

The importance of paperless maintenance has been mooted to realise greater efficiencies for airlines and MROs. Adoption of paperless maintenance has been slow across the industry and smaller airlines. A summary of the current obstacles hindering the process, and the efforts to overcome them, is provided.

The path to becoming fully paperless

The International Air Transport Association (IATA) has spearheaded an industry-wide campaign to involve all business areas in establishing paperless operations (see *The paperless aircraft operations initiative, Aircraft Commerce, December 2016/January 2017, page 63*). While the ultimate aim is to have a fully paperless industry, establishing this within all maintenance processes is a key challenge.

Previous issues that have hindered the establishment of paperless processes include: the lack of unification within the industry; the fact that different industry participants are at different stages of implementing electronic processes; and the slow recognition of the value that paperless operations can offer airlines, lessors and maintenance providers. In addition, the authorisation of electronic signatures, connectivity, and the complexity of various data formats and standards have also slowed progress.

Another issue is that data from legacy, modern and new-generation aircraft must be processed. This is whether it is delivered with paper records, portable document format (PDF) manuals, or even as raw SGML or XML data that can be directly processed into content management systems (CMS) and maintenance and engineering (M&E) systems (see *The complexities of data transfer between M&E and CMS systems, Aircraft Commerce, December 2014/January 2015, page 40*).

“Original equipment manufacturer (OEM) data standards need to be aligned,” says Ronald Schaeuffele, chief executive officer (CEO) of Swiss AviationSoftware (also known as SwissAS). “There can be many interpretations of the currently distributed SGML data. In addition to SGML, M&E systems have to be able to process other data types including

structured/unstructured, EXCEL/ASCII, PDF and of course scanned paper documents. Systems must also be able to interpret different specifications written in XML and iSpec 2200/SGML languages. We recently experienced the situation that from one issue of a manual to the next one, S1000D data was found within SGML context. It speaks for itself that this causes problems.”

“The disparity in OEM data formats for their fleets puts pressure on operators and deters them from aggressively pursuing paperless maintenance, or realising the full potential of S1000D/XML data,” adds Tony Louw, maintenance and logistics consultant at IFS Aerospace and Defence.

In recent years obstacles have been overcome to make paperless maintenance operations more accessible. Achievements include general regulatory approval for electronic signatures by the main aviation authorities. According to Hugh Revie, vice president of regional sales EMEA at EmpowerMX, during the early 2000s the Civil Aviation Authority (CAA) was initially reluctant to accommodate the adoption of electronic passwords or PIN numbers. “They preferred the signature to be captured on the electronic document before eventually accepting a secure PIN number within the systems,” he explains.

Schaeuffele says that since the approval of e-signatures, Swiss (Swiss International Airlines) is now able to sign off a substantial amount of defects via the electronic technical logbook (ETL) application (app). “Use of ETLs is the new hot topic now that e-signatures have been approved,” Schaeuffele continues. “For many years, AMOS has been capable of signing off documents with e-signature. Only a handful of customers, however, are using this feature today. The main reasons for not adopting e-signature

include the industry’s conservative approach regarding ‘dirty fingerprints’ and the necessity to align processes which can affect an organisation. Implementing an ETL as the first step of paperless operations makes the most sense for airlines, since this data is generated in huge volumes each day.” Airlines are therefore interested in finding ways to process flight and operational data quickly and efficiently.

Having an on-line platform facilitates integration between different systems and the transfer of data, so there is secure access to data whenever it is needed.

Any documents that are published can easily be distributed to electronic flight bag (EFB platforms). “For example, one of our clients, Icelandair, can publish a manual, then transfer it into the IFS paperless flight bag (PFB) server system where it is then distributed to EFBs using the PFB,” says Martin Lidgard, founder and chief executive officer at Web Manuals.

“ETLs are a good entry into paperless maintenance for airlines, but line maintenance is now proving to be a bottleneck to this, together with connectivity,” says Schaeuffele.

