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Editor's Letter

With the industry's eyes turning to the MRO Americas show in Dallas for a week in April, we've put together an article about the rich and varied

maintenance, repair and overhaul landscape in the Americas region. The Americas has a long history in aerospace and a wide variety of contributors to the MRO industry – both large and small in size – and while North America particularly is a mature market, there is still room for growth.

The nature of that growth is somewhat uncertain though, with the Covid crisis having a big impact on the market, not least on the already major challenge of finding a solution to the shortfall in qualified maintenance technicians. "Now that the recovery is taking hold, the industry is finding it difficult to ramp-up hiring as quickly as desired due to the reduced pool of available talent," notes StandardAero's president of Airlines & Fleets Lewis Prebble. This only serves to highlight the importance of MRO companies forging relationships with technical colleges and other higher education institutions to find and nurture new talent.

We spoke to four companies about the

current MRO landscape in the Americas and its future in our cover story this issue (p22).

One of the mainstays of that MRO landscape in the Americas – and globally – is the Boeing 737 family, whose importance as one of the most-produced jet airliner families in history can hardly be overstated. In our feature on p32, we asked experts to identify current trends in the 737 MRO business and assess what the future may bring. We also spoke to Fokker Services Americas' managing director Craig Winter about what it takes to maintain the 737 family from the perspective of a component MRO specialist (p40).

Elsewhere in the issue, the Pratt & Whitney

GTF programme is in the spotlight (p46), while in our regular 'Industry voices' section (p10), CFM International explains its approach to MRO and its commitment to an open and competitive market.

Finally, in the run-up to the 2022 Predictive Aircraft Maintenance conference, to be held at the Pan Pacific London hotel on 15-16 November,

we have introduced a new column on all things predictive maintenance – starting with an insightful Q&A with Air France Industries KLM Engineering & Maintenance.

I hope you enjoy reading the issue.

Jason Holland

EDITOR

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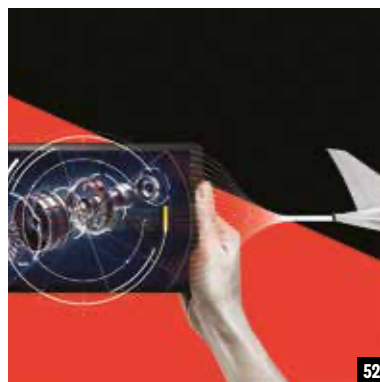
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Trend watch.

New partnerships, technologies and facilities are driving innovation in the MRO industry



01

Safe landing

HAECO Landing Gear Services and Liebherr-Aerospace have extended their initial landing gear service agreement to offer landing gear MRO services to Embraer E-Jet E1 operators in the Chinese Mainland.

Under the new agreement, HAECO Landing Gear Services' MRO services will be available to aircraft operators through cost-competitive solutions offered by Liebherr-Aerospace, bringing planning flexibility to overhaul slots for return-to-service needs.



05

Supporting the V2500

Qatar Airways has awarded Iberia Maintenance a 10-year contract for the repair and maintenance of V2500 engines. All scheduled maintenance events will be carried out at Iberia Maintenance's engine workshop at its facilities next to Madrid airport, with more than 52,000sq m dedicated to MRO and engineering services.

"We have over recent years invested heavily in the development of this product and we will continue to do so ensuring we provide a cost effective and differentiated service to our customers today and into the future," said Iberia's chief executive Javier Sánchez-Prieto.

"We will provide a cost effective and differentiated service to our customers"

02

Growing revenues

Turkish Technic has recorded revenue growth of 15.7 per cent in financial year 2021 compared with the previous year, to US\$ 1,034 billion. The company's market share increased to 1.6 per cent. Turkish Technic said that although it was negatively impacted by Covid-19, it "quickly overcame" this effect, receiving base maintenance authorisation for the C/D hangars at Istanbul Airport. It also increased its volume of landing gear maintenance work by 40 per cent, enhancing its maintenance repair capabilities in this area.

88%

Turkish Technic said it reached 88 per cent in third party revenue during FY2021 as it "grew and profited" during the year

672

The company provided 672 aircraft base maintenance services in FY2021



04

Hangar opening

SR Technics is celebrating the opening of a six-bay maintenance hangar at its centre of excellence for aircraft maintenance in Malta. The 40,000sq m facility includes workshop space, increased capacity for heavy maintenance, C-checks, and cabin modifications for up to six narrowbody aircraft at a time. It is the largest steel structure ever manufactured and built in Malta.

03

ADDITIVE LANDMARK

GE Aviation Engine Services Singapore (GE AES) has become the first MRO facility worldwide to have been approved to use metal additive manufacturing for commercial jet engine component repairs. When fixing used parts, the repair has to be customised for each individual part because they wear differently during service.

"In this part of the supply chain our customers value faster turnaround time, and that's what we are achieving," said GE AES' managing director Iain Rodger. "Using our GE Additive Concept Laser M2 machines typically halves the amount of time it takes to repair these aircraft parts."





06

Expanding service

MTU Aero Engines is to grow its MRO capabilities on Pratt & Whitney GTF engines after signing an agreement with the manufacturer. MTU will now supply overhaul services for two additional engine models, the PW1500G for the Airbus A220 family and the PW1900G for Embraer E190-E2 and E195-E2 aircraft. The contract runs over the engine programme lifecycle and also expands MTU's role in the GTF MRO network beyond the PW1100G-JM for the Airbus A320neo family.

07

Investing in the future

MTU Maintenance Zhuhai's joint venture partners MTU Aero Engines and China Southern Airline have conducted a groundbreaking ceremony for the construction of a new engineer training centre.

The centre is expected to open in early 2023 and train up to 100 engine mechanics for the company every year. "MTU Maintenance Zhuhai will get on a fast lane to be a company with abundant talents and high-quality development," said China Southern Airlines' chief engineer Wu Rongxin.



08

A CRITICAL INVESTMENT

Southwest Airlines has opened a new technical operations complex at Denver International Airport, which includes a large aircraft maintenance hangar. The 130,000sq ft complex was constructed at a cost of US\$100 million. The new hangar will support scheduled, overnight maintenance of Southwest's fleet of nearly 730 Boeing 737 aircraft.

The complex also includes maintenance shops, offices, training facilities and warehousing to support the carrier's technical operations team. It has space for three 737s inside and room for eight additional 737s outdoors. Southwest has six other hangars throughout the US.



TRENDING STATS

11,000



Bamboo Airways has selected Revima to provide overhauls on its A320 and A321 landing gears with the work to be carried out at Revima's new 11,000sq m facility in Chonburi, Thailand

20 YEARS



Magnetic Group has marked 20 years since the first C-check was performed at its MRO centre in Tallinn, Estonia

7%



Lufthansa Technik's 2021 financial results marked a big step out of the Covid crisis as the company returned to profitability, recording a revenue increase of seven per cent compared to 2020

2002

The year in which Embraer Aircraft Maintenance Services (EAMS), the manufacturer's MRO subsidiary based in Nashville, USA, was launched – 20 years ago

THE BENEFITS OF AN OPEN MRO NETWORK

CFM is to expand its LEAP MRO network as part of a commitment to an open and competitive MRO landscape, says CFM Services marketing director **Becky Johnson**



— **“The same philosophy that has worked well for the CFM56 is being carried over to the LEAP engine; we’re committed to a LEAP MRO landscape that is both open and competitive”**

▲
Becky Johnson is the services marketing director at CFM International

CFM International’s approach to MRO has always been to provide its airline customers a choice. This same philosophy that has worked so well for the CFM56 fleet is being carried over to the advanced LEAP engine; the company is committed to developing a LEAP MRO landscape that is both open and competitive, understanding that competition for shop visits and material reduces maintenance cost over the life cycle of the engine and increases asset value.

While CFM makes overhaul licences available to any MRO provider certified by an airworthiness authority, the company does work with some providers to serve as ‘CFM Branded Service Agreement’ (CBSA) licensees qualified to maintain LEAP engines exclusively to CFM standards.

To enable operators to take advantage of this extensive LEAP MRO network, CFM offers ‘Flexible Fleet Service’ options enabling airlines to: 1) maintain control of their shop visit workscopes and timing; 2) have a choice of MRO providers that offer complementary services and value

propositions; and 3) manage their cash until maintenance is required.

For CBSA-licensed MRO shops, CFM provides enhanced training and support and access to proprietary repairs to ensure they can remain competitive. While Lufthansa Technik is the only publicly announced LEAP CBSA licensee, there are shops either already committed or in negotiations according to the fleet acquisition

and MRO readiness timelines of these shops. Ultimately, CFM expects 6-8 CBSAs, distributed worldwide, to provide services for both the LEAP-1A and -1B engine models. Other MRO facilities can get access to overhaul licences as the market develops based on individual business cases.

There are nearly 40 MRO shops servicing CFM56 engines, and CFM expects that there will be 20-30 for LEAP engines. There are already seven non-CFM shops licensed and many of these will

be the same MROs that CFM56 operators use today. CFM engines, including LEAP, are the only products for which non-OEM MRO providers can freely compete.

About two-thirds of the CFM56 fleet is serviced by non-CFM MRO providers today. These non-CFM



30

There are nearly 40 MRO shops servicing CFM56 engines, and CFM expects that there will be 20-30 who will readily service LEAP engines

1. CFM expects 6-8 CBSAs distributed worldwide to provide services for the LEAP-1A and -1B engine models
2. The LEAP engine has been in service for more than five years and has been performing as expected

The LEAP engine is transitioning from launch and EIS to maturation and fleet stability

MRO providers are often airlines or aftermarket service integrators who provide other services, such as airframe or component maintenance, spare engine support, and airline operation support. Additionally, competition drives enhanced service performance as MROs compete on quality, turnaround time, payment terms and relationships.

Open MRO competition is particularly beneficial over an engine's lifecycle – especially in the mid-life to mature phase – because of repair development, the availability of, and demand for, surplus engines and parts, and the diversity of workscope alternatives to match ownership or operating horizons. This means lower maintenance costs for airlines and higher asset values for owners.

CFM56 customers have chosen a range of approaches to maintain engines:

flight hour programmes with the OEM, exclusive or non-exclusive T&M with either the OEM or another MRO provider, or engine maintenance at an in-house MRO. Maintenance programmes within an airline change over the lifecycle as the engine matures, initial contracts expire, and competing MRO providers offer expanded solutions. This is possible because customers have confidence in the performance, reliability and durability of the CFM56 engines and because there are MRO provider alternatives available.

The LEAP engine has been in service for more than five years. Initial durability issues have largely been resolved and not replaced with new ones as the fleet leaders accumulate cycles. Removal experience is similar to the CFM56 at the same point in its life cycle. Engines are performing as expected and LLP life extension programmes are progressing. This all indicates the time on-wing expectations will be achieved.

While initial LEAP EIS customers may have chosen 'rate per flight hour' (RPFH) programmes because of 'new technology' concerns, customers can now choose service alternatives going forward because CFM is delivering on its commitment to provide an engine that is reliable and durable, as well as fuel efficient.

CFM is increasingly emphasising the availability

and value of our Flexible Fleet Services product suite. It offers airlines products and guarantees that offer maintenance cost certainty as well as the flexibility to perform shop visits at either CFM or network MRO providers. Initial performance restoration shop visits on LEAP are not expected for years after an engine enters service. CFM's approach is to provide both price predictability at that event as well as open competition among many MRO providers.

For any unexpected maintenance before the performance restoration or LLP events, CFM provides support for non-PRSVs, with commercial support programmes that are an enhancement on practices employed on the CFM56 engine as it matured. Other guarantees and additional support options like spare engine support and comprehensive engine diagnostics round out the Flexible Fleet Service product suite.

After five years in service, the LEAP engine is transitioning from launch and EIS to maturation and fleet stability. The supporting MRO network is developing in anticipation of the growing fleet as engines begin to enter the maintenance cycle mid-decade and beyond.

CFM product offerings, which have always provided choice on CFM56 engines, have been enhanced on the LEAP engine to enable flexibility on maintenance options while still providing predictability. This approach will continue the CFM advantage on airline maintenance cost, MRO provider opportunity and owner asset value. **W**



STAYING CONNECTED TO STAY COMPETITIVE

MROs which stay informed of inflight connectivity technologies and installation processes will remain ahead of customer expectations, says SmartSky Networks' president and co-founder **Ryan Stone**



“To leverage industry updates and upgrades, it is important to understand customer expectations of inflight connectivity”

Ryan Stone is the president and a co-founder of SmartSky Networks. The company was founded to transform aviation through disruptive communications technologies, services and tools. The network takes advantage of patented spectrum reuse, advanced beamforming technologies and 60 MHz of spectrum for enhanced connectivity.

The demand for business aviation has increased sharply in the past two years, with many individuals now choosing to fly privately due to health considerations and the appeal of avoiding crowded aircraft terminals, long lines, layovers – and general frustration.

To keep up with the increase in customer demand, it is fundamental that MROs remain aware of the latest trends and requirements to achieve both client satisfaction and remain competitive in a growing market. Providing inflight connectivity has become a high priority for business aircraft operators and owners, often topping the list of must-haves for the next maintenance period. Keeping up to date with the latest technology options and installation processes will help MROs stay ahead of customer expectations.

