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Keeping the world's fleets flying

MRO Management

A CHANGING DYNAMIC

Investigating OEM–MRO partnerships & networks

JOURNEY TO THE FUTURE
Joramco CEO Fraser Currie on transforming a business

SOFTWARE INNOVATION
New features and functionalities to deliver MRO growth

TAKE OFF TO TOUCH DOWN
Exploring the ups and downs of landing gear overhaul

GO BEYOND

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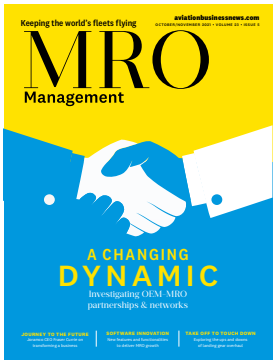

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Contents

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EDITOR'S LETTER

If any good can be said to have come out of the Covid-19 crisis, then perhaps the most positive example has been the spirit of togetherness that has so often been in evidence in communities, companies or countries.

Togetherness is the theme of our cover story in this issue, which explores the ever-evolving relationship between OEM and MRO companies. For many of them, the Covid-19 crisis has made clear the need for working together in strategic partnerships or networks, and collaboration and communication has been enhanced in response to these difficult times.

"The Covid-19 crisis has emphasised the need for all stakeholders within such networks to work closely together as we jointly determine how best to navigate the post-Covid aviation landscape," SIA Engineering Company told us. "We believe that this will only help to strengthen the relationships making up the aftermarket networks."

In the reality of the wider world though, any spirit of togetherness is often very easily threatened, and we are seeing this in over-reaching and divisive government policies around the world right now, as well as in sensationalist media coverage which can cause further fractures.

In any competitive industry too, tensions bubble just beneath the surface when companies can be partners one day and competitors the next, and with the crisis also having a negative impact on OEM and MRO companies in terms of business and revenue, this too could be driving a change in the OEM-MRO dynamic. Might, as Alton Aviation Consultancy predicted at the turn of the year, OEMs begin to exit many of their airframe and component MRO investments as they see the importance of MROs as valuable suppliers? Will they reassess their business models "with a back-to-basics theme focused on their core competencies"?

The Covid-19 crisis is also accelerating existing business trends in many spheres of industry. This has certainly been the case for MRO software, and providers are developing new features and functionalities to meet demand from maintenance companies for greater efficiencies, as we discover in another feature in this issue.

We also have articles on landing gear and APU maintenance as well as our array of regular columns, including a packed 'Industry voices' section featuring the thoughts of newly appointed Joramco CEO Fraser Currie, among others, and a fascinating interview with AJW Technique CEO Sajedah Rustom in 'Top table', in which she discusses the company's ambitious expansion plans.

I hope you enjoy reading the issue.

Jason Holland
EDITOR
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News from across the industry

HANGAR *talk*

ENGINES

Pratt & Whitney powers up in China

Pratt & Whitney is investing in its in-country product support ecosystem for Chinese customers, as the first GTF engine was inducted for MRO work in the country.

Support will range from 'EngineWise' solutions, predictive analytics, on-wing services and MRO facilities, with an "overarching focus" on enhancing the customer experience.

"Pratt & Whitney has powered Chinese aviation for more than 90 years, and we continue to grow our presence in the region to deliver the full spectrum of service and support closer to our customers," said Pratt & Whitney China's president Yogesh Farswani. "We are committed to customising solutions to meet our customers' evolving needs – in a decade and world where the pace of change and demand for innovation are accelerating. With a growing fleet of more than 3,300 engines and APUs operating in China, dependably carrying passengers and cargo while delivering environmental and economic benefits, our focus remains on ensuring our customers' success."

Pratt & Whitney said it was growing its MRO footprint in China, securing in-region maintenance support for its customers. MTU Maintenance Zhuhai and Ameco Beijing joined the company's GTF MRO network last year.

MTU Maintenance Zhuhai, a joint venture between MTU Aero Engines and China Southern Airline Company, has inducted a PW1100G-JM engine for MRO – becoming the first active GTF MRO facility in China.

