

The development in technology for maintenance records relates to two paths. The first is scanning and retrieval technology for paper records. The second relates to creating a 100% electronic and 100% paperless maintenance system, which can only be achieved in stages.

Latest developments in maintenance records

Technology for maintenance records has developed as maintenance and engineering software systems have evolved. Key issues are: scanning traditional paper records, and putting them into a readable and retrievable format; updating the status of maintenance tasks as they are completed within the M&E system; and using electronic task cards and signatures as part of realising a paperless and real-time maintenance system.

Related issues

Performing, signing off and archiving maintenance tasks cannot be considered in isolation. Completed maintenance tasks must be recorded so that their next due date is clear. Maintenance and engineering (M&E) systems track the maintenance status of all tasks: in relation to aircraft age and utilisation in flight hours (FH) and flight cycles (FC); and with respect to airworthiness directives (ADs) and service bulletins (SBs).

Aircraft utilisation and the status of maintenance tasks, ADs and SBs all affect the generation of task cards, and maintenance check composition and workscope. The completion and signing of task cards has to be recorded in the M&E system to update the aircraft's maintenance status. One limitation of the traditional system of manually signing paper task cards is that the M&E system has to be updated manually, in addition to other information on findings, non-routine ratios and statistics. With large numbers of tasks completed in large airframe checks, as well as completed tasks being produced daily in line maintenance, this meant that there were inevitably time lags, of several weeks in some cases, between the tasks being completed and the M&E system being updated accordingly.

This is exacerbated by the large number of records created after an engine shop visit, and major component repair. These maintenance events are often subcontracted to third-party providers by many airlines, and maintenance records created by another party may therefore not be delivered to the airline until several weeks after the maintenance event.

A further complication is the aircraft's component configuration. Rotable components are continuously removed and installed. Each change must be recorded and tracked, and again keyed in manually to the M&E system. The FH and FC accumulated by each component on the aircraft also have to be tracked, since some are removed for repair on a soft or fixed-time basis. The removal intervals for all components have to be tracked for reliability data. As before, there is a time lag between maintenance being performed and a record of it being entered into the M&E system.

Scanning records

Several systems are available for scanning paper records. These create tiff or pdf files which can be read with optical character recognition (OCR) software. This allows records to be archived and retrieved.

Waviatech, based in the UK, provides a scanning system, with its Stream product. The first version of Stream involved scanning paper records at high speed, either by sending the records to Waviatech, or the airline buying the software and hardware, and scanning the records itself. Waviatech would then take the scanned records and put them in a readable and archivable form. The OCR can read the records by searching for letters, numbers, symbols and characters from several languages, including Chinese. The system can retrieve records

by searching for a particular requested reference, such as a job card number. An airline may retrieve each record from the archives for a particular task card each time it was performed over the life of the aircraft, using the OCR.

All maintenance records, techlog pages, logs for major components such as the auxiliary power unit (APU) and engines, certificates for component changes, and modifications and ADs can be archived, and stored in date order or according to several other criteria.

Waviatech's new version of Stream is a cloud-based system that is accessed via a browser. "The customers can view, search and print pdfs of maintenance records using the browser. They can also add, change or index certain records, which is a useful feature," says Godfrey Ryan, director of sales and marketing at Waviatech. "This means the user has complete control over Stream and can configure it the way they want, whereas the first version of Stream was basically a scanning and archiving system. Airlines access documents via a secure link."

The cloud-based configuration of Stream means that airlines scan their own records, but do not need to buy any other hardware or software. The software is accessed via the web. The system therefore has further global reach than the first version, which involved airlines sending their records to Waviatech's headquarters, or Waviatech sending teams of its staff and equipment to the airline's headquarters to scan the records.

Another scanning service is provided by Aircraft Data Systems (ADS) of France. "Besides the basic scanning of documents, we also have a team of 46 people that re-types any significant information that has been handwritten on maintenance records or aircraft technical logs," says Julien Albrecht, general manager at ADS. "About 20% of

maintenance records are handwritten, so re-typing is required because some entries are hard to read. Once records have been scanned, re-typed and indexed, they can be read and retrieved using the OCR.

"The OCR used by a scanning service is important. There are seven different OCRs available for the scanning industry. We use an OCR with a multi-language aviation dictionary, including Arabic and Chinese, so it can translate when making a request or a search," adds Albrecht.

Scanning systems for maintenance records solves the main problem of reducing the volume of traditional paper records kept, as well as quickly retrieving records when required.