Connectivity technology

Inflight connectivity providers typically offer either air-to-ground (ATG) or satellite-based networks. To consider which technology is best suited to the aircraft type, it is important to compare the pros and cons of each network type to the mission requirements for the aircraft.

Advanced ATG technology, like SmartSky Networks, transmits from ground-based towers utilising cellular technology to connect with aircraft flying at altitude. This approach is a superior solution for aircraft performing domestic missions due to its inherent strengths in balancing performance needs and costs for getting data to and from the aircraft. Because the signals are travelling over much shorter distances – thousands

of feet to the ground vs hundreds or thousands of miles to a satellite – ATG offers very low latency that enables responsive internet access for video calling, cloud-based business applications and real-time operational data for aircraft crew and ground operations.

Further, SmartSky's ATG network includes patented enhancements like beamforming that assigns a separate beam to each aircraft so that bandwidth is not shared and makes the

connection more dependable and consistent. Not only does it improve the passenger experience, but it is also beneficial to pilots, fleet operators and management companies, giving them access to real-time operational data and reliable connections to do their best work – supporting the entire aircraft ecosystem.



20

With 20 times more available spectrum than existing ATG systems, SmartSky can meet the increasing demand for uninterrupted access to data

1. SmartSky's air-to-ground network offers innovations designed to make inflight connectivity more reliable
2. The company offers disruptive communications technologies, services and tools, according to Ryan Stone

The installation of connectivity technology should be straightforward and efficient

Customer expectations

To appropriately leverage the latest industry updates and available upgrades, it is important to understand customer demands and expectations of inflight connectivity. In the world of wireless connections, spectrum is the scarcest resource, similar to land in real estate. Simply put, more spectrum means more speed. SmartSky's ATG network is built upon a decade of patented innovation that uniquely enables it to effectively use 60 MHz of spectrum in the unlicensed band. With 20 times more available spectrum than existing ATG systems, SmartSky can meet the increasing demand for uninterrupted access to data.

Additionally, the ability to conduct business while in flight has become a passenger priority and a connectivity provider should have the capabilities to enable this type of uninterrupted productivity. The connection should include transmission symmetry of data to and from the aircraft to enable business applications such as accessing large files, video conferencing and VPN access to deliver an 'office in the sky' experience for those who require it.

Finally, as technology is always evolving, staying up to date with the latest developments and announcements in connectivity technologies helps MROs remain competitive and on top of the changing marketplace. Following key thought leaders and technology providers on social media is a great way to receive breaking news on upgrades, maintain continuous communication with providers and build relationships with suppliers. **✉**

In comparison, satellite-based connectivity relies on satellites in orbit around earth and can offer coverage for business aviation users travelling over water or internationally. With ATG connectivity not available over water, this may be a primary factor in the choice of connectivity solution. A disadvantage of satellite systems is their typically higher latency, which has a negative impact on the responsiveness of the connection or how long it takes to send and receive data in its various forms. This affects the user experience as service can appear intermittent and not conducive to two-way communications such as voice and video calls and accessing cloud applications. Additionally, satellite systems require greater power and cooling from the aircraft and often have a higher installation cost.

Choosing a network provider

Recommending the appropriate network provider can be more complex than at first glance, as there are numerous factors MRO companies should consider

to help customers find what works best for them. Firstly, and arguably most importantly, the installation of connectivity technology should be straightforward and efficient. If technicians have difficulty installing hardware onto aircraft, not only do they potentially increase the installation time, but there is also a higher risk of installation problems and higher costs. To aid this process, the MRO should ensure the network provider offers support for installations and tools to functionally test the system throughout the process. Technology that enables performance testing without requiring a test flight can considerably reduce time and costs.

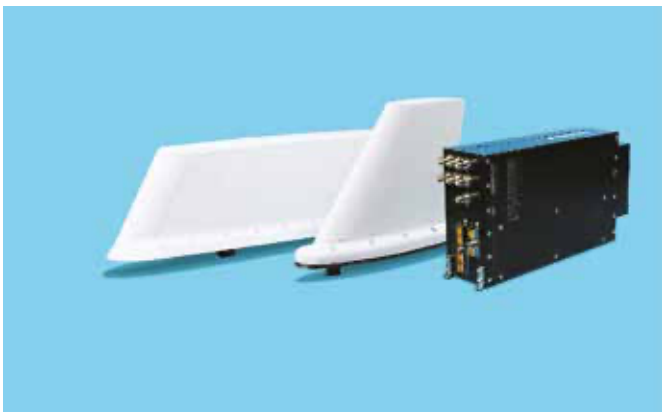
Just as the suitability of networks varies by aircraft type and mission, so too does the selection of the aircraft equipment. Antenna and radio hardware should be designed to fit the space constraints and configuration of the airframe.

Whether a small or large aircraft, equipment needs will vary and interoperability with other onboard systems such as cabin Wi-Fi access points and routers is key to providing a well-matched connectivity solution for each customer.

Finally, each connectivity provider will offer a variety of service plans which include options based on the amount of data the customer needs. Consideration should be given to the costs, mission-type and data requirements of the client before recommending a network provider and service plan.



1



2

FULFILLING THE PROMISE

In the run-up to the 2022 Predictive Aircraft Maintenance conference in London in November, MRO Management presents a new column on all things predictive maintenance. In this issue we talk to **AFI KLM E&M** – who will be speaking at the conference – about its ‘Prognos’ tool and the wider future for such solutions

MRO Management: How do you see the current state of predictive maintenance techniques in the MRO market?

Air France Industries KLM Engineering & Maintenance's (AFI KLM E&M) digital products & services manager Rik van Lieshout: Predictive maintenance is growing and becoming more and more essential. Most of the current predictive maintenance applications in the aviation industry focus on engine health monitoring or tracking servicing items such as fluid levels or tire pressures.

This is primarily done by using snapshot sensor data; in other words, single observations taken once or twice per flight. Only a few applications concentrate on health monitoring and prognostics of aircraft components using full flight sensor data. Although the acquisition of such data comes with challenges, the financial footprint of these prognostics is much higher, with benefits reaching from operational stability and schedule optimisation to supply chain and repair cost savings.

How do predictive maintenance solutions lead to meaningful MRO actions?

A Big Data solution for maintenance services is both a tool and an analysis. It retrieves data on a daily basis from the aircraft, inflight and during turnarounds, to be securely stored and analysed daily by highly qualified engineers. By training on historic failures of a specific component, an algorithm is being developed to recognise patterns in the data prior to a failure event.

Once this algorithm is applied to live data, the predictive maintenance solution alerts on suspicious behaviour and maintenance actions can be taken. By anticipating the maintenance needs, it increases the operational reliability. This means minimised AOG risks and related operating costs.

How does your ‘Prognos’ solution work and what are the next innovations?

Prognos for Aircraft’ uses continuous aircraft sensor data to calculate health metrics of various components per flight. The algorithms that calculate the health metric are developed using a large pool of historical operational data in combination with artificial intelligence. If the system recognises unhealthy behaviour on live data, an alert is sent via e-mail. The end user can analyse the situation through a graphical user interface and plan proactive maintenance actions. In order to keep expanding the component



coverage of Prognos for Aircraft, new Big Data technologies are to be applied. Running machine learning algorithms on multiple datasets, for example distributed over multiple operators, would enable algorithm development without direct access to another operator’s data.

What impact did the Covid-19 crisis have on predictive maintenance?

After years of growth and investment on Big Data analysis, the Covid-19 pandemic slowed down the development and implementation of predictive maintenance solutions. Due to a lower utilisation factor, the airline operation was less prone to



THE AVAILABILITY OF SENSOR DATA IS ESSENTIAL FOR PREDICTIVE MAINTENANCE



OPERATORS ARE MORE DRIVEN TO TACKLE THE DATA SHARING CHALLENGES

1. Most of the current predictive maintenance applications in the aviation industry focus on engine health monitoring or tracking servicing items
2. Predictive maintenance is considered as one of the most promising solutions to increase efficiency and availability



1

unplanned maintenance, reducing the potential of predictive maintenance. However, predictive maintenance also became an important topic to make the aviation industry fit for its restart but also for its sustainability. It is considered as one of the most promising solutions to increase efficiency and availability, both in the MRO and airline operation.

What are the next steps for wider predictive maintenance implementation?

The availability of sensor data is essential for predictive maintenance. Only if the right measurements arrive at the right

time, component failures can be foreseen. This requires adequate sensor recording as well as techniques to download the data in a timely manner. Many airlines and MROs cannot benefit from the full potential of predictive maintenance because they lack correct policies or tools for data acquisition, storage and analysis.

While data is essential, the combined resources and skills of engineering and data scientists are also essential to develop the algorithms that are the core of a tool like Prognos. This is why operator experience is so important in the construction of predictive models.

Is industry collaboration and unwillingness to share data a major factor?

Full flight sensor data is powerful but also sensitive data. Airlines have been hesitant to share this kind of data, because of privacy reasons, but also due to ignorance about the potential of this information. Big Data technologies are continuously improving in terms of safety and applicability, convincing the industry to open up more towards data sharing. For predictive maintenance specifically, data sharing is essential for running live prognostics, as well as for speeding up research and tailoring prognostics to the situation of a specific operator.

How do you see the future for predictive maintenance in the MRO industry?

The industry is increasingly aware of the potential of predictive maintenance and the cost savings it can generate. Accordingly, operators are more driven to tackle the challenges of data sharing and there is an increased willingness to experiment with premature component replacements.

With advancements in Big Data technology and artificial intelligence, prognostics will be developed for a broader range of components and with higher accuracy. Future aircraft will probably have more sensors to condition monitoring and thus opportunities to increase predictive maintenance solutions, which enables substitution of a large amount of periodic maintenance tasks by just-in-time actions. 



2

PREDICTIVE AIRCRAFT MAINTENANCE 2022

PREDICTIVE AIRCRAFT MAINTENANCE CONFERENCE 2022

On 16 November 2022, MRO Management and its parent company Real Response Media will host the Predictive Aircraft Maintenance Conference 2022 at the Pan Pacific London hotel to explore the future of predictive maintenance, bringing together senior level executives from airlines, OEMs, MRO specialists and Big Data experts.

Attendees will discover how to get the best out of predictive maintenance while overcoming the greatest challenges. Case studies will highlight best practices and how companies are successfully collaborating with industry partners, while panel discussions will explore the major topics from the perspective of all stakeholders. A welcome reception will be held on the evening of 15 November.

For more information, visit

 predictiveaircraftmaintenance.com

SAFETY MANAGEMENT:

Setting safety policy and identifying effective safety performance indicators

When developing a Safety Management System (SMS), an important part of that system will be tracking how well you meet your safety objectives, says Washington Aviation Group president **Jason Dickstein**

In the last issue, we discussed some of the basics of SMS, and we introduced some of the terminology that is used in this article. If you are looking for an introduction to SMS then please look at that article, which can be found online at www.aviationbusinessnews.com/digital-issue/mro-management-march-2022-digital-issue/.

One of the reasons that this is important to repair stations is because the European Commission Implementing Regulation 2021/1963 requires Part 145 organisations to establish SMS programs by December of this year. The FAA plans to issue a proposed rule this autumn which will impose an SMS obligation under FAA Part 145 regulations. So now is the time to implement your own SMS processes in your business – so you can identify which processes work best for your business – before the regulations impose a greater level of restriction on your SMS operations. In this issue, we will examine the safety policy obligation and some strategies for developing safety performance indicators (SPIs) to demonstrate safety within your system.

Start with your safety policy

A company's safety policy establishes the high-level safety goals of the organisation. ICAO's Annex 19 is the basis in international law for the SMS requirements that are being published in the laws around the world, and that annex suggests that a company's safety policy accomplish several goals. This seems like quite a lot of information to



Management should consider a safety policy to be something that guides the company

place in a simple safety policy but, when you parse through it, the safety policy itself can be quite a simple statement.

In the last issue we offered a one-sentence safety policy just for the purpose of examining safety objectives. In this article, we offer a slightly longer and more ICAO-compliant (but nonetheless quite simple) safety policy:

"Our organisation is committed to safety and to the promotion of a positive safety culture. As part of the positive safety culture, we encourage employees to report safety issues through the company safety reporting hotline. Where an employee has

made a voluntary report of his or her own safety-related action or inaction, then if the action or inaction was inadvertent and did not result in a direct hazard to safety, company policy is to waive disciplinary action against the first such reporter. Willful or repeated violations of company safety policy, on the other hand, are unacceptable. Voluntary safety reports will be treated as mitigating factors in any disciplinary action. The accountable manager shall ensure that the company commits the necessary resources to implement this safety policy."

As you can see, this is a pretty broad statement of policy and is little more than a safety strategy. As a safety strategy, it can be an important tool for management to set the high-level expectations for safety. If there is a high-level strategic safety goal for the company, then this is the place to state that strategic goal. Management should consider the safety policy to be something that guides the company. As such, a certain level of stability is expected; however management should not be afraid to amend the safety policy when necessary to ensure that the policy reflects the company's strategic goals.

