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INFORMATION TECHNOLOGY

RFID developments

Radio frequency identification (RFID) is a technology which has been available for over half a century and is widely used today across a range of industries. Over the last few years, OEMs, MROs and component suppliers, as well as hardware and software companies, have finally started to investigate its potential for automating aviation processes. *Joanne Perry* hears about the latest RFID projects and how this technology is set to revolutionise production, maintenance and logistics operations.

In November 2012, Airbus announced that it will soon become the first commercial airframer to use radio frequency identification (RFID) for part marking across all aircraft families. The technology will be rolled out progressively in 2013 for seats and life vests, complementing an existing initiative for the in-development A350 XWB. The programme is intended to increase value chain visibility, provide faultless identification, and deliver efficiency savings in component lifecycle management.

Signalling the importance of the move, Airbus' EVP of programmes, Tom Williams, described permanent RFID part marking as "an answer to the growing need for efficient and error-proof identification of aircraft components throughout their life" which will benefit vendors, integrators, airlines and maintenance, repair and overhaul providers (MROs).

Airbus and Boeing have been collaborating on the development of RFID from day one and, according to Phil Coop, program manager, RFID integrated solutions, Boeing Commercial Aviation Services, the airframers "routinely" discuss interoperability, technical risk, data standards, technology standards and "even, to some degree, process standards". The goal is to achieve as much commonality as possible for customers. "We are competitors but we also realise that we have a mutual responsibility to shepherd a smooth and successful industry transition to RFID," explains Coop.

MROs such as Lufthansa Technik (LHT) and TAP Maintenance & Engineering (TAP M&E) have also been instrumental in early investigations of RFID as a solution for the aviation industry. These efforts have been enabled by the partnering of manufacturers and MROs with hardware and software developers, among them OATSystems, MAINtag and Fujitsu.

Anurag Nagpal, director of systems engineering and solutions, OATSystems, which caters to a number of different industries, says that RFID

Left: TAP opted to use handheld readers for its engine components RFID solution. Above: OATSystems is providing software for the A350 part marking programme.

is "actually a natural fit for commercial aviation" owing to the "myriad of tracking needs": complex, multi-site manufacturing; heavy regulation; high value assets; material management challenges; and intense competition. Although aviation RFID is currently "in its infancy" as Coop notes, the technology is clearly heading for an important role across production, maintenance and logistics activities.

Tags, readers and software

RFID works on the basis of non-contact transfer of data between a transponder or tag attached to an item and a reader which is able to detect the tag and access the information contained on it. The tags may be one of three types: passive, i.e. dependent on energy transmitted by the reader; active and continually emitting an ID signal courtesy of either integrated or onboard systems; or battery assisted passive, which offers a range intermediate between the first two types. Carsten Sowa, RFID programme manager at LHT, explains that there are several methods of attaching the tags to aircraft components: qualified double-sided tape; clip connectors for screws or wings for perforated steel; and small "ears" for additional safety wires. The readers can be handheld devices or fixed gateways.

"RFID is a very old technology compared to the computers and cell phones we are all using," says Sowa, pointing to the emergence of RFID during World War Two. The capability is widely used today across numerous industries such as retail, where it plays a central role in anti-theft devices. Unlike bar codes, RFID tags offer the special advantage that they do not require line of sight with the reader and can thus be embedded in the object which is to be tracked. Other capabilities include: the simultaneous reading of multiple tags; enhanced range; high data storage; and a dynamic read/write function.

However, as Jean-Marc Lemaitre, VP marketing, communication and business development at Zodiac Services explains, there are significant contrasts in the requirements of different industries, with aviation demanding much more exacting standards "from a production, toughness and data perspective". He lists three fundamental criteria of aviation RFID solutions: quality, reliability and a rapid return on investment for each member of the supply chain. Within the scope of quality and approval, the most important guidelines on RFID are currently contained within Air Transport Association (ATA) Spec 2000 Chapter 9.