"Our system produces a CD-ROM listing the tasks performed in a maintenance event, and exports this list to the airline's M&E system," says Albrecht. "This eliminates the need for manually updating the M&E system, and reduces the time lag between maintenance

task completion and updating the status."

ADS is also developing a capability with a maintenance, repair & overhaul (MRO) system vendor that will provide a bridge between the two vendors. "This will allow the M&E system and ADS to work together automatically, so that records will not have to be scanned separately by ADS," says Albrecht. "We also have a website for lessors and aircraft owners, which will present the maintenance status of an aircraft. This is useful when lease terms expire and aircraft change operators. It can take four weeks for a lessor to analyse manual records to determine the maintenance status of a five-year-old aircraft. With our new system it should take just two days."

"Austrian uses Swiss AMOS as its M&E system, which produces a workpack of task cards," says Ronald Schaufelle, chief executive officer, at Swiss Aviation Software. "The records are manually signed, and then scanned and stored in a system called IXOS. The system allows Austrian to destroy the hard copies after two weeks. The scanned copies are archived and can be retrieved from IXOS while working in AMOS."

Supporting 30+ Airlines and MROs.

Operating more than
1300 Aircraft worldwide...
and **Growing!**



Products

- Digi**MAINT**
- Win/Web**PMI**
- Digi**DOC**

Integration Solutions

- Digi**REPORTS**
- Aero**BUY/**
Aero**REPAIR**
- Digi**PLAN**

Platforms

- MS Server/
MS SQL or
Oracle
- Linux/Oracle
- iSeries/DB2
- WebServer/
WebBrowser

Spec2000 Ch11 & Ch13 Compliant

www.aerosoftsys.com • www.aerosoft.aero • www.aerosoft.ca

Tel:

+1-905-678-9564 (Canada)
+1-954-447-7200 (U.S.A.)

Offices in:

Canada
U.S.A.
Austria

AeroSoft
SYSTEMS INC.

Maintain your **Leading Edge**

Barcode systems

One of the big inefficiencies of the paper record system is the manual updating of the airline's M&E system. The solution to this is having all maintenance task cards and related documentation in electronic format. By producing and signing task cards electronically, this automatically creates a maintenance record and instantly updates the M&E system and the aircraft's maintenance status. The complexity of maintenance means that no airline has yet achieved a 100% electronic system, and it will be several years before this occurs.

An interim solution overcomes some of the inefficiencies of the traditional paper system. "We produce maintenance task cards with a main barcode, as well as mini barcodes for each step of the task card that must be performed to complete the task," says Thanos Kaponeridis, managing director at Aerosoft. "Each mechanic is issued with a barcoded identification card, and uses a wireless scanner to record when each part of the task was started and completed, so the M&E system knows which mechanic is working on which task when they first scan the card. The mechanic scans each step of the task as it is completed, so the M&E system is informed that the task has been done, and records the man-hours (MH) that were used to complete the task. The progress of the maintenance check can be followed in real-time, and the aircraft's maintenance status is more up to date. The labour used to manually inform the M&E system that the task is

complete is therefore no longer needed and records do not have to be scanned.

"Task cards are still manually signed by the mechanic, since virtually all aviation authorities want a hard copy of all maintenance records," says Kaponeridis. "The M&E system, however, electronically records the fact that the task was done, and allocates the paper record to a particular box, which it allocates to a particular location in a storage facility the original hard copy of the maintenance record ever be needed."

Radio frequency identification (RFID) tags can streamline aircraft's maintenance records and status. They track the removal and installation of rotatable components, and provide instant data on each aircraft's rotatable component configuration, and the total FH and FC that each component has accumulated on the aircraft. This gives valuable data on component reliability in terms of mean time between removal (MTBR) and failure (MTBF). As standards for RFID tags have only been recently agreed, however, it will be several years before an operator is able to make full use of them.

Electronic solution

The solution to the disadvantages of the traditional manual system is an M&E system and maintenance solution that is

100% electronic and 100% paperless.

"Using electronic signatures on task cards means the M&E system is updated automatically as soon as the task is complete, as in the case of using barcodes on task cards," explains Schaufele.

"Electronic signatures, however, require the creation of an electronic task card, which the mechanic accesses via maintenance terminals or a handheld device or tablet computer. The task card is closed electronically by the electronic signature, and the M&E system is automatically informed.