A safety strategy sets high-level strategic goals but these are typically not enough to guide an SMS implementation. This is why the rough description of the safety policy typically needs to be supplemented with safety objectives. In the last issue, we introduced the concept of safety objectives in support of the safety policy (take a look at that article to



1. Now is the time to implement your own SMS processes in your business to identify which work best

get additional information on setting safety objectives in support of the safety policy). If you have already identified safety objectives for your company (independent of your safety policy), then you may want to consider amending the safety policy if it does not adequately describe all of your safety objectives.

It makes sense to begin to measure your safety objectives and then to refine those objectives as you get better data. This measurement allows management to use the SMS to judge the system's success.

How will we measure success?

The safety objectives should each be judged through one or more safety performance indicators (SPIs). SPIs are metrics used to judge the effectiveness of performance in a specific area. Often the SPIs will be developed in concert with a data-gathering effort that provides data to support the SPI measurement.

Don't make the mistake of assuming that there must be a 1:1 relationship between safety objectives and SPIs. Sometimes you need more than one SPI

to get a good read on a safety objective. Sometimes one SPI might illuminate more than one safety objective.

The important thing is to identify SPIs that – when taken together – will yield information that reveals the health and success of your SMS and of your operation's safety accomplishments. It is normal to use the SMART approach for identifying safety objectives, and this same approach can be used to develop the corollary SPIs.

Let's say that the company's safety policy states a commitment to continuous improvement. It also states a commitment to safety performance. The company might decide to gather data that it feels represents a measurement of the company's safety performance and it might have a safety objective that correlates to the data, while also allowing the company to measure continuous improvement (thus potentially addressing both safety policy elements with a single objective).

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1. A company's safety policy establishes the high-level safety goals of the organisation
2. Safety objectives should each be judged through one or more safety performance indicators (SPIs)

1

Let us examine an example where warranty returns have been identified as an indicator of safety performance. The basis of this (for our hypothetical repair station) is because experience has shown that warranty returns tend to have a negative correlation to safety compliance. With this in mind, the company might choose to (1) track total number of warranty returns (for purposes of measuring performance), and (2) set a safety objective that the total number of each fiscal year's warranty returns shall be not more than 95 per cent of the number recorded the

Try to identify the extent to which metrics do correlate to safety performance

prior fiscal year (for purposes of driving continuous improvement).

Here, we have identified a measurable metric that we think is related to safety performance, and we have set a safety objective related to that metric. This is an exercise that we would like to be able to perform for each safety objective – identifying related metrics and tracking

those metrics to then assess whether we are meeting our safety objectives.

In the next issue we will continue to drill down into safety objectives and SPIs, and we will examine how a repair station should use the SMART approach to ensure that the safety objectives and SPIs are optimal.

Developing these SMS elements is the sort of thing that you can do before your formal SMS is implemented. Because the EASA SMS regulations don't become effective until December of this year (and the FAA won't publish their proposed SMS regulations for repair stations until later this year), it makes sense to take advantage of this extra time to start testing the elements that will become part of your SMS. You can try to identify which metrics can be tracked, and the extent to which they really do correlate to safety performance (or any other safety goal established by the company). 



2

Jason Dickstein is a Washington-DC based attorney who has advised aviation businesses on transactions and contracts for 30 years. He is active in several of the aviation trade associations, including associations representing repair stations, distributors and PMA parts manufacturers.



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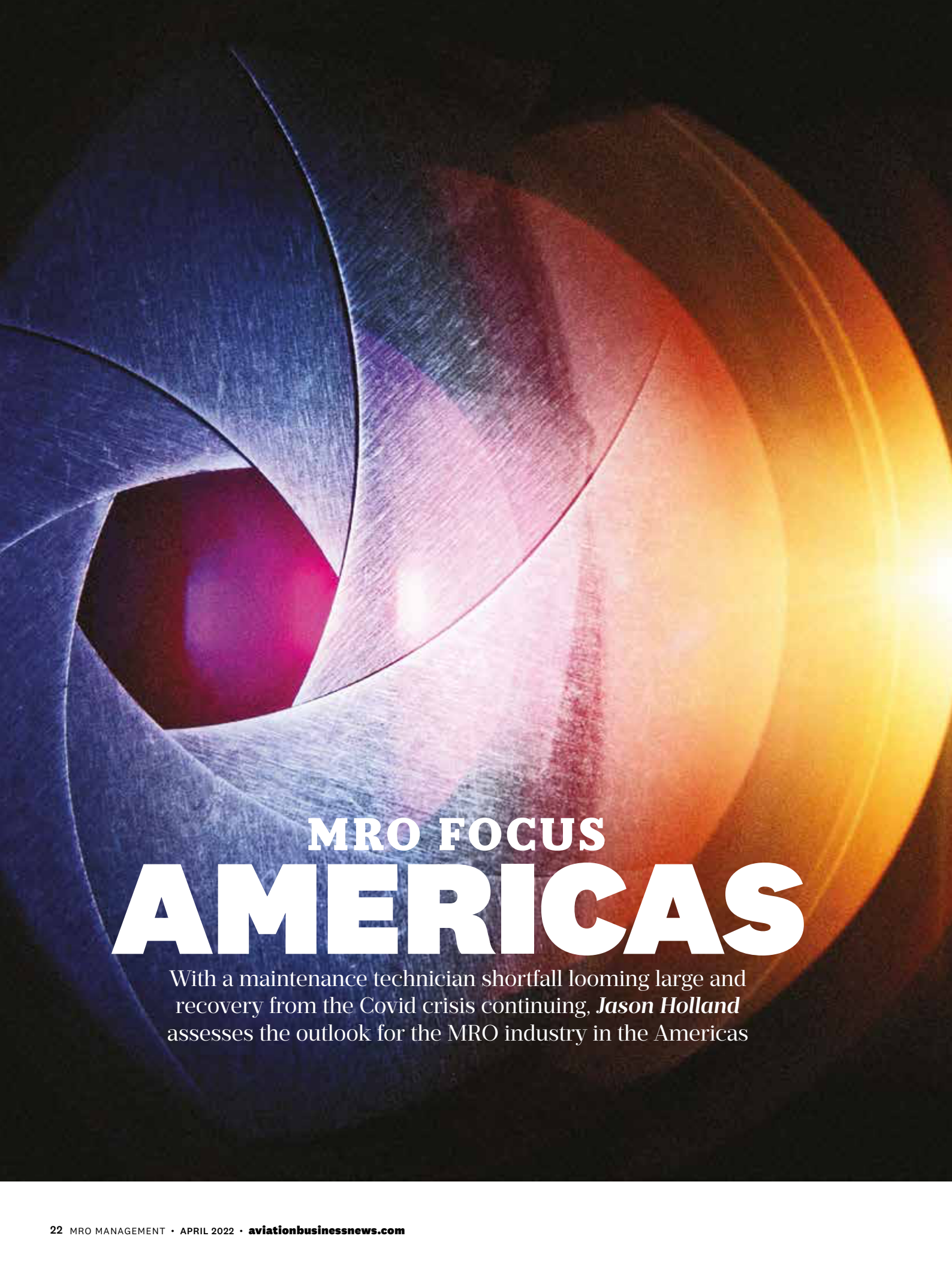
The background of the advertisement is a collage of blue-toned images. At the top, the word "DASI" is written in a large, white, sans-serif font, followed by a logo consisting of several white, curved, parallel lines that resemble a stylized wing or a fan. Below the logo, there is a photograph of a commercial airplane in flight, seen from a side-on perspective. The entire image is overlaid with various geometric shapes and patterns in shades of blue, including diagonal stripes in the top left and bottom right corners, and a large, dark blue rectangular area in the bottom right corner.

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MRO FOCUS **AMERICAS**

With a maintenance technician shortfall looming large and recovery from the Covid crisis continuing, *Jason Holland* assesses the outlook for the MRO industry in the Americas

The aerospace industry in the Americas is vast and varied, and features some of the world's biggest hubs of companies and related organisations. These include the Boeing-influenced Washington state; Quebec in Canada; Florida; Oklahoma; and Sao Paulo in Brazil, the home of Embraer. Within these hubs, and across the Americas, are a plethora of commercial aviation MRO companies varying in size and capabilities, but all playing an important role in the maintenance landscape.

The big aircraft and engine manufacturers such as Boeing, GE Aviation and Pratt & Whitney naturally have a major influence on the MRO market, as do the likes of AAR – the largest independent third-party MRO in the Americas – and companies such as Delta TechOps, StandardAero, STS Aviation Group, Ascent Aviation Services, Aviation Technical Services, AJW Technique and Avianor in North America. In Latin America, some of the biggest MROs are MRO Holdings/Aeroman and Mexicana. In addition to those companies headquartered in the region, global companies such as Lufthansa Technik, ST Engineering and HAECO also have subsidiaries and joint venture companies in the Americas.

Despite this breadth of capability and opportunity, one major long-term challenge faces the MRO industry in the Americas – a shortage of qualified maintenance technicians. We spoke to a few of the above-listed companies to assess the current MRO landscape in the region and how it has been affected by the Covid-19 crisis.

“Overall the industry is recovering well from the effects of the pandemic, with the outlook for the remainder of 2022 looking positive,” says StandardAero’s president of Airlines & Fleets Lewis Prebble. He notes data from Airlines for America (A4A) and the International Civil Aviation Organization (ICAO) indicating the domestic US airline market has recovered close to 2019 levels of activity, with international demand back to within 25 per cent of pre-Covid levels.

“This has, in turn, driven a recovery in demand for MRO services – including heavy engine shop events – as operators seek to catch up with deferred maintenance and to prepare for what is hoped to be a strong summer season,” he adds.

“That’s not to say that operators don’t face headwinds: the recent rise in oil prices has pushed Jet-A prices well above pre-Covid levels, necessitating higher ticket prices. Personnel shortages also continue to be an issue for many operators, not least those regional carriers who have seen employees – both air crew and technicians – tempted away by mainline carriers offering higher wages. However, the overall recovery trend is positive, with the International Air Transport Association (IATA) forecasting North American passenger numbers to reach 94 per cent of 2019 levels this year, ahead of a full recovery in 2023.”

STS Aviation Group’s CEO PJ Anson describes the past six months as a “bit chaotic”. “Limited MRO facility resources, coupled with significant MRO labour shortages, seem to have caused a bit of panic in the industry,” he says. “The amount of travel uncertainty coming into this year has led to many operators holding off on securing maintenance slots until they knew what their flying schedules were going to be. Unfortunately, that has left many operators on the outside looking in as the available maintenance slots have been spoken for by operators who foresaw the shortages of MRO resources coming.”

AAR’s vice president sales & marketing for the Americas Carl Glover and senior vice

president repair and engineering services Brian Sartain note that MRO businesses “whose primary exposure is to domestic narrowbody fleets had recovered to pre-pandemic levels by early 2022”; however, businesses that had exposure to widebody international fleets “remained at least 30 per cent depressed”. They add: “With many operators rushing to get their narrowbodies back in the air, many hangars were at capacity. For the rest of the year, we expect demand to continue to increase as international travel recovers in the summer.”

In a wider context, AJW Group’s SVP strategic material & asset management Conrad Vandersluis notes that the global aviation industry is “bracing itself for a decade of growth that we expect will test the industry’s resilience, not only from the pandemic and associated



The International Air Transport Association is forecasting North American passenger numbers to reach 94 per cent of 2019 levels this year, ahead of a full recovery in 2023



1. A CFM56-7B fan inspection is performed at StandardAero facilities
2. STS Aviation Group provides aircraft maintenance, engineering, recruiting and component services to the global aviation industry – with about 30-40 per cent of its revenue coming from international origins



1

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complications of travel restrictions and supply chain challenges, but also a reduced labour force too small to support the expected growth trajectory. Add in the industry challenge of meeting the COP26 climate change ambitions with no immediate alternative to fossil fuels that substantially cut emissions, and it will be a turbulent decade of growth for the industry.”

Vandersluis notes that the changes in fleet, predicted growth and the elevated number of aircraft retired that were due to enter a period of intensive MRO expense directly impacts the component maintenance market, in which Montreal, Canada-based AJW Technique specialises. “It is now forecast that by 2024, MRO demand should reach pre-pandemic levels but at varying rates round the world. For instance in China the MRO demand has already surpassed pre-pandemic figures but Western Europe is not expected to see full recovery until 2025.”

As well as the factors noted, Russia’s invasion of Ukraine has had many

knock-on effects, increasing economic and general uncertainty. Prebble says there is a potential fivefold impact for the MRO industry. “Firstly, the imposition of sanctions on Russia has led to a ceasing of customer activity in Russia and Belarus,” he explains. “Secondly, the conflict has had a ‘chilling’ effect on air travel in Europe, as noted by IATA, with European bookings down by eight per cent the week

after 24 February. Any impact on travel demand risks a downstream impact on demand for MRO services.