OEMs have a large part to play in establishing paperless processes, particularly in maintenance. They have the power to develop sophisticated aircraft data, and make this available to their customers via electronic manuals. Often regarded as the ‘top of the chain,’ OEMs have begun to set a precedent via new-generation aircraft for digitisation, and intelligent, dynamic aircraft documentation.

It is airlines and lessors, however, that will allow paperless processes to flourish if they are adopted industry-wide. “Airlines implementing paperless operations will try to gain the most cost benefit,” adds Louw. “An ETL is simpler



to implement than base maintenance. Streamlining and interfacing M&E systems to process digital records is far more complex.” Revie adds that while the ETL is important to facilitate the transfer of real-time data for airlines, it is not essential for the adoption of paperless maintenance processes.

As will be explored, third-party providers to airlines and maintenance, repair and overhaul providers (MROs) must also be receptive to mobile and paperless maintenance. A paperless process becomes less efficient if a participant in a transaction insists on reverting back to paper.

Intelligent documentation

For MROs and airlines still using paper records, transitioning to paperless processes is difficult. One of the most complex areas of paperless maintenance is the development of an interactive and electronic task card (e-task card) that allows mechanics to be assigned to tasks by maintenance control, tooling to be advised, tracking of man-hours (MH) and

ordering of parts. “The content within maintenance documentation is gradually becoming more digital,” says Revie. “A taskcard that can suitably interpret the content of an AMM, IPC and other OEM-provided documentation is therefore required.” Via EmpowerMX’s integrated OEM taskcard, for example, MROs can ensure that the correct mechanics and engineers are assigned to tasks, qualifications are current, and so can sign off tasks accordingly. “Electronic task cards also enable the real-time transfer of data between the MRO and its airline customer,” adds Revie.

The configuration requirements of an M&E system to process electronic task cards have been explored (see *Configuring an IT system for electronic task cards and maintenance production, Aircraft Commerce, April/May 2013, page 55*).

With a paper task card or workpack, the only way to make the documentation ‘electronic’ is to scan it. By their nature, scanned documents are not dynamic. “Extractable data from a scanned paper document is impossible,” begins Nick

According to Chris Reed at Trax, some intelligence can now be given to PDF manuals, aiding paperless maintenance. An example is a PDF e-task card whose header can be swiped on a PED to track task times.

Godwin, managing director at Commssoft OASES. “With PDFs it is also challenging but data can be scraped and utilised electronically if formats are consistently used, as with some manufacturer’s cards, for example. This is naturally an available option to customers with legacy aircraft that subscribed to the OEM software. The format of this task card is rigid, however, and not able to be customised by customers, in addition to being proprietary with the OEM.”

The need is for a ‘digital’, rather than an electronic version of a task card, so that paperless maintenance processes can be fully realised. What is truly digital, and how can intelligent documentation be incorporated?

“There are two options available,” says Chris Reed, managing director at Trax. “The most basic is PDF, which is the format in which most operators typically receive their manuals.” The benefit of PDF manuals is that they are in a recognisable, readable and printable format.

“The essence of the PDF is that it is ‘patient,’” says Louw. “While a mechanic can call up a document on a portable electronic device) PED, and record observations, these are non-dynamic so problems are not immediately communicated. Meanwhile, a truly electronic and interactive document allows items to be flagged immediately, and mechanics to communicate instantly actionable tasks.” Louw adds that the biggest challenge for the industry is the fact that so many legacy aircraft are at best PDF orientated.

“Basic intelligence can now be given to PDF manuals,” says Reed. “A PDF task card can be set up as an e-task card in the sense that a mechanic can perform instructions according to the written information on the PDF.

“Trax can set up a PDF e-task card whose header can be swiped on a PED to signify the clocking time and start of a task in the workpack,” adds Reed. “This introduces some digitisation into the process. Clients can also annotate observations and measurements onto the e-task card which allows a basic level of interaction.”

Reed says that the mechanic can also e-sign off and track task times via the header on the PDF task card. The PDF format also allows the MRO to print onto paper if a client requires it, but



importantly the basic process within the organisation is maintained as electronic.