Zodiac Services' own RFID solutions focus on oxygen systems and emergency evacuation products, using MAINtag transponders and ATA Spec 2000 software from Aerospace Software Developments (ASD) called 'RFIDAeroCheck'. MAINtag began working with Airbus on the A350 programme in 2009 and in 2010 commenced delivery of tags to over 46 OEMs. MAINtag has now diversified its offering into 'nano', 'fiber' and 'skin' variants for use respectively on: small parts; life vests; and curved, metallic surfaces such as oxygen generators.

The RFID tags can be loaded with information such as the manufacturer's name, date of manufacture, part reference, serial number and part description, as well as data which is added during the lifecycle of the component, for example maintenance operation, repair description, expiry date, date of next revision and new part numbers. Lemaitre says that a "major consequence" of the storage of data on the parts them-

The A350 XWB is the focus for an RFID part marking initiative.

"Some of our key customers consider RFID-based operational efficiencies a closely guarded secret that gives them a competitive edge."

Anurag Nagpal, director of systems engineering and solutions, OATSystems

selves, within the tags, is that any member of the supply chain can access relevant information about the components without recourse to databases. "Data structure and content are standardised using ATA Spec 2000, making the system fully harmonised and interoperable," he states. Although new data may be added, encoded information cannot be modified or deleted, which Lemaitre says prevents "involuntary or wanted but not approved modification of part maintenance history and identity".

According to Lemaitre, major trials with airlines have already produced quantifiable evidence of the benefits of Zodiac's solution for emergency equipment, most obviously time and labour savings during daily or weekly inspections. "But we have also identified huge benefits in the aircraft configuration management and tracking, for example any products reaching life limits, leading to potential anticipation on the supply chain side," he states.

One of the software companies contributing to the A350 part marking programme is OATSystems, whose ATA Spec 2000 RFID solution has since 2008 played a key role in the A380 value chain visibility (VCV) programme now being rolled out across all Airbus aircraft families. Airbus is also using the software during production for tracking and tracing components from receipt through assembly to delivery. OAT has worked with companies such as Rockwell Collins, Parker Hannifin and TAP M&E on RFID applications, although Nagpal says many deployments have not been widely publicised. "Some of our key customers consider RFID-based operational efficiencies a closely guarded secret that gives them a competitive edge," he explains.

Nagpal sees plenty of scope for expanded use of RFID in commercial aviation in future, particularly in light of the growing trend to use composites, which he says "essentially changes the manufacturing paradigm from discrete metal fabrication to process manufacturing", with materials management challenges that can be addressed by RFID. "Airbus and Boeing expect to produce more than 8,000 aircraft through 2019, all of which incorporate 10 times the composite material of previous models," he states, adding that as the rate of composite manufacturing increases, RFID "will help to drive process efficiency and product quality". He believes that today's applications are "only the tip of the iceberg".

Unlike Airbus' project for the A350, Boeing's RFID offering currently focuses on applications for existing fleets. According to Coop, early plans to implement the technology on the 787 were dropped when it became clear that development could not keep pace with the aircraft itself. In-

Life vests and other emergency equipment are a popular choice for RFID. LHT offers 'avio check' as a solution.

stead, Boeing took up a suggestion by All Nippon Airways (ANA) and Japan Airlines (JAL) in 2007 that "what the industry really needed now was a comprehensive, turn-key solution for the legacy fleets", says Coop. Boeing partnered with Fujitsu to provide tags, readers and software solutions and in 2010 established a developmental partnership with Alaska Airlines, which contributed more than 4,000 hours towards development, validation and functional testing on the ground and in the air.

Boeing's effort incorporates RFID and similar technologies such as contact memory buttons (CMBs) and covers five areas: emergency equipment; rotables; repairables; structural repair and airframe degradation; and essential cabin items. As an example of the benefits available to users of RFID, the OEM calculates that time savings during emergency equipment inspections amount to 85 per cent for life vests and 99 per cent for oxygen generators; additionally, oxygen generator life cycle can be extended by up to 20 per cent and inventory cut by more than 50 per cent.