“Thirdly, the impact of the conflict on oil prices places further cost pressure on operators, who were already facing significant increases on Jet-A prices. Oil prices surged to a 14-year high following the invasion, and airlines are now passing these increases onto passengers through increased ticket costs, which could impact demand.

“Fourthly, the industry’s supply chain is now facing an impact due to Russia being a prime producer of raw materials such as titanium. Finally, with lessors facing a potential US\$10 billion impact as Russia moves to nationalise the 500+ aircraft that local operators have leased from Western companies, it’s possible some of the big names in the leasing industry may seek to minimise costs by postponing MRO work wherever possible.”

Anson describes the situation of leasing companies losing access to their aircraft in Russia as “scary”. He says:

“I am not sure how it is all going to play out, but rest assured that it will end up costing us all in the end. The loss of carriers to transverse airspace over Russia will have an impact on many routes and operators of the same.”

Americas advantages

Speaking more generally, AAR’s Glover and Sartain think there are many advantages for MRO companies to be based in the Americas. “Our location in the Americas allows us to stay close to some of the world’s largest carriers that are constantly innovating,” they say. “Our global headquarters and warehouse located near Chicago O’Hare alongside our facilities in Atlanta and Jacksonville allows us to react quickly and dispatch parts immediately worldwide for AOG support.”

But they add that although AAR is headquartered in the Americas, the company is a global solutions provider

10

Since 2015, StandardAero has made 10 acquisitions, most recently PTS Aviation and Signature Aviation’s ERO business, which includes Dallas Airmotive and H+S Aviation

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1. AJW Technique has the ability to process 35,000 units a year across 6,000 separate part number lines
2. AAR's global headquarters is located near Chicago O'Hare, while in the Americas it also has facilities in Atlanta and Jacksonville allowing the company "to react quickly and dispatch parts immediately worldwide for AOG support"

1

decades, North America does still remain the largest commercial aviation market in terms of installed fleet, with South America further extending the Americas' advantage in this regard. The Americas also still represents by far the largest business and general aviation market, this segment also being of great importance to StandardAero.

"Finally, the service culture which is ingrained across North America is closely aligned with StandardAero's DNA: as a 'can do' company that's always ready to go the extra step to keep our customers flying, we pride ourselves on the customer service focus of our employees, and on the consistently high scores that we achieve in customer satisfaction surveys. While we maintain this customer-focused culture across all of our locations globally, it perhaps comes most naturally to our teams in the USA and Canada, thereby facilitating our recruitment and training"

Differentiated offerings

Glover and Sartain see AAR's main competitors in the aircraft MRO segment in the Americas as being ST Aerospace, Aeroman and Aviation Technical Services. "We differentiate ourselves by having the largest number of licensed mechanics as a percentage of our workforce of the industry and that allows us to provide superior quality, turnaround time performance and lowest total cost," they say. "In addition, our locations at major destination airports like Miami and Indianapolis allow our customers to have the most efficient crew swaps and aircraft scheduling"

Anson says that STS does not "see anyone out there" as a direct competitor on a group level. "The very thing that differentiates STS Aviation Group also limits the number of organisations we would view as direct competitors," he



2

with MRO, warehousing, sales & engineering staff in the Americas, the Middle East, Europe and Asia. As an example of this global reach, the pair state: "Alongside our component shops, AAR's landing gear & wheel and brake shop in Miami, Florida has extensive in-house capability so we are able to support Americas and international customers from that facility with full domestic capabilities."

Prebble notes too that while StandardAero is a globally focused MRO provider, with facilities and customers worldwide, "there are obvious benefits to having our headquarters in the Americas" – in its case in Scottsdale, Arizona. "Firstly, four of the big five engine OEMs that we support are located in the Americas, namely CFM International, GE Aviation, Honeywell Aerospace and Pratt & Whitney Canada, with the fifth OEM – Rolls-Royce – also having a major local presence. This in turn facilitates effective communications,

coordination and – not least – logistics, thereby helping us to offer the most efficient and responsive level of service to our customers," he says.

"Secondly, despite the rapid growth of the Asia Pacific market in recent

A big challenge to MRO growth is the availability of maintenance labour

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says. “Each of our service offerings (line maintenance, MRO heavy maintenance and modifications, OEM component sales, recruiting services and engineering support) have their own competitors within their own specific industries, but the true competitive advantage of our company is realised when we bring the full-enterprise value to our customers. This is done on a global scale, and that is where the true strength of STS Aviation Group comes to light in our customers’ eyes.”

Prebble does not name any companies specifically as direct competitors but says StandardAero will compete with “airline MRO shops, independent authorised MRO shops, and so-called ‘gray shops’ which lack OEM approvals”. StandardAero’s service offering to customers is differentiated in a variety of ways, he adds. “We are one of the world’s largest independent providers of aerospace MRO services, but we operate strictly as an OEM-authorised service provider,” he says. “This means that customers are able to rely on the quality of our support, while avoiding any potential concerns that could arise from using an MRO facility run by a competing airline.”

Prebble notes too that StandardAero supports a broad range of engines and APUs, meaning that in many cases the company is able to provide support

60

AJW Group manages a streamlined vendor supply chain of 60 primary repair workshops with 700 approved facilities and spends US\$400 million annually on almost 100,000 repair orders

for the operator’s entire fleet, thus simplifying MRO logistics. In-house component and engine capabilities mean that StandardAero can offer a range of service options, “further enabling our ability to offer customised solutions tailored to our customers’ operations”.

AJW Group’s Vandersluis says the last two years of sector turmoil “has changed the dynamic in the industry”, and is driving far closer strategic alliances between companies such as AJW Group and its airline, aircraft manufacturers, component OEM and MRO partners.

“We managed a streamlined vendor supply chain of 60 primary repair workshops with 700 approved facilities

and spend US\$400 million annually on almost 100,000 repair orders,” he says. “Our prime objective is to deliver improved cost and reliability efficiencies for customers and strive for optimum efficiency and profitability whilst keeping our customers at the core of everything we do. That means working with partners that understand our business, exchange reciprocal work based on core competencies and collaborating to innovate and collectively expand. We forge great working relationships with our suppliers, viewing them as partners not competitors.”

AJW Group expanded its global MRO footprint last year with the opening of AJW Technique Europe, which operates as a centre of excellence for aircraft batteries and will expand into a series of other capabilities to complement the repair services offered at AJW Technique in Canada.

In light of the accelerated replacement of ageing aircraft, the company is also focused on developing its technical capabilities for next-generation equipment, and this resulted in the company’s investment in a sole distributorship agreement with Honeywell for the Boeing 737 MAX ADIRU, the A320neo ADIRU and a suite of Boeing 787 components. “This has also allowed us to

1. StandardAero has nine overhaul-level facilities on five continents worldwide, backed up by 18 service centre facilities and global field service technicians
2. STS Aviation Group is expanding its global line maintenance network and its MRO capability footprint
3. AAR says its location in the Americas allows it “to stay close to some of the world’s largest carriers that are constantly innovating”

2

increasingly develop our in-house MRO capabilities at AJW Technique,” says Vandersluis. “The Honeywell product lines are current production aircraft types which are being delivered with significant backlog of deliveries going forward which will require the support that the AJW Group can offer.”

We see potential for consolidation and the pace of this may pick up

Future challenges

The companies interviewed for this article agree that the biggest challenge to MRO growth in the Americas is the availability of qualified maintenance technician labour in the post-pandemic economy. STS’ Anson goes so far as to say that the tight labour market is such a large challenge “that it is the only challenge at this time”. Supply chain challenges exist too, of course, but are “quite a way behind the labour shortages we are experiencing” in terms of significance, he clarifies.

Prebble explains that prior to the Covid crisis, the industry knew that it was facing a near-term wave of retirements, and the pandemic served to accelerate this process, “with many technicians taking advantage of early retirement options as the industry reduced its workforce in response to reduced demand for MRO services. Now that the recovery is taking hold, the industry is finding it difficult to ramp-up hiring as quickly as desired due to the reduced pool of available talent, aggravated by strong demand from the airlines who are also ramping up their recruitment efforts.”

All this highlights the importance of “encouraging and nurturing” new talent through direct relationships with technical colleges and other higher education institutions, he thinks.

Might the Covid crisis also lead to an upswing in partnerships, joint ventures or consolidation in the region? AAR’s Glover and Sartain note: “Despite the predictions of consolidation and potential failures of smaller businesses, the demand for aircraft MRO services as the industry recovers has prevented many of these things from happening. We see some potential for new partnerships and consolidation and believe the pace of this activity may pick up in the coming years.”

AAR has recently announced some contractual partnerships with some larger OEMs, for example, whereby the company is supporting their products and services globally in support of the recovery in demand for their products and services. “These agreements align with AAR’s unique market presence in both supply chain, component and

aircraft maintenance activities,” say Glover and Sartain.

AJW Group expects to see MROs join forces and consolidate to right-size to customers reduced budget strategies, according to Vandersluis. “We also expect to see an increase in partnerships formed,” he says. “This month AJW Group was recognised as Honeywell’s ‘Global Channel Partner of the Year’, which recognises Honeywell’s most trusted partners. Honeywell Channel Partners are chosen for their unique market reach, commitment to growth, and strong track record of performance, integrity, and compliance and whose innovation and performance exemplify those of Honeywell and who consistently go above and beyond to support global airline and MRO customers.”

Prebble thinks there are two reasons why we might see a continued upswing in partnerships, at least. “Firstly, the continued globalisation of the market encourages local partnerships – whether simple teaming arrangements with sales intermediaries, or more substantive joint ventures with fellow MRO providers – in order to ensure that the needs of local customers are fully appreciated and serviced,” he states.

“Secondly, the quickening pace of new product introduction – a trend which many industry analysts believe may accelerate in the wake of the pandemic – will likely find OEMs having to focus their attention on technology development and certification. This will in turn increase the importance of ‘life-of-type’ partnerships with experienced MRO providers, enabling OEMs to be assured that their legacy operators will continue to receive the same high level of support that they’re used to receiving.”

3

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TRENDS

IN THE 737 MRO MARKET



1. Ryanair is among the passenger airlines in Europe to operate the 737

As one of the two most-produced jet airliner families in history, and now in its fourth generation, the Boeing 737 is enormously important to the aircraft maintenance industry. **Chris Kjeldgaard** asks experts to identify current trends in the 737 MRO business and assess what the future may bring

The importance of the Boeing 737 family – in all its four generations – to the commercial aircraft MRO business can hardly be overstated. The 737 and its rival the Airbus A320 family completely dominate the single-aisle passenger jet market, having between them sold (in the 55 years since the

737 first appeared as the 737-100 and 737-200 and in the 35 years since the first A320-100 entered service) nearly 30,000 units.

For reasons in part political and patriotic, the global distribution of the 737 and the A320 families in service isn't even in two of the world's major regions. In North America, more 737s are in service with major carriers than are A320 family members. While several large carriers such as Frontier, Spirit, JetBlue and Allegiant today largely or wholly operate A320 family fleets, and others such as American, Delta and Air Canada have somewhat even splits between

A320s and 737s, carriers such as United, Southwest, Alaska Airlines and WestJet rely more on the 737 family – in the case of the latter three carriers, entirely so. (Alaska is disposing of the remaining A320-family jets it inherited in its takeover of Virgin America, Allegiant picking up many of the young A320s Alaska is selling.) In Europe, however, the A320 family dominates major airlines' single-aisle fleets, probably to an even greater extent than 737s dominate North American fleets. Other than Ryanair, KLM/Transavia, Turkish Airlines/Anadolu Jet, Jet2.com, Sun Express and the TUI group, few European carriers operate 737s as passenger aircraft

– Norwegian Air Shuttle, Icelandair, LOT Polish Airlines and Air Europa being exceptions.

All of the other big European single-aisle fleets – easyJet, all five mainline Lufthansa Group carriers, Wizzair, Air France, SAS, Finnair, TAP Portugal, Italy's ITA, Volotea, Pegasus, Aegean, and IAG carriers British Airways, Iberia, Vueling and Aer Lingus – are A320 family jets. Additionally, Turkish Airlines operates nearly as many A320 family aircraft as it does 737s.

Elsewhere in the world, particularly in China and the Asia Pacific region, the in-service balance between the two single-aisle jet families is more even, though most South American, Central American and Mexican carriers have tended to prefer A320 family jets for the past two decades.

While to date the second-generation A320 family, the A320neo family, has handily outsold the rival Boeing 737 MAX family for various well-publicised reasons, the fact remains that Boeing's 737 MAX orderbook is still well-stuffed with approximately 5,000 examples sold, the vast bulk of which are yet to be delivered.

Reactivations of stored 737NGs

While most customers to date particularly have preferred to order the A321neo stretch over the rival 737 MAX 10, it seems many lessors are preferring to reactivate their parked 737NGs – particularly 737-800s – over their parked A320s as the world's air transport industry gradually recovers from the unprecedented traffic slump caused by the Covid-19 crisis. This is having implications for the Boeing 737 MRO market, according to Žilvinas Lapinskas, CEO of Vilnius-headquartered MRO company FL Technics.