Meanwhile, the best way to establish full digitisation is to process and maintain a stream of data, without ever using paper. This approach is rarely adopted by MROs and airlines. “For example, Trax can process any SGML and XML data and merge into its application for task cards in its TaskControl application. The task card will show task steps, type of inspection, how many mechanics are required, and the materials needed on a step-by-step basis,” says Reed. “If an inspector is needed for a borescope, then the mechanic can summon one via the e-task card in the app. An intelligent task card also validates the skills and licence requirements of the mechanic performing the task before permitting them to use the task card, and all time is tracked as each step is completed and then relayed back to the supervisor.”

A digital task card can also inform a shift supervisor of the progress of each task within a workpack. Such updates facilitate easy handovers between shift mechanics.

Reed explains that what prevents most maintenance providers from implementing truly intelligent task cards is the OEM’s charge for digital data. Ten years ago the charge was about \$3,000 a quarter for updates and access per fleet type. Reed hopes that airlines will use data access as leverage when negotiating aircraft orders, allowing greater use of digital records. He estimates that 20% of Trax’s customer base is investigating or using digital task cards.

Swiss-AS task cards can be accessed via the AMOS application. “Uploaded manuals from the OEM (ranging from PDF, SGML, \$1000D) are passed via the

software’s CMS in accordance with an executable document stored in AMOS, which is a dynamically linked content,” says Schaeuffele. “The content of work steps is therefore structured and dynamic within the task card, regardless of the source data’s format. This works by defining measuring points that map across to a task card format within the app, that can be customised by a client. The AMOS task card can also be signed by a mechanic digitally, negating the need for paper. Structured information is then converted into a PDF ‘intelligent job-card’ that is stored electronically. Again, because it is converted to a PDF, the task card can be printed if required.

“AMOS retains a PDF layout in its document execution process because it is recognised by users,” adds Schaeuffele. “The PDF can be signed via e-signature, which can be combined with user validations through passwords or biometrics for further security, for example.”

Through the Web Manuals application, content can be extracted from maintenance manuals or flight manuals into other maintenance systems. Procedures relating to specific tasks can then be visualised next to a task card.

For legacy aircraft, paper scans often remain the only option. The same is true for MROs receiving paper task cards from their airline customers. “More operators and MROs are starting to at least commence ingesting paper records into an M&E system via scans, in an effort to streamline operations,” describes Neel Praveen, advanced development programmes at Ultramain. “Even if the information ‘extracted’ is just a job identifier (such as a task card number) and a job title that the system can record, it then allows production planners to start

Hugh Revie says that there is a gap in paperless processes being implemented within parts repair shops, because repair are often carried out using paper records. Repairs therefore need to become electronically documented (source image: PAS Technologies & Standard Aero).

applying their planning templates and more importantly allows technicians to work on the scanned cards on their mobile devices in a paperless environment.”

Praveen explains that ULTRAMAIN brings in a C Check with about 1,000 task cards in about 10-15 minutes electronically, whereas if manually undertaken by an engineering department this could take a couple of days of data entry before actual production planning can begin in the system.

Maintenance environments

While summoning an e-task card via a PED has been one challenge, another consideration is how paperless processes can be developed to meet the demands of different maintenance environments. The two main maintenance environments are line and base: line maintenance needs to process a high number of non-routine task cards requiring access to an MRO IT system and delivering and accessing real-time data; while base maintenance is less ad hoc and more structured via pre-defined workpacks.

“The underlying processes between line and base maintenance environments are the same,” says Godwin, “although line maintenance requires immediate rectifiable actions, and time-critical tasks. While the overall content of the tasks is less than for base maintenance, the content is adaptable and based on observations, which can make identifying the rectifications more complex.

“For example, a flickering fuel gauge or intermittent fault may indicate an actionable task in the future, or a trending ‘diary event’ that needs to be monitored, rather than undertaken straight away,” adds Godwin.

Line maintenance activity revolves around fuel uplifts, observed defects, unscheduled maintenance and last-minute part requirements. Real-time and instantly transferable data optimises processes in this environment, and it is easy to see how airlines can justify the benefit of mobile line maintenance to turnaround and dispatch times. “Being able to consult manuals on a PED via software that is integrated to an inventory system for material availability, is obviously advantageous in line maintenance,” says Louw, “especially if

the system is interfaced with an ETL to record observed defects.”

