC fault codes on the technical log kept on the aircraft. These fault codes are then manually entered by clerks in the maintenance control centre (MCC) after a copy of the technical log has been given to the line maintenance department.

Fault codes sent by ACARS are forwarded to the airline's MCC and line maintenance department for diagnosis.

"A line maintenance department's first function is to start the diagnosis of technical faults and CMC fault codes," says Elliott. "This involves consulting the aircraft's MEL to determine the fault category: if it has a no-go status, it has to be cleared at the aircraft's next downtime; or if it can be deferred, for how long. Line maintenance then updates the aircraft's maintenance status as these technical faults arise. A third function is to plan and carry out the process of clearing or deferring the defects."

The main purpose of an airline's MCC is to complete the diagnosis of technical faults, following an initial diagnosis by the line maintenance department. The MCC will coordinate with the flight operations department to organise a fix for a technical fault that cannot be deferred to a later line maintenance check. This is because some faults will cause long delays, or require the aircraft to be in a particular location. This will affect the fleet's flight schedule and crewing requirements.

CMC codes can be diagnosed in several ways. Line mechanics in the MCC department used to diagnose fault codes by manually searching through printed documents, such as the fault isolation manual (FIM) and troubleshooting manual (TSM). The faults would also be manually entered into the M&E system.

Now CMC codes can be transferred to systems that automatically diagnose them while the aircraft is in flight. "We use systems provided by the main aircraft manufacturers to analyse CMC fault codes," says Amary. "We use Airbus's AIRMAN system for collecting CMC fault codes sent by Airbus aircraft, and Boeing's aircraft health monitoring (AHM) system for codes sent from Boeing aircraft. Both these systems make alerts to fault codes that relate to a no-go or MEL item that prevents further operation until rectified. The MCC assesses the impact of all CMC messages.

"We then manually take the CMC fault code information from the AIRMAN and AHM systems and key them into our M&E system, which is Maintenix. There is no interface for this yet," says Amary. "We use Maintenix to keep the maintenance record of each aircraft, by recording all maintenance tasks required for each aircraft, and all technical faults that have arisen against them. Maintenix then plans all the line maintenance tasks into a package."

There are several other systems for diagnosing CMC fault codes. Many M&E systems have modules for analysing CMC codes. "Feeding ACARS messages into the Ultramain M&E system is a fairly simple interface with the ACARS ground system," says John Stone, vice president of product management at Ultramain. "Ultramain's aircraft health and reliability module (AHRM) processes and analyses CMC messages for inclusion in the reliability report for each aircraft, in addition to raising alerts for MEL and no-go CMC faults upon receipt."

The AHRM module in Ultramain takes CMC messages, and catalogues them for review by MCC and line maintenance. "It correlates the CMC codes with the system or component failures reported on the aircraft that they could possibly relate to," explains Stone. "The AHRM page has the illustrated parts catalogue (IPC), TSM and FIM in the module. The AHRM is therefore used for on-going analysis of technical faults. It also looks at repeat and reoccurring faults. The user has a list of possible explanations for a fault code being issued. The system points the user to the TSM to help pinpoint the cause of the problem. The system also looks for symptoms that could be related to the fault, in other CMC messages that have been sent. The AHRM is basically a decision-tree process that is used to narrow down the ultimate cause of the CMC code being sent."

Other examples of CMC code diagnosis include Trax, which has its own maintenance control module. "A CMC fault code received via ACARS, will flash up on the MCC," says Reed. "The user, either an MCC staff member or line mechanic, can use the system to diagnose the fault. The MCC module says if it is a 'no-go' or 'go' fault, and how long it can be deferred for. It will defer the defect to be fixed at a later date, or send instructions to rectify it before the aircraft can operate again."

Trax provides the user with access to several manuals that are used to analyse and diagnose the faults. These include the FIM, the TSM and the FRM.

"When a fault has to be fixed, the MCC module shows a 'pending' status for the affected aircraft, which indicates the aircraft is waiting for clearance," continues Reed. "This information is interfaced with the flight operations department so that it is aware of the aircraft's operational status."