Its lessor customers are asking FL Technics, which is storing more than 40 commercial aircraft for their owners as a result of the pandemic, to reactivate Boeing 737NGs for two reasons, according to Lapinskas. One is to put the aircraft directly back into passenger service and the



5K

Boeing's 737 MAX orderbook is well-stuffed with approximately 5,000 examples sold, the vast bulk of which are yet to be delivered



1. FL Technics serves both passenger and cargo aircraft operators, whose maintenance requirements alternate conveniently throughout the year
 2. The company's CEO Žilvinas Lapinskas

The 737NG's ubiquity will continue to make it a staple for MROs

other is to take advantage of what all in the industry agree is a hot market for freighter conversions of older 737-800s, and reactivate the aircraft so they can be converted, he says.

Initially stimulated by a strong increase in online shopping during the Covid-19 crisis, air cargo demand will remain high for the foreseeable future, says Lapinskas. While the pandemic led the e-commerce industry to grow globally for two years at several times what would otherwise have been its natural rate, that much higher new norm of online retail activity is the new baseline for e-commerce's future growth. As a result, demand for air cargo services and for conversions of single-aisle aircraft to carry that cargo will stay strong, he says.

One reason for lessors' current preference for reactivating stored 737-800s rather than stored A320s may lie in the type's structural resilience. Scott Butler, chief commercial officer of Ascent Aviation Services, says that because of Boeing's decision not to "reinvent the

wheel" in design terms for the 737NG compared to the CFM56-3-powered second 737 generation (the 737-300/400/500 models), the 737NG is "a very resilient aircraft and seems to age longer and better than the

Airbus competitor", in Ascent's experience of maintaining the two families.

This may be one reason why the 737-800 has proved and continues to be a popular candidate for conversion of older examples from passenger to freighter configuration. Published in its March 2022 'IBA Advisory Monthly Newsletter', an IBA Group analysis of market values for half-life, 10-year-old Boeing 737-800s and A320neos indicates market values for such 737-800s are at least US\$3.8 million higher than comparable A320s. In part, the difference lies in the 737-800's popularity for freighter feedstock – and also the fact fewer 737-800s are available in the market than A320s, according to IBA Group.

Reactivations strain MRO capacity

Paul Dolan, CEO of Aviation Technical Services (ATS, a major provider of 737 airframe MRO for several big North American 737 operators), says the mass reactivation of aircraft – many 737NGs among them – after more than a year



in storage is creating additional strain on maintenance capacity for a North American MRO market which is already capacity constrained because of reduced labour levels.

When the Covid-19 crisis created a devastating slump in passenger-traffic levels, airlines scrambled to cut costs in whatever ways they could as they fought to stay in business. One of the first major areas of cost-cutting they identified was to defer as much scheduled maintenance as possible on the aircraft they kept in service. Meanwhile, the airlines' moves to park hundreds of temporarily unneeded jets took the MRO business on those aircraft away from MRO facilities as well.

This created cost crises for various MRO facilities. (ATS was not one of them, its balance sheet allowing the company to invest for future growth even in the depths of the pandemic). One of the most obvious and most direct ways

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"AMOS, which is already used as a standard tool by many LH group airlines, will also help us at Lufthansa to make our Technical Fleet Management processes even more transparent and, above all, even more efficient. Among other things, we are relying on the already very broad AMOS know-how of our sister companies. We chose AMOS because of its 30 years of success in the industry, but also because of its continuous product innovations, which help us to establish state-of-the-art processes in Technical Fleet Management at Lufthansa as well."

says CEO Lufthansa German Airlines
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1. Many lessors are preferring to reactivate their parked 737NGs over their parked A320s
2. The 737NG is "a very resilient aircraft" that ages well

1

The forecast conversions of 737-800s will create a capacity crunch for MROs

MRO facilities could reduce their own costs enough to stay in business was immediately to cut their own staffing levels to levels consummate with the much lower levels of MRO business coming into their shops.

Intensifying the strain on North American MRO facilities' capacity even further is the fact that many of the aircraft reactivations being carried out are also involving transitions of leased or owned aircraft from one operator to another, according to Dolan. Not only are MRO facilities having to perform the reactivations of aircraft, and also the maintenance check each reactivated aircraft requires, but in many cases they are also having to install new cabin interiors and/or to repaint aircraft in new liveries. "This is putting a lot of strain on MRO capacity, not just for next year but for years to come," he says.

737NGs dominant

Butler, Lapinskas and Dolan agree that the Boeing 737NG family will dominate the overall 737 family MRO landscape for anywhere from the next six to ten years. This is due to the fact that most in-service 737 MAX jets are very young: the first 737 MAX was delivered to a customer in the summer of 2017 and none

have yet aged to the six-year point at which the 737 MAX requires its first major 'C' or 'six-year' check, according to Dolan. Additionally, thousands of 737NGs (a handful of 737-600s, many hundreds of 737-700s, thousands of 737-800s

and hundreds of 737-900s) remain in service, far more than the numbers of 737 MAXs there will be in service for much of the next decade.

While a substantial number of those 737NGs have yet to see their first major 'C' check, let alone their first heavy 'D' check, the 737NG family's ubiquity in service since the late 1990s will continue to make it the 737 family staple for MRO facilities for some considerable time yet. "I think it's going to be six to ten years before the MAX begins to displace the NG in any meaningful way" in terms of the MRO capacity the family will require, says Dolan.

The nearly two-year global grounding of the 737 MAX and the concomitant cessation of all new MAX deliveries throughout that period has only intensified the requirement for 737NG MRO capacity for the next few years, according to Butler. Being unable to take delivery of the new 737 MAX jets they had on order "forced people to fly their 737NGs longer and harder" than originally planned, he says.

Keeping older 737NGs in passenger service made operators "spend more and do more costly later-year checks than they would have done", he says. "Otherwise they would have sent them for conversion or teardown."

MRO implications of 737NG freighter conversions

The strong market move to convert older Boeing 737-800s into freighters – and increasingly other 737NGs too, with 737-700 conversion programmes recently appearing – has its own major implications for MRO market capacity, according to Lapinskas.

Every 737NG being inducted for conversion spends several months on a conversion line at an MRO facility and the numbers of such lines are growing, potentially reducing MRO capacity for scheduled maintenance checks and unscheduled maintenance.

Additionally, in almost every case, an aircraft inducted for conversion also undergoes a heavy scheduled maintenance check as the conversion is



Photo: Annette Fassel/Ascend Aviation Services

2

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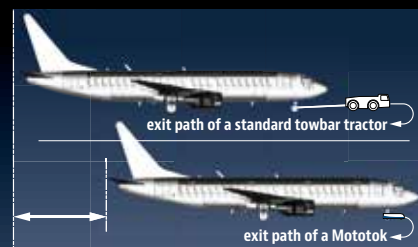
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The forecast conversions of potentially 1,000 or more 737-800s will create a capacity crunch for MRO facilities in North America and elsewhere, according to Butler. Those aircraft are not being taken out of the MRO market, he says. They are merely being replaced in passenger service by newer aircraft (in many cases Boeing 737 MAXs) and ultimately both the converted aircraft – their economic lives now extended from 20 to 40 years – and their passenger-carrying replacements will require scheduled maintenance. There will be increased demand for MRO capacity and in North America that will result in the newly converted freighters “creating an even bigger crunch for narrowbody MRO capacity that isn’t there”, says Butler.

The growing market for freighter conversions of Boeing 737NGs and their Airbus equivalents (particularly the A321ceo and A320ceo) is likely to provide many MRO facilities with increased business in years to come.

It certainly has strong potential business implications for ATS, FL Technics and Ascent Aviation Services. “We are already doing maintenance on [737-800 freighters] now, both at our Kansas City and our Everett facilities,” says Dolan. “It will be a big part of what we do in the future. It’s only just begun to be a significant part of



Photo: Annette Feasel/Ascent Aviation Services

1

Getting parts for 737 Classics is not getting easier as they age

what we do, but it’s going to be a big market. The [maintenance] checks are still the same, apart from the interiors. And it’s also something we like a lot, because it’s counter-seasonal.”

What Dolan means, and as FL Technics – most of whose 737 MRO work is on freighter-converted 737-400s and 737-300s for four Europe-based cargo operators – has long known, is that although in Europe and North America the summer months are the year’s peak passenger traffic months, the winter months are the strongest for e-commerce-driven cargo traffic. As a result, says Lapinskas, the passenger and cargo aircraft operators’ maintenance requirements alternate conveniently to spread FL Technics’ MRO facilities’ workloads evenly throughout the year.

While Dolan says ATS does not intend to venture into the freighter conversion market, but only to provide MRO for the operators of converted aircraft, FL Technics is very interested in entering the conversion market. “We will do cargo conversions in the future,” says Lapinskas. FL Technics is studying the market closely and awaiting the right opportunity to join the fray – a step which might not be far distant given that, anecdotally, reports suggest all the induction slots in existing 737-800 conversion lines are booked for the next seven to eight years.

For its part, Ascent Aviation Services has already partnered with Sine Draco

(which is providing the supplemental type certificate) to convert A321ceos into A321SDFs. Ascent is also contracted to perform a scheduled heavy maintenance check on each A321 inducted for conversion. The first A321

is already in work at Ascent’s initial conversion line at Tucson International Airport and Butler says the company is looking to increase the number of conversion lines it operates to be able to handle up to 10 A321 conversions a year within four years. Additionally, says Butler, Ascent will also consider opening a 737-800 conversion line, given the opportunity to partner with a suitable STC holder.

737 ‘Classics’ not forgotten

In judging when the 737NG family might eventually cede its current domination of the 737 MRO market, maintenance facilities are well aware that forecasts as far back as 2013 that the first CFM56-powered 737 generation (the 737/300/400/500, the second 737 generation overall) would at that point soon see its operational demise were comprehensively proved wrong. Nowadays CFM56-3 powered 737s are widely referred to in the industry as ‘737 Classics’, where formerly the first 737 generation – the 737-100, 737-200 and 737-200A, of which very few now remain in service – were known by that sobriquet.

Mainly saved by the first major wave of narrowbody freighter conversions, in part to serve the growing e-commerce market, many 737-300s and 737-400s continue today to operate fruitful commercial lives on a daily basis as freighters. The 737-300F mainly flies in developing and emerging markets



Photo: Annette Feasel/Ascent Aviation Services

2



3

such as Indonesia, Brazil and Mexico and the 737-400F mainly operates in North America and Europe.

While Dolan says ATS sees virtually no 737 Classics in its maintenance shops today and Butler says Ascent sees only one or two a year, maintaining the 737-400Fs of customers Swiftair, ASL Airlines, West Atlantic and Cargoair is FL Technics' main 737 MRO activity at present. The company's MRO shop and mechanics at Vilnius specialise in 737 Classics, many of the mechanics having worked on the Classic 737 models since 1992, when FL Technics inducted its first 737 Classic for maintenance. As a result FL Technics is particularly qualified to comment on how the MRO market for 737 Classics compares with the MRO market for the 737NG.

"Checks are becoming fewer and fewer on 737 Classics as they become older and older, and getting parts is not getting easier," says Lapinskas. "The response from Boeing is much faster for the NG than for Classics and the NG is supported better than the Classics. Support from the OEM is becoming more and more important, particularly regarding

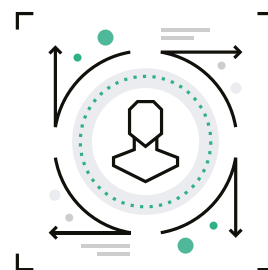
structural defects in Classics. We wait a long time for a response from Boeing. The aircraft blocks the bay and takes a long time to repair. Zero-stress repairs mean sometimes only a few people can work on the aircraft and so the bills are high. Checks are becoming more and more complicated, and this will be a game-changer."

Eventually these market forces will put all remaining 737 Classics out of service, Lapinskas says, and they will be fully replaced by 737NGs. However, that day is still some way off, and many 737-400s and 737-300s will continue to provide sterling service as freighters for some years yet.

One day, diminishing support from the OEM and other market forces may put all 737NGs out of service too, to be fully replaced by 737 MAXs and other jets. But given that many more 737NGs than 737-300s and 737-400s will be converted to freighters – most forecasts say 800-1,200 737-800s will undergo conversion – the replacement process could well be more gradual than that experienced by the 737 Classics. Clearly, final replacement of all 737NGs now in civilian service is 20-25 years away, at a minimum. **Q**

737 MAINTENANCE

1. Ascent Aviation Services is able to perform all levels of maintenance visits – from quick turn A-checks to C- and D-checks
2. The company has completed more than 600 heavy maintenance visits for a range of aircraft platforms
3. The 737-900ER is the largest variant of the 737NG generation



3.8m

An IBA Group analysis of market values for half-life, 10-year-old Boeing 737-800s and A320neos indicates market values for such 737-800s are at least US\$3.8 million higher than they are for comparable A320s

1,000

The forecast conversions of potentially 1,000 or more 737-800s will create a capacity crunch for MRO facilities in North America and elsewhere

25

Given that many more 737NGs than 737-300s and 737-400s will be converted to freighters, final replacement of all 737NGs now in service is at least 20-25 years away

EXPANDING REACH

As an independent aerospace service provider, Fokker Services is expert in component MRO across many aircraft. We spoke to Fokker Services Americas' managing director **Craig Winter** about what it takes to maintain the 737 family

MRO Management: What is Fokker Services' 737 maintenance strategy?