Logistically, however, airlines have to deal with third-party maintenance providers in remote locations, handling agents, fuel companies and ad-hoc parts suppliers. “Security rights, access and permissions to third-party contractors are complex for airlines to resolve,” says Godwin. “Implementation of paperless line maintenance processes has been slow, due to the lack of third-party support, and the issue of carrying out electronic sign-offs for line maintenance tasks if the line maintenance provider is not yet mobile,” confirms Schaeuffele. “It is so easy for line maintenance providers to physically hand over paper documents to flightcrew, that it is difficult to encourage radical overhauls in processes,” adds Louw. Therefore, how can different interests be aligned into going mobile?

“One South American customer has commenced mobile line maintenance operations,” advises Reed. “To facilitate this without disruption through third parties using paper, it is providing some sub-contractors with iPads and insisting that others buy PEDs so that they can carry out their line maintenance requirements, and retain contracts. Trax then provides third-party access to its apps so that the line maintenance provider can directly update the airline’s

system.

“By insisting that third parties implement mobile processes under a tendered contract, airlines can promote the importance of paperless maintenance processes in the industry,” adds Reed.

Regarding base maintenance, Godwin explains that this is more controllable, because it tends to be heavily scheduled. Therefore, it is less difficult to prepare the content of task cards when setting up digital workpacks for customers.

According to Reed, setting up paperless operations in base maintenance hangars is more complex, however, if it is between airlines and third-party MROs, rather than an airline and its own in-house maintenance. An MRO will have to deal with some airlines requiring paper workpacks, others accepting PDF, and a handful wanting digital documentation; whereas an airline implementing digital maintenance processes will struggle to find an MRO with the IT infrastructure to process digital records. He cites LHT Philippines as an example, which set up an online interface that allows the MRO to use and update workpacks for airlines. LHT Philippines can update via the interface as and when tasks are done, and then send the paper workpack to the client upon completion, or carry out the work completely digitally if required.

“Fully digital base maintenance

providers tend to be in-house airline MROs, with a self-contained system that is easier to maintain paperlessly, and is sculpted around the airline’s individual requirements,” says Reed.

EmpowerMX’s FleetCycle software suite includes a Planning Manager (FCPM) module. FCPM incorporates a set of milestones within a typical workpack, which enables MROs to stay on target during a base check. “By splitting a large workpack into a series of smaller checks, maintenance providers are able to set manageable targets and keep shop visit turnarounds consistent,” says Revie.

The interaction between airlines, MROs and other third parties presents the additional challenge of establishing secure yet reliable data transfer. The processing, execution and transfer of mobile data must be flexible and compliant. The term ‘cloud-based service’ is often used when advertising M&E systems and suggests a way to solve the complexities of data sharing between third parties. However, Schaeuffele explains that the interface between an airline and its MRO provider is what chiefly facilitates data transfer outside an organisation. “When Swiss International Airlines sends aircraft to SR Technics, there is an interface that allows SR Technics to carry out the maintenance of

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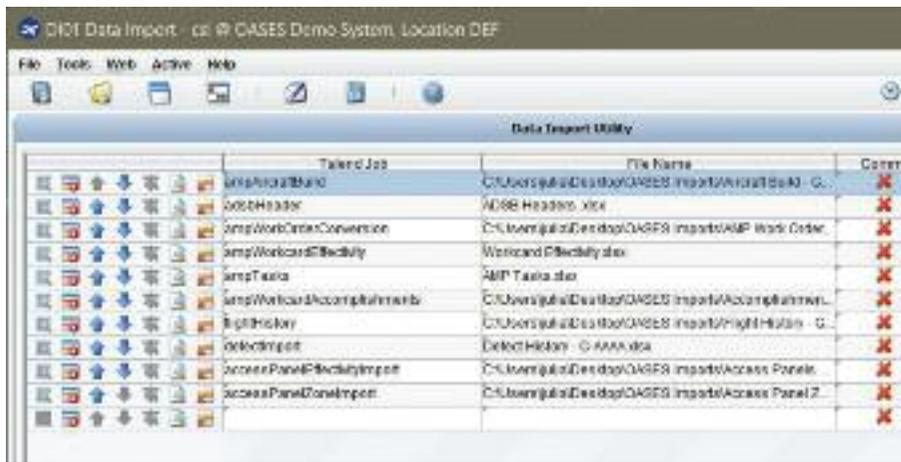
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Realising the benefits