Non-CMC faults

While BITE can detect malfunctions and problems in systems and components, there are faults that may not generate, or have a mechanism for generating, CMC fault codes. These faults have to be described by the flightcrew, and include, for example, handling difficulties with the aircraft's flight controls, or physical damage. Such faults are manually written in the flight technical logs by the flightcrew. Since they are non-CMC code faults, they cannot be reported to the MCC or line maintenance departments until the aircraft has landed, and the flight technical log has been handed to the line mechanic.

"Traditionally, copies of the flight technical logs were given to clerks in the MCC by the receiving line mechanic," says Reed. "The faults on the logs were then manually keyed into the M&E system by the clerks. There was always a delay of at least some hours before the faults were manually entered into the M&E system. In the meantime, the line mechanic would inform the MCC of a technical fault as soon as possible, so that a diagnosis could be started, if necessary, and a decision made on whether or not a fix can be deferred."

There are situations where the fault is fixed, and the fix entered into the log kept on the aircraft, before the clerks have had time to enter the unfixed fault into the M&E system. This results in the aircraft's actual maintenance status on the M&E system being out-of-phase with that shown in the technical log kept on the aircraft.

"Manually recording technical faults in the M&E system can be expedited in some cases by the flightcrew sending an ACARS message from the flightdeck while in flight. This is made easier by the crew looking up a fault code for a non-CMC defect in the aircraft's fault reporting manual (FRM). The code is keyed into the multifunction control and display unit (MCDU)," says Reed. "The MCC or line maintenance department can then log the fault into Trax, or any other M&E system, while the aircraft is still in flight. Simple ACARS messages, however, for non-CMC faults are not always sufficient to describe a defect."

Electronic fault reporting

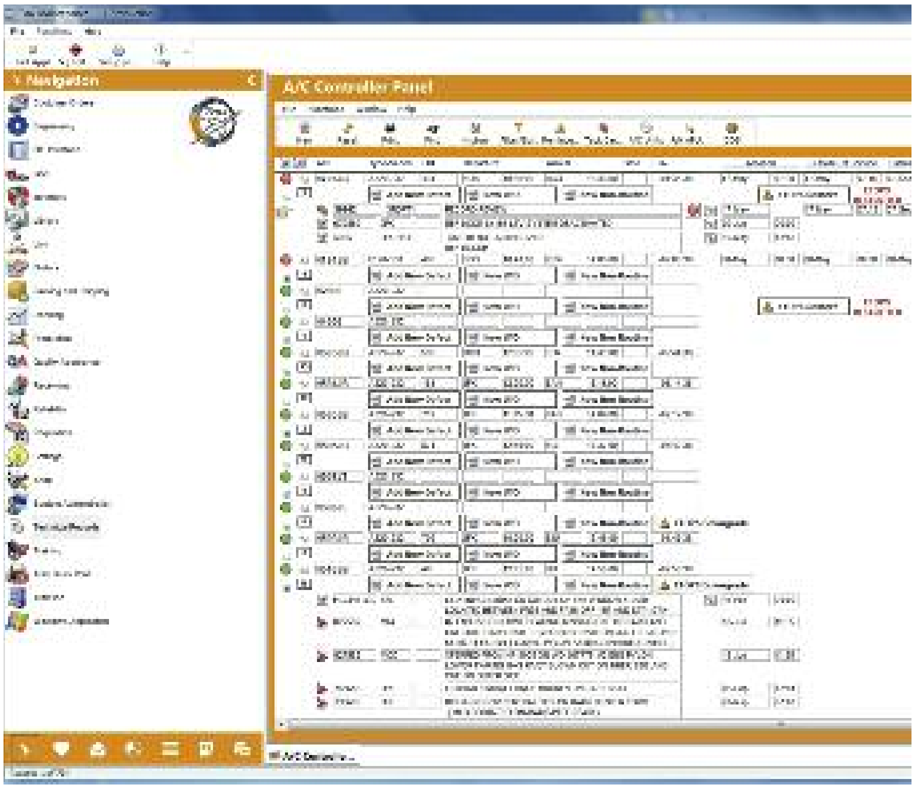
The process of reporting non-CMC faults and defects that require a description in text of some kind has been transformed by electronic technical logs (ETLs), a software application used on an electronic flight bag (EFB).

Class 1 and 2 EFBs are standalone devices. The original definition of a Class 1 EFB is a device which has no connection to the aircraft's systems, and could only be used above a specified altitude. A Class 2 EFB has been defined as a device which operates with Class A and B software. These are applications that only take data in a one-way communication from the aircraft's avionics, such as the flight management system.