Craig Winter: Our vision with Boeing 737 maintenance is to expand our reach through the different aircraft variants, supporting legacy to modern 737 aircraft. From the 737 Classic to the 737NG and 737 MAX, today we serve all these platforms with our ever-expanding component repair capabilities, which enable us in our strategy to move to full nose-to-tail platform support of the 737NG.

To enhance the development of our in-house avionics, power generation and pneumatics repair capabilities, we analyse our current capabilities to see where key learnings can be transferred to new solutions. For example, we have supported Boeing 737NG CFM56 engine accessories for years. When we began designing new capabilities for the LEAP, we applied our extensive operations and engineering experience from the CFM56. The LEAP platform is another step on this journey to continuously evolve our capabilities and technology together.

In-house technology provides benefits such as fast turnaround times

Another important element is our partnerships with major OEMs. Last year we signed a ten-year repair license agreement with Honeywell Aerospace for LEAP engine accessories and line replaceable units (LRUs) that is, amongst others, the engine on the 737 MAX. As an authorised service centre and warranty repair station, we have access to the latest data and technology to support these advanced components well into the future as a leading engine accessories maintenance centre.

What are the main trends and technologies in use, and is there anything in these areas that differentiates 737 maintenance?

As we support hydraulics, pneumatics, power generation, avionics and more, we constantly see new technological developments across these different areas. By investing in new technology, we offer customers reliable solutions no matter which aircraft they operate. For example, we have an electric test stand for IDG electric testing, as well as flying probe and x-ray inspections for circuit board repairs.

The newest addition to our LaGrange facility in the US is our fully automated twin wire electric arc spray; it uses a robotic arm to apply thermal

spray coatings, which allows us to manage the entire component restoration process in-house for hundreds of part numbers including Boeing 737 pneumatic valves and engine accessories. All this in-house technology provides many benefits,

including fast turnaround times for our customers.

How do you see the current state and future of the 737 maintenance market?

Due to the disruptions caused by Covid-19 there is pent up demand for maintenance support. Over the next couple of years capacity at repair centres will likely be constrained. As we have all experienced, as well as the influx of demand, aerospace global supply chains are struggling to recover from these disruptions.

With rising oil prices and high demand for passenger to freighter conversions to support cargo operations, airlines are putting heavy emphasis on utilising 737NGs while rapidly on-boarding the MAX. Accordingly, our component MRO operations also focus on 737NG support while preparing for the shift to the MAX as those aircraft come out of warranty.

In Spring 2021, we began preparation for this forecasted increase in demand by investing in maintenance technology and increasing our inventory to minimise supply chain issues where possible. As a result, we are ready to support a wide range of components on the 737 platform, and we are particularly well positioned for the ramp up of CFM56 and LEAP engine accessories from global engine MROs as well as operators worldwide. **M**

1. The fully automated twin wire electric arc spray uses a robotic arm to apply thermal spray coatings
2. Fokker Services is committed to investing in new technologies



1



2

AIRCRAFT INTERIORS EXPO (AIX) RETURNS FOR 2022

Registration opens for the world's leading event for airlines and the cabin supply chain

After a long-anticipated wait, Aircraft Interiors Expo (AIX), the destination for the cabin interiors industry, will return to Hamburg, Germany, from 14-16 June 2022 for its first physical event in three years.

The leading event for airlines and the cabin supply chain will welcome more than 400 aviation suppliers this June, with confirmed exhibitors including major OEMs, Boeing and Airbus, as well as industry stalwarts such as Safran, Stelia Aerospace, Diehl Aviation, Jamco Corporation, Collins Aerospace, Lufthansa Technik, STG Aerospace, Sabeti Wain Aerospace, MGR Foamtex, Tapis Corporation and Recaro, who will demonstrate the emerging innovations that are fuelling the aviation industry's recovery.

In addition, the event's popular In-flight Entertainment and Connectivity (IFEC) Zone returns to offer attendees a chance to gain insights into the most up-to-date



2

“There will be innovative products, ideas and solutions; along with networking opportunities”

technology solutions covering everything from servers to OTT systems, and 5G to VR from the likes of Astronics, Thales and Panasonic Avionics Corporation.

Also returning is the popular, free-to-attend CabinSpace LIVE Seminar Theatre, which will welcome cabin interior leaders to inspire and debate current market trends and challenges.

The carefully curated programme will include an industry market outlook from Cirium, Business Aviation panels and insights from innovative start-ups. The theatre will also play host to the winners of the 15th Crystal Cabin Awards – the only international awards for excellence in aircraft interior innovation, recognising and honouring the very best innovations for the



3



PARTNERSHIP

aircraft cabin, spanning eight categories including Cabin Concepts, Cabin Systems and Health & Safety.

Attendees can also join the Passenger Experience Conference, which returns on Monday, 13 June 2022. It is set to welcome renowned and acclaimed global aviation leaders, allowing attendees to learn more about how the industry will be building back differently through a wide range of topics from the growing importance of intermodal travel, rapid digitalisation, and sustainability.

To assist attendees, for the first time, organisers have introduced AIX Connect, a tool that will enable attendees to assemble a list of meetings ahead of the show. The programme will help key airline buyers meet exhibitors during the show, to build connections and discuss new projects.

Polly Magraw, event director, commented: “After three years, we’re excited to bring the entire industry together again and offer attendees the widest range of innovative products, ideas and solutions, as well as facilitate the much-needed networking and sourcing opportunities for our industry.”

Aircraft Interiors Expo (AIX) returns to the Hamburg Messe from 14-16 June 2022, co-located with the World Travel Catering & Onboard Services Expo and Passenger Experience Conference.

For more information and to register to attend, visit the Aircraft Interiors Expo website. [W](#)

1. Aircraft Interiors Expo returns for its first physical event in three years

2. Emerging innovations will be demonstrated at the event

3. Airline buyers and exhibitors will be able to connect

RECRUITMENT SOLUTIONS

JMC Group's *France Caissy* discusses how she will grow the company's business in North America in light of a shortfall in maintenance technicians

An established sales and operations aerospace professional, France Caissy has 30 years of experience in human capital roles, including the last 15 years with a leading aviation industry staffing company in North America, exclusively assigned to a prominent aerospace manufacturer. In July 2021 she joined aviation services talent recruiter JMC Group to lead the company's North America operation.

Here, she discusses JMC Group's – and her own – evolving role in the market, and the various challenges that a shortage of qualified aviation technicians in the industry presents.

❶ Could you outline your role at JMC Group and the company's main areas of focus?

A I am tasked with managing and growing JMC's business in North America, and am responsible for the overall management and delivery of



“We work closely with the employer as an aviation services specialist”

services with JMC customers across the region. My remit also covers developing strategies and providing innovative solutions to clients.

I started here in a perfect storm – in the teeth of a pandemic. Prior to Covid-19 we were already experiencing a big shortage of qualified aviation technicians leaving their roles through redundancy and early retirement. Many technical services' personnel and engineers decided not to return to the workforce. Others chose to abandon aviation for new careers. This has given us a challenge, but aviation is very cyclical and we are starting to see an upturn again.

❷ Why did the business establish in North America?

A Canada, especially Montreal, is the third-largest aviation hub in the world for aviation, aerospace and defence. Strategically, opening in Canada gives JMC the opportunity to further build on its reputation in the UK and Europe.

❸ What differentiates JMC's offering over its competitors?

The key to JMC's success lies in its commitment to its people, contractors, clients and candidates. It's all about building long-term relationships. We understand that when a customer is selecting a partner to support them with a staffing need, there are a variety of providers to choose from. We are never complacent. Our goal is to build on our proven track record in Europe and become a trusted market leader in staffing solutions in North America.

Our portfolio of solutions is diverse. Building on two decades of activity and expertise of putting aviation services personnel in jobs – from offices in the south west of the UK, Malta, Budapest and Sofia – we work closely with the employer, advising on typical rates and fees, as an aviation services specialist.

JMC has been especially active redeploying employees who left their regular jobs owing to the pandemic. Identifying abilities and strengths in candidates is a key added value, customers tell us.

❹ How did you get into aviation and how is your experience helping you in your current role?

A Throughout my career I worked in IT staffing. The company I was supporting responded to an RFP from Bombardier Aerospace and as the only French speaker in the company I was invited to get involved. We won the work 12 months later and the client asked me to take the lead. This led to a long and rewarding relationship providing technicians/engineers and management in Montreal and Toronto; eventually expanding support client sites in the USA.



1. France Caissy joined aviation services recruiter JMC Group in July 2021
2. In Canada and the US, apprenticeships are growing in popularity
3. If you are not learning you are not moving forward, says Caissy

“There is something hugely rewarding about helping put an aircraft into the air”



3

We found personnel to work on the Dash 8, CRJ, CSeries and business jet family – and helped place thousands of talented people into a new career. My 15 years with this specific client is one of my proudest professional achievements.

We supported the whole journey of the CSeries – culminating in tears of joy when the aircraft made its maiden flight. The director of that programme became one of my mentors and the great teamwork between our client and my team to ensure the delivery of the right manpower was exceptional.

Q What is the best business advice you have ever been given?

A As you grow in confidence so your goals and advice will evolve. Failure is a gift and you can learn from it – and if you are not learning you are not moving forward. From every decision, there is something to learn. I often say to the people around me we all have the potential to be great.

I always try to tap into the ‘why’, because it keeps you focused. Show up – don’t just walk in, take ownership and smile. Many incredible people have been in my path – both men and women, but it’s mostly the women I have admired

for their leadership and their extra grit. Strong quality relationships with clients and a focused internal team are essential for a successful partnership.

Q How did the Covid-19 crisis impact on your work?

A Like many of us, the pandemic had a huge impact on how we conducted business. From travelling weekly to working at home, Canada had some of the strictest mandated restrictions during the crisis. We turned to Microsoft Teams and Zoom for internal and client meetings. Travel restrictions and reduced airline timetables made travel difficult. Most Canadian events were either cancelled or went virtual.

MRO Europe in Amsterdam [held in October 2021] was a big success and meeting new colleagues face to face after such a long time was rewarding. It also led to a solid business lead we are now in regular contact with. As we head to the MRO Americas show in Dallas, we are pleased to have just added to the team with a new recruiter, Patrick Ramsay.

Q Given your expertise in recruitment, what advice would you give to a young person getting into aviation?

A Regardless of the role you pursue – and in aviation, the choice is vast, from administration and HR to working directly on an aircraft – it’s a sector that people will quickly get hooked on and take pride in. There is something hugely rewarding about helping put an aircraft into the air. Whatever role you do, embrace it and take pride in it. There are multiple opportunities to explore and a raft of entry-level pathways.

The good news is apprenticeships are returning. They are an excellent way for students to gain experience, learn the culture of the employer, enjoy on-the-job training, and get paid too. In Canada and the US, apprenticeships are growing in popularity and they are being supported by the governments there.

I am pleased to be a member of the Canadian Mobility and Aerospace Institute (CMAI). CMAI works to ensure Canada is a world-class leader in the attraction, development and retention of the highest quality workforce talent from Canada abroad. It’s a very helpful association for trade schools advising on careers in aviation to university. JMC is looking forward to doing more with them this year. **Q**





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Julie Dickerson
Chief Executive Officer

SES Fly Certain



GEARED FOR SUCCESS

1. Pratt & Whitney spent approximately US\$10 billion over two decades to develop the GTF engine



The Pratt & Whitney GTF programme is being as innovative as the technology which created the engine itself, as *Bernie Baldwin* reports

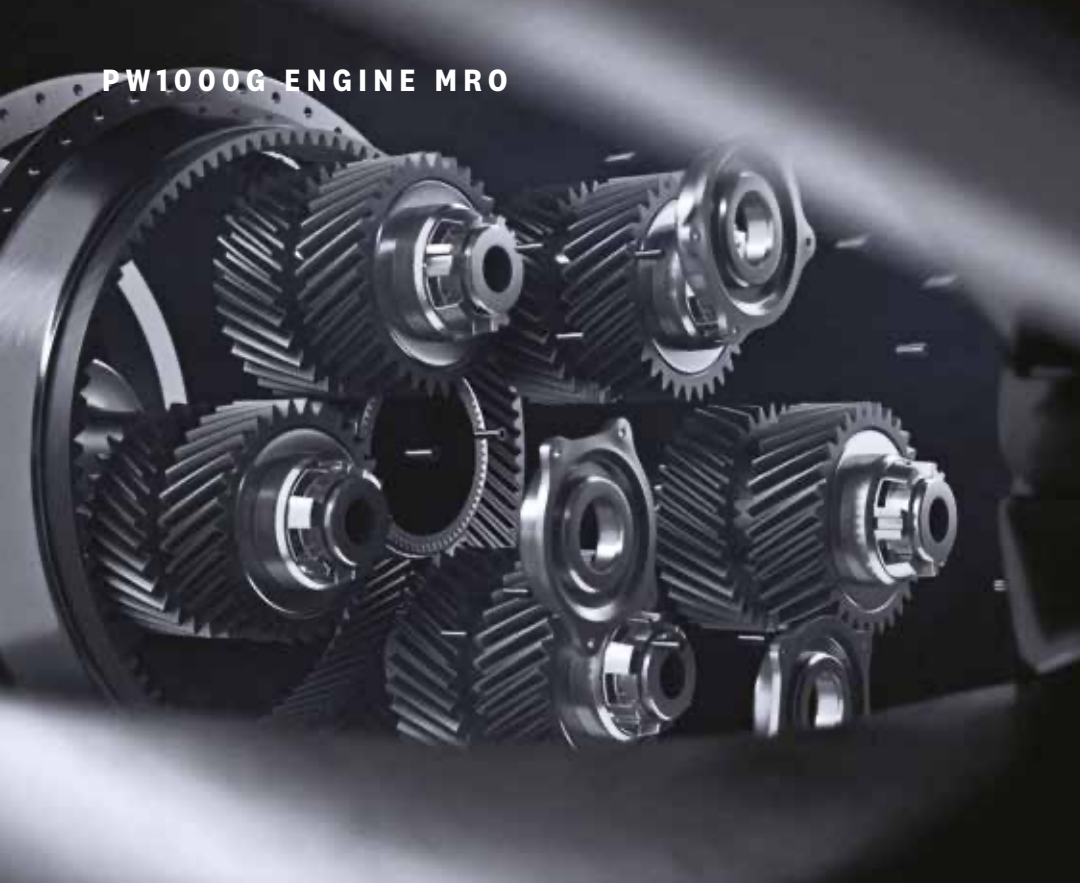
It's hard to believe that October this year will mark the 15th anniversary of the first selection for an aircraft programme of the Pratt & Whitney Geared Turbofan (GTF) engine. It was then that Mitsubishi chose the engine for its regional jet (MRJ) family.