"While electronic signatures are efficient, they are not always flexible," continues Schaufele. "Mechanics working on the aircraft need deep access for some maintenance tasks, so handheld devices or tablet computers have to provide them with all the information needed to carry them out. This means that connectivity between the tablet computers is required at all line stations, including outstations, if all tasks are to be produced and signed for electronically."

It also means that task cards for line maintenance have to be produced electronically by all the different providers carrying out line maintenance at locations and outstations across an airline's route network. The completed task cards are sent back to the airline's M&E system.

Engine and component maintenance, which is subcontracted to third-party suppliers by almost every airline, must also be taken into consideration.

It is therefore extremely complex for all of an airline's maintenance task cards to be generated and signed for electronically. The business processes and hardware needed for this do not yet exist.

Electronic signatures could, however, be used throughout an airline's base maintenance process. This requires a lot of hardware and software infrastructure and changes to an airline's business processes. "Many aviation authorities are not ready to handle electronic signatures, although the bigger countries are now pushing for their use," says Schaufele.

Business processes

Airlines and operators need to adopt many new business processes for some of their maintenance process, such as base maintenance, to be completely electronic.

The first step is having electronic documentation and manuals, digitising the maintenance programme and producing electronic task cards. InfoTrust specialises in managing documents and manuals of all types for airlines. "Having data electronically at all levels in the maintenance process requires a significant change in airlines' business processes, but

AMOS
OFF TO NEW HORIZONS

—

THE WORLD-CLASS MAINTENANCE & ENGINEERING SYSTEM
SPREADS ITS WINGS TO THE AMERICAS

WWW.SWISS-AS.COM

swiss Swiss
+ AviationSoftware

represented in the Americas
by Lufthansa Systems
(Miami, FL, USA)

will result in everything being paperless and all information being updated in real time," says Brian Morse, vice president sales and business development at InfoTrust. "The first challenge is to get all the data into an electronic format."

The writing and format for aircraft documentation has changed several times over the past two decades. An airline's documents can be written in Spec 100, Spec 2100, Spec 2200 and S1000D, while the documents are provided in paper, pdf, SGML and XML formats for all its airframe and engine types. The more recent writing standards are Spec 2100, which was first used on the 777, and Spec 2200. Documents for new aircraft types, like the A350 and 787, will be written in S1000D. In 1993 documentation format changed from paper to the intelligent, electronic format of SGML. The 777 was the first type to have its manuals and documents in this format. SGML was later followed by XML, a more advanced electronic format. SGML documents can be converted into XML, while documents written in Spec 2200 can be converted to S1000D.

Besides older types like the 727 and 737-200, the documents and manuals for older Airbus and Boeing types are available in SGML and XML format. Moreover, the paper documents and manuals can be converted into SGML,

and this is one service provided by InfoTrust. In parallel to the conversion to SGML, the writing standards and specification also has to be upgraded from word to iSpec 2200.

One of InfoTrust's specialities is putting all types of document for all aircraft and engines into XML format. "By converting all its manuals and documents to XML, an airline is taking its first step towards a paperless and fully electronic system," says Morse. "Its maintenance programme must then be converted to an electronic format."

An electronic maintenance programme tracks each task with respect to its due date. This also involves tracking and monitoring aircraft utilisation in calendar time, FH and FC. This information can be entered manually or electronically into the M&E system. Several airlines have now fully implemented electronic flight bags (EFBs) and electronic technical logs (ETLs), and have realised several benefits. The use of ETLs is less prevalent, but airlines that use them are able to transfer aircraft utilisation data, and technical faults and defects wirelessly in real time to the airline's M&E system. The real-time transfer of these data means the aircraft's age and utilisation status in FH and FC, its maintenance status, and outstanding defects are kept up to date. ETLs also

provide the basis for replacing paper technical logs. Keeping an aircraft's maintenance status with respect to outstanding defects in real time is an important element of line, as well as, base maintenance, and is crucial for maintaining airworthiness.

"It is a lot easier to go completely paperless in a heavy maintenance environment, since this is easier to predict," says John Stone, director product and market management at Ramco. "For a paperless line maintenance process, all log books and technical logs must be electronic, and an EFB and ETL system fully implemented and communicating wirelessly with the M&E system. This is expensive and complex. EFBs and ETLs are not yet standardised by the industry, which has been slow to adapt to them. It will be a long time before all airlines have all data transmitted wirelessly from the aircraft to the ground."