Other than the complexities of processing various data formats, and OEM allowances, what other obstacles are there to becoming fully paperless? Is it the M&E system configurations, or the regulatory authorities? Godwin says that regulators are ‘pacing’ the progress.

“It comes down to motivation of the overall industry,” says Reed. About 10% of Trax’s 160 customers are interested in pursuing fully paperless maintenance processes. “None are against the concept, but some are not interested at this stage,” he adds. “Those at the forefront were pioneers when they started. Air Canada Jazz, for example, is 98% paperless, but it took about seven years from a regulatory perspective. The airline is now vocal about its overhaul of processes so that others in the industry can benefit. Also, Transport Canada’s involvement in reviewing and approving Air Canada Jazz’s processes has given the regulator confidence in going paperless, which it can convey to other US operators.” Reed adds that lessors are starting to accept the idea of electronic records and maintenance, although processing airworthiness directive (AD) record updates is still a concern.

“People are seeing cost savings,” says Reed. “Transavia has cut significant aircraft delays a large amount, by processing AMM defects via an iPad in line maintenance.” While not only beneficial for reliability and turnaround times (TATs), this reduction realises cost savings from Eurocontrol penalties.

According to Schaeuffele, easyJet has advised MROs that they need to perform electronic processes to win and retain maintenance contracts. Airlines remain at the forefront of the push to paperless.

ADs & data management

It is clear that some automation can now be realised via the digitisation of records, insofar as dashboards can be updated, mechanics can be allocated, and materials can be ordered at the click of a

button. However, while areas such as connectivity, e-sign offs and process overhauls are steadily being overcome, others, such as facilitation of AD and service bulletin (SB) updates, require further consideration.

Godwin explains that smaller carriers are wary of the costs of AMP revisions and electronic AD or SB revisions; these sometimes requiring expensive subscriptions from the OEMs. “ADs and SBs are more challenging to import electronically, with many opting to perform this manually after importing headers. OASES has extensive AMP revision modelling capabilities,” he says.

As highlighted earlier, processing ADs and SBs electronically remains a considerable concern to lessors. It can be difficult to determine the applicability of each AD on its release, and some manual intervention is needed, even if the notification and implementation are electronic. For example, an engineer typically evaluates the AD to determine which aircraft it applies to, before determining the appropriate course of action, including when the AD must be performed and at what frequency. The engineer then generates a recommended engineering order (EO). For operators and MROs handling multiple OEM fleets, with different variants and series, the process of electronically approving an AD can be complex and time-consuming.

Louw advises that a fully integrated solution involves transposing an AD into an electronic task card, so that materials can be ordered and necessary maintenance scheduled. He adds that an engineer will always receive, evaluate and authorise the AD.

Swiss-AS aims to address some of these complexities, however, via a new AMOS service called AMOScentral. This is an initiative whereby (mainly) airline users can subscribe to a shared network of participants. It is built on collaboration and sharing data between subscribers.