The distinction between Class 1 and 2 EFBs has now become less clear with the use of iPads as EFBs, and securing devices that now make it possible to use an iPad as a Class 1 device in all phases of flight, and so become a Class 2 EFB.

Class 3 EFBs are devices built into the aircraft's flightdeck. They also operate with Class C software, and have a two-way communication with the aircraft's avionics.

All classes of EFBs can operate together with an aircraft interface device



Trax has a maintenance control centre (MCC) module. This will receive CMC and non-CMC messages that have been received from the aircraft. The user can then diagnose the faults, and the MCC module will indicate if the fault has a 'go' or 'no-go' status.

(AID), or have one built in, so that they interface with the aircraft's avionics that operate with ARINC protocols. The EFBs, and ETL software, can therefore send messages to the ground via ACARS.

ETLs first save time by carrying an electronic version of the FRM, which avoids the need to carry a printed hard copy on the flightdeck. The code and description of the non-CMC defect can be looked up in a menu on the ETL software.

A main provider of ETL software is Ultramain, whose system is being used by British Airways, KLM and Singapore Airlines. In addition, Ultramain has recently contracted to provide ETL software for all of Cathay Pacific's fleet. Ultramain provides the ETL software on Boeing's optional Class EFBs for the 777 and 787. Its ETL software can also be used on Class 1 and 2 EFBs for other aircraft types.

"Our ETL application works similarly to a paper tech log in some ways. It has an FRM to look up codes for non-CMC faults and defects," says Stone. "Our ETL also allows the user to search for faults by air transport association (ATA) chapter. So if there is a problem with a damaged flightdeck windscreen, or a physical problem with the flight controls through the control column, for example, the flightcrew user can search through ATA chapters, and choose ATA chapter 56 for windows, or ATA chapter 27 for flight controls. The user can find the specific fault by following a menu or search tree of key words to describe it, or by typing in key words to find it. This eventually arrives at the specific fault, and the corresponding FRM code. There is also a word search facility, which allows the user to type in some text describing the fault that is associated with the defect. Once the specific fault has been found, a message can be sent to the ground."

"The Ultramain ETLs will also have the MEL in XML format in the system," says Robert Saunders, head of engineering cost management at Cathay Pacific. "This means that once the ETL has determined what the fault or FRM code is, it can be automatically correlated with the MEL. With the non-CMC fault sent to the ground, the system will inform the MCC or line mechanic if the fault is a 'no-go' item; or if it can be deferred, and for how long. This should be 100% accurate. First, it will avoid the errors made in the traditional, manual system of analysing faults and recording them in logs and the M&E system. It will also save a lot of time by diagnosing the defects while the aircraft is in the air."

Cathay Pacific chose EFBs supplied by DAC. "We did not opt for Boeing's Class 3 EFB/ETL on the 777, because there are only two sets on the aircraft," says Saunders. "The DAC system will be built into the flightdeck, but only have Type A and B software. The Type B software includes Ultramain's ETL.

"The system will have four processor units, each for a screen in the electronics bay, and three touchscreen displays that will be built in to the aircraft's avionics, so will look like a Class 3 system," continues Saunders. "Each pilot will have a unit, and there will be a third one in the observer's seat on the flightdeck, and a fourth in the cabin. The units will be installed with Ultramain's ETL software."

Transmissions received from the EFB/ETL on the ground then have to be fed into the MCC and line maintenance departments for analysis.

"Our ETL can be used by airlines in three different ways," explains Stone. "The first is not to integrate with an M&E system, but to use our EFB Technical Ground System, which allows the non-CMC faults to be diagnosed by MCC and line maintenance. If the ETL has been integrated with the aircraft's avionics and CMC, the ETL could have a complete log of all CMC and non-CMC faults and defects. It can also be used to diagnose the CMC faults and defects.

"The second option is to integrate the ETL with our Ultramain M&E system," continues Stone. "The user can diagnose both CMC and non-CMC faults and defects using Ultramain's AHRM module. The third option is to interface the ETL, and the messages received from it, with a third-party M&E system, by using a Spec 2000 Chapter 17 interface."