"Ideally, everything used in the maintenance of the aircraft will be in an electronic format," adds John Snow, vice president of marketing and business development at Enigma. "M&E systems also need to track the rotatable component configuration of the aircraft, which is an element of base maintenance, and the aircraft's status with respect to ADs and SBs. In reality, airlines will only be able to



STREAM™

Technical Records on Demand.

For Airlines



A STREAM™ Interactive license allows an airline of any size to scan, index and share access to its records in a standardised and secure format.

For Lessors & Banks



A STREAM™ Interactive license allows a lessor or bank to gather its records from anywhere in the world utilising its own technical staff or contractors.

For MROs



A STREAM™ Interactive license allows an MRO of any size to scan, index and provide access to live workpacks as the workcards are being signed off on the hangar floor.

Contact Waviatech for an online demo or to discuss your exact requirements.

+44 (0) 1293 817 655 info@waviatech.com www.waviatech.com



Waviatech is now part of AerData



convert their business processes to an electronic format in stages. This means that airlines will have to manage the maintenance process both traditionally and electronically, and have records in a variety of formats. Outsourcing different elements of maintenance to third-party providers is a problem, since an airline's maintenance record system usually depends on the system used by the MRO provider."

Electronic task cards

Electronic task cards, written in SGML or XML format, have all relevant data on the task included, or provided by links to other documents or manuals. This information includes effectivity and interval, the parts and skills required to complete the task, instructions, and diagrams and graphics from manuals.

"Enigma generates electronic task cards for unscheduled maintenance and planned checks, as close as possible to the due date of the check," says Snow. "These can either be printed and signed manually, or signed electronically."

Generating electronic task cards is also done by InfoTrust. "We build task cards automatically in XML. These are sent to maintenance terminals and tablet computers for use by the mechanics, who then sign the cards electronically, once the maintenance is complete," says Morse.

Electronic signatures

Electronic signatures are one of the most complex areas in creating a paperless maintenance system. Most regulatory authorities are slow to allow them. "Most authorities still demand paper records, even though it is technically possible to have just electronic records and signatures," says Kaponeridis. "Task cards are still in SGML and XML, but hard copies have to be printed, signed and stored. Each task card in SGML or XML has a unique number defined by a specific naming convention, which links the task card to data in the M&E system. The number can also be mapped into a barcode."

E-signatures require new processes to be established. "Sufficient connectivity is needed between the maintenance terminals or tablet computers and the M&E system, so the airline has to invest heavily in hardware," explains Schaufele. "Each mechanic must also be certified to use electronic signatures, so investment is needed in further identification and security hardware and software, as well as training."

Stone adds that electronic signatures have been an issue for 15-20 years, and are still only used for a very small proportion of maintenance. The conversion to an all-electronic system is thus decades away.

A 100% electronic maintenance system would require mechanics to have access to maintenance terminals and connectivity across an airline's entire route network and all its maintenance basis and facilities. While this development is probably several decades away, the easiest part of maintenance to implement an electronic system is in base maintenance.

Benefits of paperless

If an operator is able to achieve a paperless system for at least one element of the entire maintenance process, they can derive many benefits. As well as the automatic and instant updating of the aircraft's maintenance process, the airline can monitor the progress of maintenance events and the aircraft's maintenance status in real time, have better control over managing its airworthiness, and find it easier to prove compliance.

"There is also lot of useful data in electronic maintenance records that can be used for management purposes," says Morse, "such as information on MH and materials used, non-routine ratios, and component and system reliability data in the form of MTBR and MTBF. Details of findings are also provided."

All of this is useful to an airline in optimising its maintenance programme, and can generate large savings. "With maintenance records in XML, it is quicker and easier to go into the maintenance records database and pull out all relevant data when making an analysis," says Morse. "When extending an inspection interval, engineers need to analyse findings, MH used, non-routine ratios, and MTBRs/MTBFs for each task each time it was performed for the fleet in order to produce statistics. It can take a team of engineers several weeks or even months to analyse all the historical data when records are in paper format. With records in digital XML format, the same process can be performed by one person in a few days. The speed at which the analysis can be done depends on the type of database used to store the maintenance records. An XML database has data already tabulated, while an SQL database does not. Tabulation is required first, which uses more manpower."

While it may be several decades before an all-electronic maintenance system is possible, the technology is now available for airlines to make the transition in stages, and derive the benefits. **AC**

To download 100s of articles like this, visit:
www.aircraft-commerce.com