“Each organisation can opt to share EOs from an AD for a particular aircraft type within its fleet. For example, SWISS is processing A330 data updates such as

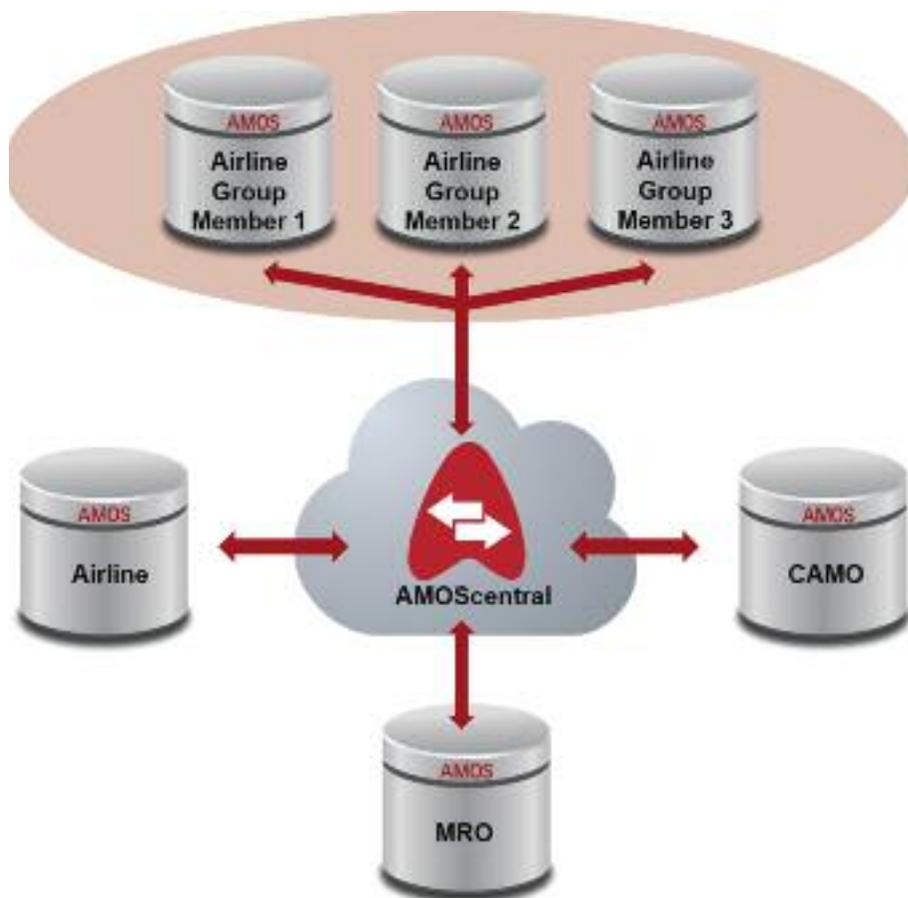
OASES handles multi-OEM aircraft and multiple formats by re-writing key points using routines specifically developed by Commsoft for each data source. These routines are designed to be able to ‘map’ and identify unique identifiers to reformat the data.

ADs and producing EOs that subscribers could access and apply to their own fleet, thereby saving administration time,” says Schaeuffele. “This recommended EO can therefore be replicated into any system subscribed to the network, via a click and save process. This minimises interaction and processing time for the subscriber. SWISS could eventually expand the data it shares to include the C Series, which is entirely in S1000D and XML.”

The AMOScentral Initiative is in its infancy, and will be rolled out within the next two years in a trial phase across seven AMOS customers in the Lufthansa Group. “AMOScentral could eventually give all external AMOS users the option to subscribe for AD and SB updates provided from trusted and approved sources, across a range of fleets,” adds Schaeuffele. “This would be highly advantageous for low-cost and start-up airlines, as a fast and easy service without the need for sophisticated XML editing capabilities.”

The AMOScentral Initiative, once it reaches its full potential, will address many issues in sharing and processing complex data revisions. AMOS has 158 customers using its software, suggesting huge potential as a dynamic network of subscribers supplying fleet updates and AMM revisions from aircraft in their respective fleets. AMOScentral could also branch out into subscribers sharing spares information among mutual line maintenance providers. “For example, two AMOS customers with spare parts on a particular station could allow each other to see these spares. In time, participants could execute transactions via AMOScentral,” adds Schaeuffele.