Using an ETL therefore makes it possible for the MCC and line maintenance department to analyse both CMC and non-CMC faults that occur during the flight, rather than waiting for the aircraft to land and arrive at the gate. This gives the MCC and line mechanics time to diagnose a fault, decide if it needs to be fixed or can be deferred, and prepare for its rectification while the aircraft is in the air if necessary.

An ETL also has the advantage of having electronic versions of the FIM, TSM, MEL and aircraft maintenance manual (AMM). Line mechanics can use the ETL to diagnose faults while on the flightdeck, if these were not transmitted or diagnosed in flight.

Once a line mechanic logs a fault as having been cleared on the ETL on the aircraft, the system sends a message, via the aircraft's various connectivity systems, to the ETL ground module. "The ETL on the aircraft asks the ETL ground module for confirmation that the mechanic is legitimate, and that the system has confirmed the fault as being cleared. This is because the ETL ground module is the replacement for the aircraft's 'golden' copy of the paper technical log," explains Saunders. "The ETL ground module is therefore the aircraft's certified technical log, and keeps all log entries. Once the mechanic has been confirmed as legitimate and the defect has been logged as being cleared, the ground module sends a message to the aircraft ETL and the M&E system that the fault has been dealt with.

Aircraft connectivity

Airlines have a choice of connectivity systems for transmitting fault-related data when the aircraft is in the air. The various systems available for flightdeck connectivity are described in more detail *(see Flightdeck connectivity: the systems available, page 16)*.

ACARS messages, which comply with ARINC protocols, can be transmitted to the ground by VHF or HF radio datalinks, by Inmarsat's standard Satcom service, or by Iridium's standard Satcom service.

VHF has the limitation of relying on land-based receivers and a transmission range of about 250nm. Not all regions of the world have ground-based VHF datalink receivers, so there is limited coverage over some land masses, the oceans, and polar regions.

HF radio is used for long-distance transmissions, but is perceived as being old-fashioned by some.

Standard Inmarsat Satcom has almost full global coverage, except for polar regions. Iridium Satcom services provide full global coverage, but have only been approved for safety transmissions from the flightdeck since 2008.

These four systems have a transmission rate for standard ACARS messages of 2.4Kb per second. They can all be used for sending ACARS messages from the CMC, and so can send CMC fault codes.

Since these four systems function on ARINC protocols, they can be used to send messages from built-in Class 3 EFBs, which are based on ARINC protocols.

Standard ACARS messages could be sent from standalone devices, such as iPads, that are used as Class 1 or 2 EFBs, which work on I.P. protocols, if they operate with an AID, or have an AID built in. This is the case with EFBs from several suppliers, such as UTC Aerospace and NavAero.

Inmarsat will soon launch its Swiftbroadband (SB) service. This will work on I.P. protocol, but will carry encapsulated standard ACARS messages. SB will have a higher transmission rate of 432Kb per second for ACARS, and also be a cheaper connectivity system than the earlier systems.

Class 1 and 2 EFBs, which work on I.P. protocol can now have connectivity through two different systems. The first is through a WiFi signal on the flightdeck, that will interface it with Inmarsat's new SB service. The WiFi apparatus is then connected to Inmarsat's SB equipment.

The second is to connect a standalone device (Class 1 or 2 EFB) to the aircraft's avionics via an (AID), such as that provided by Teledyne Controls; or via a tablet interface module (TIM), provided by UTC Aerospace.

If an AID or TIM is used, the ETL can be integrated with the CMC. It would therefore be possible to send CMC and non-CMC faults to the ground, via standard ACARS messages, from the ETL.

Cathay Pacific aims to make the entire fault reporting and line maintenance process electronic, and it has chosen ARINC to provide it with an e-enabled solution.

Cathay Pacific started using ACARS in 1989, with the introduction of the 747-400. "We currently send ACARS messages through Inmarsat Satcom and VHF datalink," says Saunders. "We will retrofit our fleet with the capability to send standard ACARS messages through VHF datalink and Iridium satcom for air-to-ground communications, and will use a terminal wireless lan unit (TWLU) with WiFi connectivity for on-ground communications. We will only use

Ultramain's ETL provides a menu for the user to describe a non-CMC fault, and ultimately locate a FRM code. This is then transmitted to the ground, together with a typed description. The ETL ground module, that receives the information, can be interfaced with a M&E system.