Boeing's RFID Integrated Solutions entered into service in November 2011 and there are other projects in the pipeline, although Coop says a decision has been made to introduce applications at a modest pace "so that our customers can integrate RFID more easily". According to Coop, the Boeing approach is to "encourage standardisation and platform stability", following the philosophy that innovation "has to be balanced with productivity and cost effectiveness". Boeing still intends to develop RFID as a standard feature on new aircraft, based on its existing RFID platform.

In Coop's opinion, the big advantage of Boeing's RFID Integrated Solutions is a completeness which makes it "very simple" for an airline to adopt. Rather than basic provision of hardware and software, the offering is "a comprehensive and supplemental aircraft maintenance programme" with ongoing support which Coop says will enable "a continuous transformation of an airline's maintenance operation". The system was accepted by the Federal Aviation Administration (FAA) in April 2012 as an alternative means of compliance.

"RFID in itself is not a big breakthrough," notes Coop, explaining that the concept of using RFID as a means of compliance "is a big breakthrough, and a paradigm shift for the industry". Given that the technology provides the possibility of moving away from a situation where a mechanic typically spends 85 per cent of available time on non-value added tasks, the industry can look forward to a whole new level of efficiency. Together with highly reliable configuration data and real-time decision-making, Coop believes this capability "will push RFID to become a standard in aviation very quickly".

RFID and MROs

According to LHT's Sowa, Airbus' initial specification for the use of RFID on the A350 prompted a greater awareness of its potential

LHT has achieved a 70 per cent reduction in lead times since introducing RFID to its logistics and maintenance activities in Hamburg.

"If it [the RFID] works in the engine workshop we can say that it will work anywhere in an MRO."

Fernando Matos, head of information technologies, TAP M&E

in the wider industry. He says that attention is growing because the technology is "mature now, standardised and ready to roll-out" and that solutions of particular interest to the market will feature IT integration scalability, low-cost and a quick ROI.

LHT began working on RFID in 2006, having identified it as "a future technology" which could be used throughout the Group. In Sowa's words, the basic approach is to find RFID-based solutions "to reduce manual work, gain efficiency and accelerate processes as well as raising quality". The company has worked with Airbus, Boeing, SITA and Fujitsu to establish common data standards, as well as Fraunhofer Institute for Integrated Circuits and Harting for the development of its own tags. LHT has also co-ordinated with Lufthansa Systems for RFID consulting among airlines, OEMs and MROs.

LHT now offers 'avio.tag' as an off-the-shelf transponder and 'avio.check' as an internally developed software solution. While 'avio.check' tackles what Sowa describes as "the low-hanging fruit" of emergency equipment which was widely targeted by early industry efforts, 'avio.tag' can be used for line replaceable unit (LRU) components both inside and outside the cabin. Following several years of development, the transponder is now ready for roll-out and distribution. "The unique selling position is that the tag is the only one on the market which can be supplied with an official airworthy certificate EASA [European Aviation Safety Agency] Form 1," states Sowa.

LHT's automated identification product range also includes 'id.tect' for outdoor localisation of ground support equipment (GSE) based on global positioning system (GPS) capability. Complementing these solutions, the MRO is additionally developing a suite of other applications which are used internally and are in preparation to be offered to customers.

According to Sowa, software is the critical element of RFID solutions, since the hardware is standardised and tags from one manufacturer are readable by devices produced and used by other companies. The fact that the software encodes and decodes the information on the tags is the reason behind concerted efforts to establish common data standards.

The results of these RFID solutions are impressive: 'avio.check' can reduce emergency equipment inspections from over three hours on a long-haul aircraft to under five minutes. Furthermore, a portal solution which was first implemented at LHT's workshop in Hamburg in 2007 has enabled the bulk reading of around 100,000 parts per year, reducing lead time between the repair shop and warehouse availability by 70 per cent. A similar scheme within LHT's logistics operations at the same location has cut lead time between aircraft removal and the repair shop by a comparable amount for an annual volume of 35,000 parts since 2008.