Times change, of course, and the likelihood of GTF-powered Mitsubishi SpaceJets (as the aircraft have since been rebranded) ever entering revenue service seems slim – indeed, the OEM no longer has any mention of the Japanese aircraft's planned PW1200G on its GTF fact sheet. However, that selection in 2007 will remain an important milestone in GTF history.

In the intervening period, GTF engines have garnered more than 10,000 orders and commitments from over 80 customers around the world. And while, yes, the engines for each aircraft programme have their own official designation (see box on p51), the industry and Pratt & Whitney itself have come to refer to them by the initialism which technologically sets them apart from other commercial powerplants.

Operationally, 2016 was a landmark year for the GTF. It entered service on an Airbus A320neo operated by Lufthansa in January that year, before the first Bombardier CS100 (now Airbus A220-100) began commercial service on 15 July. To finish off the year, the first CS300 (now A220-300) was put into service by airBaltic on 14 December 2016.

“AN AVERAGE TWO-HOUR FLIGHT FOR A GEARED TURBOFAN ENGINE GENERATES ABOUT 4 MILLION DATA POINTS”



1. Key to the geared turbofan is the fan drive gear which uncouples the fan from the low-pressure compressor and the low-pressure turbine, which drives the fan
 2. There are currently ten active GTF MRO engine centres worldwide
- Photo: MTU Maintenance

1

With six years of service now under its belt, new repairs continue to be introduced for the maintenance of GTFs. Pratt & Whitney's executive director, GTF engine aftermarket Marc Meredith outlines the company's MRO strategy for the family. "Having entered service in 2016, the GTF engine is still relatively young and its configuration and associated repair portfolio continue to mature," he says. "We see the evolution of GTF engine maintenance proceeding on two parallel tracks.

"Currently, through our network of global MRO providers, we are focusing our efforts on targeted upgrades and retrofits to existing hardware designed to improve performance and extend time-on-wing.

"At the same time, we are constantly evaluating potential repairs that could extend the engine's life cycle and decrease the overall cost of ownership to our customers in the future.

"As the GTF fleet grows, we continue to add capacity and expand the GTF MRO network, which is comprised of the industry's leading service providers. There are currently ten active GTF MRO engine centres worldwide. [As we went to press, Pratt & Whitney announced that SR Technics would be joining the GTF MRO Network, serving PW1000G-JM engines for the A320neo family with full disassembly, assembly and test capability.] Supplementing the shop work, our Pratt & Whitney Line Maintenance Services team travels globally providing the highest level of technical support and issue mitigation."

Meredith highlights Pratt & Whitney's close relationships with its customers as a major factor in being able to provide good visibility around forecasting and scheduling maintenance. "This played a key role when we had to tailor maintenance strategies to the realities of the pandemic," he explains. "For example, with many aircraft inactive during the pandemic, we had a window of opportunity to incorporate planned upgrades into the GTF fleet. Rather than slow down MRO activity, we accelerated upgrades and restored the fleet to full readiness in anticipation of the recovery."

2016 WAS A LANDMARK YEAR FOR THE GTF AS IT ENTERED SERVICE ON AN AIRBUS A320NEO

2



The aftermarket is arguably the part of the industry where one can assess the true qualities of a company. When things do not go straightforwardly, which is often the case with new technology – and the GTF brought the industry a significant amount of that – a company's response and its customer support are hugely important.

In 2019, P&W took the decision to reduce the life limits on the high-pressure compressor (HPC) front hubs of the PW1500G and PW1900G models due to corrosion effects. The company then put the affected engines through a rectification process to overcome the problem, as Meredith recalls.



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1

“The August 2021 FAA airworthiness directive made mandatory Pratt & Whitney guidance to operators of PW1500G and PW1900G engines requiring replacement of the HPC front hub and HPC rotor shaft with redesigned hardware at the next regularly scheduled shop visit. The replacement with redesigned hardware ensures that these engines now have increased durability and remain within applicable limits,” he confirms.

The key to the engine family is, of course, the geared turbofan itself. Central to this is the fan drive gear system (FDGS) which uncouples the fan from the low-pressure compressor (LPC) as well as the low-pressure turbine (LPT), which

drives the fan. As a result, the fan rotates at a lower speed while the LPC and LPT each rotate much faster. This means that the fan pressure ratios are lower and the bypass ratios much higher and all components can achieve their respective optimum speeds, which improves the engine’s overall efficiency considerably.

The GTF took some years to refine and bring to the market. While some competitors looked at the technology and rejected it, P&W pushed ahead with great belief in its benefits.

“We spent approximately US\$10 billion over two decades to develop the GTF engine,” Meredith points out. “Now, with more than 11 million flight hours

of experience, we are a generation ahead of our competitors in understanding and perfecting the geared architecture. In the pre-launch days of the GTF, the FDGS was considered a significant step change by industry experts. And, as is often the case with a revolutionary new technology, there were some teething

issues,” he confirms, before adding that the FDGS “is exceeding expectations and is the foundation of our engines – and is clearly the architecture of the future”.

While the well-maintained engine delivers operational savings, further cost reductions can be achieved by ensuring that expensive problem-causing events do not occur. Thus, as is common nowadays, predictive maintenance methods are applied to the GTF family as part of the OEM’s ‘EngineWise’ portfolio to reduce downtime.

“EngineWise Data by ADEM (Advanced Diagnostics and Engine Monitoring) allows us to manage customers’ engine health and maintenance planning requirements, working to maximise each customer’s specific engine performance and engine time on-wing, while maintaining predictable MRO spend,” Meredith reports. “Our system currently provides analysis for more than 9,500 in-service engines. Our latest GTF series of engines generates about 40 per cent more data than the V2500 family of engines. An average two-hour flight for a GTF engine generates about four million data points.”

“THE FAN DRIVE GEAR SYSTEM IS EXCEEDING EXPECTATIONS AND IS CLEARLY THE ARCHITECTURE OF THE FUTURE”

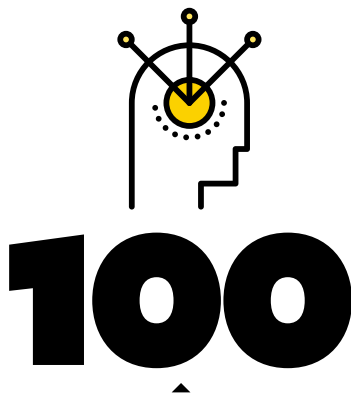
1. GTF engines have garnered more than 10,000 orders and commitments from more than 80 customers around the world

2. The PW1900G powers the Embraer E190-E2 and E195-E2

Photo: Embraer

He continues: "Through our EngineWise solutions, customers of our GTF engines, V2500 and mature commercial engines benefit from our engineers who harness the power of data to project trends and pinpoint anomalies. Ultimately this helps operators to reduce operational disruption through predictive and preventative maintenance. We also transparently share insights or data trends with each customer through an engine health management application within 'EngineWise Connect', our customer portal. This application allows customers to review the history of the engines they have under contract with us and gives them a complete picture of their health. In addition to the digital interface, each customer has an analyst assigned to them who monitors the engines and provides personalised service. This individual oversight and monitoring is performed around the clock to support our customers worldwide."

Returning to the global network of facilities where GTF engines can undergo maintenance, repair and overhaul, one of the key partners is MTU Maintenance. The company, whose parent MTU Aero



MTU Maintenance Zhuhai has strong growth plans and held a groundbreaking ceremony in mid-March 2022 to start the construction of a new training centre, where it plans – from early 2023 – to train up to 100 engine technicians for the company every year



2

Engines has an 18 per cent stake in the PW1100G-JM programme for the Airbus A320neo family, and which assembles one third of all such engines, has its own site in Hannover, Germany plus joint ventures elsewhere. In fact, MTU Maintenance Zhuhai – which is a joint venture between MTU Aero Engines and China Southern Airlines Company – is relatively new to GTF maintenance and has just recently completed its first engine. The JV has strong growth plans and to support those it held a groundbreaking ceremony in mid-March 2022 to start the construction of a new training centre, where it plans – from early 2023 – to train up to 100 engine technicians for the company every year.

MTU also has an MRO joint venture with Lufthansa Technik for GTF maintenance services which is based in Jasionka, Poland. EME Aero began operations in January 2020, with a planned annual capacity of more than 450 shop visits of geared turbofans by 2026. It began with work on PW1100G-JM engines, added the capability for PW1500G engines in September 2021, and aims to be certified to maintain PW1900G engines in the near future.

Meredith clearly sees these facilities and others as a differentiating factor in the company's aftermarket offering. "The GTF MRO network is part of Pratt & Whitney's EngineWise solutions portfolio, which provides engine operators with a variety of aftermarket services to maximise engine performance and fleet availability. Our network is designed

PW1000G ENGINE MRO

THE GTF FAMILY

PW1100G-JM

powers the Airbus A320neo family

PW1400G

designed to power the Irkut MC-21; unlikely to enter service following Russia's invasion of Ukraine

PW1500G

powers the Airbus A220 family

PW1700G

designed to power the Embraer E175-E2; entry into service now expected in 2027

PW1900G

powers the Embraer E190-E2 and E195-E2

to meet the needs of our customers," he emphasises. "We are focused on setting up a network that delivers the highest level of service and value to our customers and ensuring there's sufficient capacity to support the fleet."

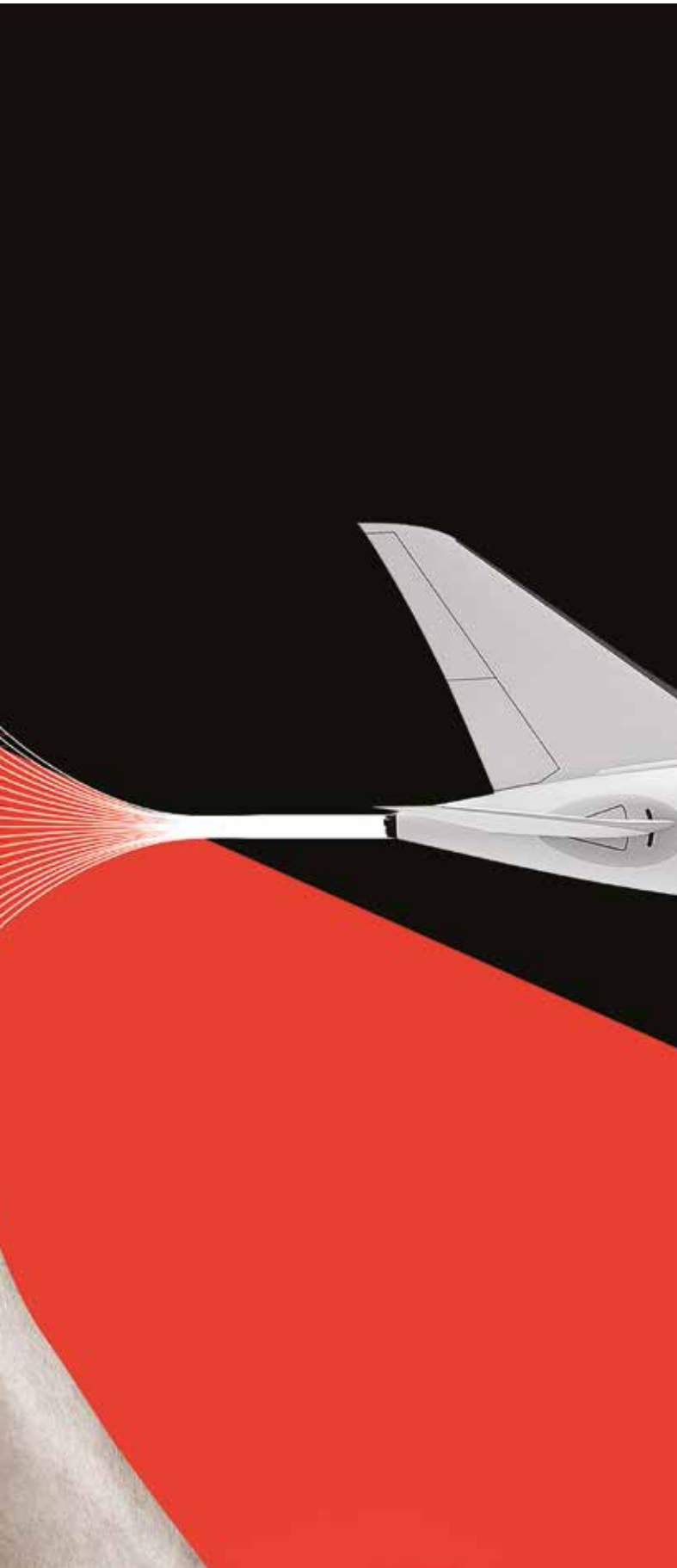
While the Mitsubishi aircraft programme that helped the GTF programme on its way may have drifted away, the aftermarket plans mean that the engine family will be a force for many years to come. 