TWLUs at Hong Kong for reasons of access and cost. Iridium will give us coverage over polar regions, since many of our flights transit the North Pole.

"We have the A350 on order, and will have Inmarsat's SB service as a standard specification from Airbus. So far there has been no demand from any A350 customers for Iridium," continues Saunders. "Inmarsat SB does not provide polar coverage, however, so the aircraft will need to have HF datalink equipment as well. The arrival of SB will help, because of the increasing volumes of data that now have to be sent from aircraft while in the air. We may retrofit Iridium later. The A350 will also have VHF HF datalink and TWLU units."

On-ground connectivity can also be established with a unit that uses a GSM signal.

Cathay Pacific will use the various air and on-ground connectivity systems to download or transmit quick access recorder (QAR) data, the cabin log, the technical log, charts and the MEL.

"In addition to these wireless connectivity systems for air-to-ground and on-ground communications, we will have ethernet ports at various points around the A350, when it gets delivered. This will allow line mechanics to connect a portable maintenance access terminal to perform diagnostics," adds Saunders. "It will connect to the CMC and the aircraft condition monitoring system.

"We want to be able to send CMC codes while in the air, and will also have the ETL to send non-CMC and cabin defects while in the air," says Saunders. "We also want line mechanics to electronically sign off outstanding defects at the ETL. Such a procedure means that a duplicate sign-off also has to be sent to the ETL ground and M&E systems, and then a recognition of this sign-off has to be sent back to the ETL on the aircraft. This process will be done on the ground, so we will probably use VHF or Iridium datalinks via ACARS to do this. We will also have a smart box in the avionics on the aircraft to decide which is the cheapest communication system to use, according to the aircraft's location."

Health monitoring data

AHM and engine health monitoring (EHM) data are generated by the aircraft's systems and engines. The data indicate if the aircraft's systems and components are operating correctly.

Boeing's AHM application enters CMC fault code data, which have been sent to the ground by ACARS, into a database. "The data are used to help troubleshooters in line maintenance diagnose faults," says Dave Kinney, chief architect of airplane performance management, at Boeing Commercial Aviation Services. "AHM is a decision-support tool that provides MCC or line mechanics with information to help them decide whether a fault should be deferred or fixed. The AHM system has links to the MEL, various technical publications, and the M&E system. It can also have links to the aircraft's past maintenance history. The advantage of AHM is that it has a database of past faults for the entire fleet of the Boeing aircraft type in question."

AHM data are sent from the aircraft to the original equipment manufacturer's (OEM's) ground server, and are analysed by the OEM's software. The OEM sends the AHM data and its analysis to the operator, which converts them to a format that their M&E system can use. The AHM data can identify problems with systems and components, which can be correlated with CMC faults, or repetitive problems that the aircraft is experiencing.

Maintenix, for example, has a range of APIs so that it can receive AHM data from a range of OEMs. "The AHM data can also go straight from the aircraft to Maintenix," says Elliott. "Analysing the AHM data aims to try to anticipate a component or system failure."

Trax users can have AHM data fed into the system via an XML interface, or supplied by the OEMs.

Some airlines also process EHM data, which relate to the performance of engine turbomachinery. They are used for planning and managing engine removals.

The health and performance accessories and LRUs on an engine are monitored through AHM.

Maintenance planning

The record of all aircraft defects in the M&E system, ETL, and various other systems used by MCC and line maintenance is constantly added to and deleted after rectification. The flight schedule will have downtime allowances for scheduled line maintenance events. The random occurrence of defects and non-routine line maintenance means that planning their rectification and coordinating this with the flight schedule and planned routine maintenance is a dynamic process.

Technical defects will be most disruptive if they are 'no-go' items, they occur at outstations, there is a limited amount of time in which to clear them, or if they require a lot of logistics to complete them. Some technical defects can take priority over routine tasks. The planning of line maintenance therefore has to be fluid. This requires clear communication between the aircraft, MCC and line maintenance department. It also requires the fastest communication of faults and defects to the ground and entry into the M&E system.

Traditionally routine and non-routine line maintenance have been treated separately, due to the logistical problems and complexities of combining the two. Routine and non-routine maintenance can be combined, however. "The two types of tasks can be combined in Trax," says Reed. "Viewing all the tasks on a single page, and the legal interval or limit, allows the planner to defer routine tasks where possible if some defects require priority for rectification, for example.