Sowa believes that future RFID development will focus on tag miniaturisation, performance improvement and long-term durability. He feels that one potentially rich avenue of development is real-time localisation of the kind currently enabled outdoors by the 'id.tect' GPS solution; indoor localisations in assembly lines and maintenance hangars could be "very interesting". However, the high price of the active tags required in this case, plus the IT and infrastructure, makes it difficult to secure an adequate ROI in the short term.

Another MRO which is considering a mixed GPS/RFID solution is TAP M&E, which has been investigating RFID since 2007. Fernando Matos,

TAP M&E implemented its engine components solution in January this year and recently began collecting KPIs to measure the results.

head of information technologies at the company, says that a GSE application "is not rocket science" but can "very much" improve safety. More importantly, the MRO has already pioneered a RFID solution for engine components which began life in 2008 as a partnership with Airbus, OATSystems and the TAP Group company Megasis before being implemented in January this year. According to Matos, the thinking behind this project lay in the fact that the well ordered environment of an engine workshop requires the simultaneous control of an immense number of components — over 10,000 for 100 engines. Plus, the high density of metal in an engine means that "if [the RFID] works in the engine workshop we can say that it will work anywhere in an MRO".

Three central MRO operations were pinpointed as areas of interest: the repair phase, the logistics phase and subassembly. According to Matos, even at the most highly organised workshops time spent searching for components is "a major problem", whether it is simply a case of a manual search by a mechanic, mislaid parts which result in payment of fees to customers or the unplanned borrowing of parts for aircraft-on-ground (AOG) situations. Thus it was clear that in these scenarios the greater visibility enabled by RFID would be of great benefit. Additionally, Matos says there was "a huge potential" to address a lack of confirmation of parts availability for delivery to the next repair station or for re-assembly.

For its 'Mobile Enabled Engine Repair Application' (MEERA), TAP M&E is using passive ultra-high frequency (UHF) tags, which are less expensive than active transponders. Since engine components must endure extreme temperatures, the tags are not attached directly but placed with task cards in a plastic bag to accompany the parts around the repair circuit. The composition of the engine is loaded into the server of the RFID module upon induction, then transferred to the readers. TAP M&E opted for handheld devices rather than a portal solution for reasons of cost. Matos says it would be "great" to have an RFID gate at every workshop or workstation entrance and exit but that the expenditure is unjustified.

Matos is open about the fact that the RFID project has been "a learning curve". Progress was delayed by three months while the MRO switched from readers with horizontal polarisation to devices with circular polarisation which are capable of reading tags in all positions, after discovering that scanning had to be performed both horizontally and vertically if the tags were not properly aligned. "So this was a mistake and we have alerted everyone in the industry that is working with RFID not to make the same mistake as we did," says Matos.

TAP M&E started collecting key performance indicators (KPIs) only at the beginning of November but early experiential results are promising. "We have shown already that we have reduced the parts idle time brutally," says Matos. Mechanics are reporting decreased idle time, less production disruption and "very evident" improvements in manual searching. Matos does not believe that the predicted ROI of €2.5m per year is achievable at present, owing to the induction of fewer engines in a difficult market, but he is "fully confident" that the investment of €750,000 will be repaid within one year.

In addition to a mixed RFID/GPS solution for GSE, upcoming projects for TAP M&E include: a solution which will cut the danger of foreign object damage (FOD) and near accidents from implements such as pins being misplaced during overhaul: the marking of at least 80 per cent of tools; RFID-enabled vans with secure cabinets for the most commonly used components and tools; the monitoring of chemical products with a shelf life; and onboard emergency equipment. Matos says it has taken "some courage" to push forward the development of RFID but that the effort will be worthwhile: "I believe it has a really great future."