More importantly, this type of subscription-based data-sharing does not lead to conflict between different airline and MRO processes. Subscribers can also choose the extent of their sharing capabilities and data visibility, such as whether other subscribers can see their spares numbers and aircraft modification status. Managing this is easy, with subscribers applying red, yellow or green to show the level of data they allow to be visible to others on the network. “AMOScentral shifts the boundaries of collaboration,” adds Schaeuffele. “It could create continued airworthiness management organisations (CAMOs) just creating EOs for subscribers.”



Data has now reached levels of sophistication that should mitigate the issue of data management. “XML is so advanced that it is almost readable, while most applications developed to process data come with appropriate security and access controls for users,” adds Louw. “For example, administrators in an organisation can now limit the work a mechanic carries out in accordance with his role profiles and licence codes, using IFS mobile applications.

“The MRO can also choose how strict it wants to be with electronic sign-offs,” continues Louw. “For example, it can have two signatures for task sign-off, from two different and validated mechanics or engineers.”

The next step

The path to paperless maintenance is slowly becoming easier. Airlines are starting to leverage maintenance contracts in exchange for electronic processes from providers, initiatives are under way to aid data management issues, and software vendors are establishing ways of making unstructured data work within digital environments. If airlines begin adding third-party raw data access as a requirement for new-generation aircraft orders, then MROs could benefit from the sophistication the new data brings.

“Authorities are still unwilling to push forward on new paperless

incentives, while airlines are reluctant to proactively innovate,” says Louw. “If the ability to convert new-generation aircraft data into paper formats existed, it might encourage a further push into mobile and paperless processes. Undeniably, however, converting data into paper is counter-intuitive when considering electronic processes.”

“Aviation still requires a culture change to convince all participants of the benefits of paperless maintenance,” says Schaeuffele. “Swiss AMOS’s motto is ‘too high-tech can easily become low-tech’. Wearable technology is a case in point, since it has yet to make any real impact, despite years of case studies and initiatives. The industry still needs to focus on developing easy-to-implement mobile processes, and keep the balance between technology and proven successes.”

“We are seeing that paperless processes are being adopted first in the ELB (Electronic Logbook) area, followed by the airline’s internal maintenance processes. In parallel, third-party MROs using ULTRAMAIN have also started getting approvals from their local authorities and their customers for paperless operations using the PDF import capability. The supply chain and logistics areas look to be the last areas where both airlines and MROs become paperless” says Praveen.

“Any airline that is not prioritising or investing in compliance will be the

AMOScentral is an initiative whereby users can subscribe to a shared network of participants, namely airlines, which choose to take part. It aims to allow access to complex digital revisions.

slowest to respond to going paperless,” adds Lidgard. “To remain competitive and continue to grow their business, airlines need to digitise. Airlines whose business is stale and non-competitive will be the last to change to paperless processes.

“Digitising manuals saves our clients time in the long term, so airlines need a tool that will allow them to do this in the easiest way,” continues Lidgard.

As long as the tools are in place to ensure the control and traceability of information through an electronic system, which facilitates the revision, approval, submission and signing of manuals, then there is no area of the industry that cannot go paperless.

“We still see a big gap in paperless processes being implemented within parts repair shops,” says Revie. “Actual repair processes tend to be carried out using paper records, before at best being transferred into an electronic Form 1 document. What is really needed is an electronically documented repair to help ensure the repair process becomes paperless.”

Schaeuffele believes that lessors are finally realising the benefits of, and need for, digitisation. He believes that lessors will start to encourage more airlines to go paperless over the next two years. “With the ability to print any digital record into a readable PDF, mobile processes are providing benefits that lessors can no longer ignore,” he adds. For lessors, the benefits are even greater, as mobile processes make phasing out and transitioning aircraft faster. “The change in demand will go from nothing to 100%,” says Schaeuffele. “Lessors will transition to paperless at a much faster rate in the near future.”

“Lessors deliver data to new operators in their own formats, so if paper is their chosen method, it filters back through the industry,” adds Louw. “It is therefore important that they back the initiative.” He does not foresee fully paperless operations occurring in the industry for some time. “If motivated, an airline and its own in-house MRO could do it within a year, yet the rest of the industry, including part stores, regulators, CAMOs and financiers, still need to follow suit,” says Louw. - CLD 

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