It is now possible to send line mechanics routine and non-routine tasks on tablets or other portable devices. Tasks can be signed-off electronically. This saves mechanics, and the whole MCC and line maintenance process, a lot of time. It requires the portable devices to have constant connectivity, however.

Trax also gives the user information on maintenance facilities and availability, and resources, so that extra labour or equipment can be organised if necessary.

"We use Maintenix to keep a list of outstanding maintenance tasks and defects on the A380 and some other aircraft in the Air France and KLM fleet," says Amary. "Line mechanics based around our global network all have access to Maintenix so that they can see the aircraft's maintenance status and the list of due maintenance tasks.

"A planning engineer, called a 'Query Man' by Air France and KLM, prepares a line maintenance package by using the M&E system to provide a reference of all the relevant documentation associated with each fault and routine tasks," continues Amary. "The workpackage is then transferred to the mechanics when it is completed. It is viewed on Maintenix or our other M&E system."

Task instructions have traditionally been printed on manual task cards, and still are in many cases. When used by line mechanics and signed following completion of a task, the line mechanic can sign the log book on the aircraft. In the case of most aircraft this is a manual book. The line mechanic therefore has to inform the MCC and line maintenance department that the tasks have been completed, and that the aircraft has been released for service. This takes time and results in some delays. Some time can be saved if the completion of tasks can be recorded on the ETL on the flightdeck.

Electronic maintenance

The use of electronic task cards and electronic signature through laptops, or tablet computers such as iPads makes it possible to further streamline the line maintenance and communication process.

Electronic task cards save mechanics' time, because the cards and all technical documents and manuals, and the aircraft's maintenance status and technical log can be viewed in one place. Line mechanics' time can also be saved because they do not have to keep moving between the outside of the aircraft, the flightdeck, and their office if all the information they require is on one device. This is only possible, however, if the electronic device is permanently connected. This will therefore require some form of on-ground connectivity, which is most likely to be a WiFi or a GSM signal.

Connectivity in the line mechanic's office and near the aircraft, as well as inside the flightdeck will allow the dynamic completion of the following: receipt of new tasks by remote devices; viewing of up-to-date information; ordering of parts and tools in the shortest possible time; sign-off of tasks. This will keep the MCC and line maintenance department informed in the shortest possible time of defects being cleared and routine tasks being completed.

A lack of connectivity will mean that requests for parts, for example, will have to be made by radio. Signing-off of rectified defects and routine tasks will result in some time delays if electronic devices are not connected, since mechanics will have to move to areas where connectivity can be established, and wait for confirmations to come through before the work can be logged as completed.

There are now several examples of line maintenance being performed electronically by airlines. "The latest version of Maintenix, Maintenix 8.0, is web-based and browser-independent," says Elliott. "This means it can be viewed and used through tablets, PDAs and desktop computers. We have also built a line maintenance mobility application, which has a tablet computer interface that allows the technician to view information and perform a variety of tasks. Information that can be viewed includes: when an aircraft is due to arrive and depart; the airport gate that the aircraft is using; the list of open defects on the aircraft; which mechanics are licensed to fix each type of defect; and which parts are required and available. It can also be used to write in new faults as they arise, as well as routine maintenance tasks as they come due. In other words, the system gives the line mechanic full visibility of what is going on, as well as providing access to all task cards and relevant manuals and documentation."

Air France is using an electronic system for line maintenance at both Paris airports. "Our mechanics use a special PC in a van, and the device has a wireless connection to the WiFi signals available at the airport terminals," says Amary. "They can view all task cards on the PC, and sign them electronically. We are studying using iPads, tablets or laptop computers across our entire network for line maintenance, and will make a decision by early next year. KLM is in the process of installing iPads, and will use either a WiFi or a GSM signal."

Summary

Some leading carriers have managed to configure a complete system to manage the whole process of line maintenance electronically. This starts from fault detection and transmission to relevant airline departments, all the way to maintenance execution and task sign-off. The main elements are connectivity and communication between the relevant systems and elements. Substantial investment is required, however. Initial experience gained by the leading airlines in this area, and further technological developments will see this process for line maintenance becoming standard procedure over the next decade. AC