ESSENTIAL



INTERFACE

Maintenance planning and scheduling software has developed in recent times to better account for the interface between the CAMO and the MRO, enhancing efficiency and safety, says *Mario Pierobon*



Illustrations: Phil Couzens

The interface between the continuing airworthiness management organisation (CAMO) and the maintenance, repair and overhaul (MRO) company is a critical one to ensure the efficiency and safety of both airworthiness management and maintenance operations. Lately, maintenance planning and scheduling software has developed to better facilitate the interface between the CAMO and the MRO.

According to Daniel Tautges and Shaun Polley, respectively senior vice president and senior sales and implementation engineer at Component Control (developer of the 'Quantum Control' ERP software), the integration between CAMO and MRO is essential. "A link between the two areas reduces the risk for data entry areas and provides the ability to accurately forecast maintenance and analyse trends," they say.

Swiss AviationSoftware's (Swiss-AS) product owner Ana Malešević comments: "With CAMO being responsible to keep the aircraft airworthy and the MRO performing the maintenance on the aircraft, it is of great importance that these two major elements of the continuing airworthiness concept have a fast, reliable and effective way of ensuring safe operations."

The CAMO-MRO arrangements foresee that the CAMO side schedules maintenance and then the MRO side is responsible for executing it, highlights Dave Purfurst, global pre-sales director at Rusada. "The MRO side in return also discovers unscheduled maintenance, which is reported back to the CAMO side, who then instruct whether to perform or defer," he says. "The data collected by both sides helps the other



1. Software that handles CAMO activities and MRO maintenance is crucial for many aviation operations
2. WinAir has both CAMO and MRO products built into its software

1

THE EXCHANGE OF DATA BETWEEN OPERATORS AND THIRD-PARTY MROS HAS ROOM FOR IMPROVEMENT

work more accurately and efficiently, so it really is a two-way relationship where neither side can successfully operate without talking to the other.”

As one of the most complex industries where any discrepancy can directly impact flight safety as well as financial aspects, it is not surprising that aviation is also one of the most technology intensive sectors, observes Malešević. “AMOS software helps users by simplifying their CAMO and MRO processes through high level integration by bringing transparency and quality of work to the highest level for both organisations, all while reducing costs and supporting optimisation of available resources,” she says.

Indeed, software that handles CAMO activities and MRO maintenance is crucial for many aviation operations, according to Emilio Castro, product

specialist at WinAir. “Our software handles CAMO and MRO maintenance tasks in a single software solution that seamlessly interfaces and transmits data in one product,” he says. “When one is operating with a fleet of aircraft, one requires information at their fingertips, which is why managing maintenance records on spreadsheets does not meet the threshold for what can be considered ease-of-access.

“Without a CAMO-MRO interface, there is a high likelihood that the business will expend significant time tracking and managing maintenance records and maintenance tasks by manually having to re-enter information into two dissimilar systems that do not share information.”

Currently, a high percentage of third-party MRO service providers manage their workscope input in PDF

format, says Saravanan Rajarajan, director of aviation solution consulting at Ramco Systems. “It is quite likely that they will receive the package one or two weeks before the aircraft’s input. Dealing with varying package content types and formats generated from the airline’s respective MRO systems poses considerable challenges,” he says. “The challenges include listing the task information and checking the internal data for a possible match and creating task cards in the MRO system if a match is not available.

“Another challenge is listing the part information to check the part nomenclature and stock availability and creating a part record if the former are not available. In addition, extracting and auditing the tools’ availability and planning for the overall manpower requirements and matching the task with the task cards if they are provided separately and if they are not downloading task cards from OEM site are also challenges.”



2

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IT IS NOT TOO SURPRISING THAT AVIATION IS ONE OF THE MOST TECHNOLOGY INTENSIVE SECTORS



1

Interface functionalities

The complete process of exchange of information between the CAMO and the MRO can be digitised starting from the initial work package – with the subsequent revisions – until the work completion update, affirms Rajarajan. “Technical requests from the MRO requiring the airline CAMO feedback are embedded within the ecosystem workflow,” he says. “Having all the interactions within the system framework enables the institutionalising of the knowledge and deriving the intelligence using advanced artificial intelligence and machine learning (AI/ML) tools.”

The CAMO data provides the maintenance intervals and due list items, such as routine and airworthiness directives and service bulletins. The MRO functions provide the shop floor activities, such as bill of material management, tooling, labour estimate, direct labour recording and quality functions, including multi-level sign-off, highlight Tautges and Polley. “All of the above are embedded directly into Quantum Control,” they say. “This allows the CAMO to schedule and launch the maintenance activities. This integration allows the CAMO to provide the hangar with all of the templated details for the selected maintenance.”

With AMOS’s ‘Transfer MRO Workpackage’ and ‘Transfer MRO Results’ interfaces, users have a way to exchange work packages and work order information between CAMO and MRO organisations, says Malešević. “Work packages are exported from an operator IT system and imported into an MRO IT system that might be in either or in both cases AMOS,” she says. “This allows an easy and progressive transmission of work package information to the MRO as well as reading back of the work performance and finding data from the MRO.”

According to Purfurst, the ideal solution is to have both CAMO and MRO functions managed by one solution. “As so many processes and data points are exchanged between them, one can only achieve maximum efficiency by having these fully integrated. In ‘ENVISION’, both sides have live visibility over the progress of work packages and work

orders through various dashboards and reports,” he says. “This visibility is vital for planning as the CAMO side has a clear view of hangar capacity, available resources and current unscheduled maintenance. Meanwhile, the MRO side has an accurate pipeline of work coming their way and can plan accordingly.”

WinAir has both CAMO and MRO products built into its software. “Businesses can use the features and functionalities that best align with their current requirements, then boost their software package by adding new items as these needs change,” says Castro. “If a business uses a separate CAMO or MRO product in conjunction with WinAir, they can import that information into the software via structured data exports. We have built-in data import and export tools, which makes the transfer of information a straightforward process.”



2

1. WinAir's software as displayed on a tablet
2. The process of exchange of information between the CAMO and the MRO can be digitised
3. In Rusada's 'ENVISION', both sides have live visibility over the progress of work packages and work orders through dashboards and reports
4. With new technologies, maintenance planning and scheduling software is constantly evolving



4

Enhancing interface efficiency

According to Purfurst, the area in the CAMO-MRO interface that has the most room for improvement is the exchange of data between operators and third-party MROs.

"Many have moved away from transferring records via paper, but the practice still exists. To be more efficient, organisations must look to electronic interfaces for the transfer of data," he says. "These however can still present problems as there is no one format for these records to reside in. This means a maintenance provider could have different task card formats for each of their customers, making it very hard for them to attain maximum efficiency."

Tautges and Polley affirm that there is room within the Quantum ERP that can generate additional capabilities and efficiencies on top of CAMO when implemented. "As maintenance intervals and due lists are generated or forecasted, the ERP provides a demand forecast for requirements around parts and labour requirements.

"This demand forecast is used to create detailed work plans and scope, as well as integrate with capacity planning processes and systems," they say. "Quantum automatically downloads job cards associated with aircraft

maintenance. Once completed, the job cards and work performed automatically updates the CAMO to log the maintenance records of the aircraft."

Swiss-AS's plan is to further improve data exchange efficiency between the CAMO and the MRO by introducing 'AMOScentral' and spanning a virtual cloud over all AMOS instances. "This will allow each AMOS customer to individually open its platform to collaborate to the desired extent with other members of the AMOS community and beyond," says Malešević.

With the CAMO-MRO electronic data interchange (EDI) interface in ATA SPEC 2000 Chapter 18, the job cards can exchange data in EDI format across organisations, observes Rajarajan. "A right EDI strategy enables seamless exchange of data, reducing the time to push it to production, the

ability to manage the revisions between successive work scope changes, reducing errors and finally the ability for the mechanics to perform their jobs digitally from their place of work, thereby gaining significant operational efficiencies and real-time tracking of work progress," he says.

As for future efficiencies, there is also the potential for timely task and access panels sequencing, automatic assignments of the rostered staff with the right skills to tasks and non-routines, proactive identification and mitigation of bottlenecks due to capacity, labour, parts and tools, affirms Rajarajan. "The feedback loop from MRO to CAMO systems provides the complete visibility on the work progress and automated update of compliance and work execution details, thereby improving the efficiencies of both the MRO and the CAMO," he concludes. 

THE DATA COLLECTED BY BOTH SIDES HELPS THE OTHER TO WORK MUCH MORE EFFICIENTLY

POWERING UP

Airbus has developed a high voltage lithium-ion battery for the 'EcoPulse' hybrid-propulsion light aircraft which it says will enable its future aircraft to further support decarbonisation

A new battery which is "pushing the boundaries" for high voltage batteries used in an aircraft is being finalised by Airbus for use in the 'EcoPulse' hybrid-propulsion light aircraft demonstrator.

The lithium-ion main battery system is being developed by Airbus Defence and Space in Toulouse and is central to the electrification demonstration with EcoPulse – which is being developed in partnership with Daher and Safran. Its first test flight is scheduled for later this year.

The battery is approximately 2.3m long by 75cm wide and 20cm deep. It is mounted under the fuselage and integrated with a reinforced aerodynamic fairing. The battery is one of the two electric sources on the demonstrator, the other being an 'e-auxiliary power unit' (e-APU) provided by Safran.

The battery is lightweight, compact and has very high battery power and energy density, according to Airbus, which is seeing several years of research

"The battery system includes a tailored management system that minimises maintenance"

and development as part of its aircraft electrification and sustainability initiatives pay off.

The new battery unit weighs around 350kg, is able to achieve 800 Volts DC and can deliver up to 350 kilowatts of power. Not only is this power level sufficient for driving EcoPulse's six electric propulsors, depending on the test conditions, but is also similar to what would be needed for an airliner's non-propulsive secondary systems. Airbus is exploring the latter separately as part of its 'micro-hybridisation' research, with the high-voltage battery concept being a key 'technology brick'.

"Our design featured several thousand lithium-ion cells, incorporating various safety measures to prevent thermal runaway – such as connecting each cell with wire bonding," said Julien Laurent, lead for the battery project. "Another innovative part is the active cooling system which ensures the optimum temperature for normal operation. Furthermore, this battery system also includes a tailored battery management system. This helps to minimise maintenance thanks to its built-in test features and ability to highlight the charge status or whether the cells need to be rebalanced."

The battery's high-voltage capability when applied in

this context is not available today either in aerospace or automotive industries. The majority of batteries currently used on aircraft are Nickel-Cadmium based – which, under the EU's REACH regulation, will soon have to make way for alternative environmentally compliant battery chemistries such as lithium-ion.

Following cell selection and subsequent design integration for EcoPulse, several prototype/specimen batteries will soon be subjected to testing in Toulouse according to stringent aeronautical standards. These tests will evaluate performance and environmental and

BATTERY CHARACTERISTICS

Li-ion (lithium-ion) technology



800 Vdc



350kg



750 mm x 2300 mm x 200 mm



REACH compliant

safety attributes so that Airbus can be confident it will behave properly and safely once installed on EcoPulse.

By understanding high voltage battery behaviour during this testing, Airbus said it would ultimately be able to develop vital competence for applying micro-hybridisation architectures to future aircraft. It could optimise power/energy management of non-propulsive functions such as air conditioning, auto flight and flight controls, for example. 

1. EcoPulse is a distributed hybrid-propulsion aircraft demonstrator



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