"TO HAVE AN ACTIVE SHOP IN CHINA BRINGS IMMEDIATE BENEFIT AND WE ARE EAGER FOR THE INDUCTION PACE TO BUILD"

"This is a monumental achievement for the GTF MRO network. We formally welcomed MTU Maintenance Zhuhai to the network in December 2020, and now here we are [with] its first induction," said Pratt & Whitney's vice president, aftermarket global operations Joe Sylvestro. "The GTF is a young fleet with a long runway of growth ahead of it. To have an active shop in China brings immediate benefit to our customers in the region. We are eager for the induction pace to build and for our other GTF MRO network members in China to begin maintenance operations as well."

Pratt & Whitney also announced that its GTF engines have now saved Chinese operators more than 95 million gallons (nearly 360 million litres) of fuel and avoided more than 910,000 metric tonnes of carbon emissions, accumulating over 400,000 flights and over 1.73 million hours of experience in China.

The engines power 11 airlines across the region on nearly 200 Airbus A320neo family aircraft. Chinese operators are benefiting from a dispatch reliability rate of 99.97 per cent globally.

"The GTF engine family is delivering economic and environmental benefits today that will continue to grow in the decades to come," said Farswani. "To deliver the most sustainable and smart engine possible, we did the hard work first by introducing the gear. This bold move and the proven technologies behind it are offering unmatched efficiency, world-class operating costs and high aircraft utilisation. With the geared fan mastered, we have the right foundation for future innovations, keeping the GTF at the forefront of sustainable propulsion."

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"I've been an engine module technician on CFM56 and CF6 engines for 10 years. Thanks to this experience I have joined the LEAP team. I'm determined to provide the best quality and TAT to meet our customers' expectations, while always looking for ways to improve our processes."

Leandro Rodrigues Oliveira, *Engine Module Technician*

AFI KLM E&M has extended its capability list to include maintenance for the LEAP* engine, with an MRO service offering that covers both On Wing/On Site support and shop visits. AFI KLM E&M, which has provided support when new engines go into service on a number of occasions in the past, is capitalizing on the know-how of its teams to support early-stage operations on the LEAP worldwide. We are ready to meet the needs of the airlines with services that are always the **Best4You.**

** LEAP engines are products of CFM International, a 50/50 joint company between GE and Safran Aircraft Engines.*

AIRFRANCE INDUSTRIES KLM Engineering & Maintenance

ADAPTIVENESS®

in brief

- Atlas Air is partnering with Sharp Technics K to develop a dedicated MRO facility at Incheon International Airport in South Korea. The companies have signed a Memorandum of Agreement to enter into a joint venture to that effect. The custom freighter aircraft maintenance facility is expected to open in 2025.

- Rolls-Royce has signed a definitive agreement to sell 100 per cent of ITP Aero to Bain Capital Private Equity, which is leading a consortium of investors of Spanish and Basque companies including SAPA and JB Capital. The transaction is valued at approximately €1.7 billion.

- Storm Aviation has acquired Manchester-based Chevron Technical Services and its Prestwick, Scotland-based subsidiary Chevron Aircraft Maintenance. Storm is a subsidiary of Avia Solutions Group company FL Technics.

- Air China and CFM International have signed a Letter of Intent (LoI) to strengthen the LEAP engine MRO capability of its joint venture Sichuan Services Aero-engine Maintenance (SSAMC). The LEAP-1A engine was introduced into Air China's fleet earlier this year.

- Chinese airline Air Travel has agreed a 12-year LEAP-1A engine rate per flight hour (RPFH) contract with CFM International. The agreement includes the purchase of LEAP-1A spare engines and is valued at US$992 million at list price. The airline operates a fleet of 16 A320s.

3

Icelandic start-up Play has selected OEMServices to provide component support for its fleet of three A321 neos

8,000

Jet Aviation has completed the extension and renovation of an 8,000sq m production centre at its facility in Basel, Switzerland

TRAINING

Establishing a maintenance career pathway

Constant Aviation is partnering with a US technical college to provide a career pathway in aviation maintenance.

The partnership with Western Technical College of El Paso, Texas aims to provide flexible, long-term career paths for students. Students will be able to exit the Western Tech programme and enter directly into the aviation workforce, earning their Federal Aviation Administration (FAA) certifications while also working at Constant Aviation.

Constant Aviation said it was seeing "rapidly growing demand" for its services, having expanded its nationwide AOG mobile response network by more than 15 per cent this year, making the partnership "timely".

In order to fulfil needs in AOG and at facilities in Cleveland and elsewhere, Constant Aviation said it was recruiting for positions including technicians in avionics, AMT, paint, wire harness and other areas.

Constant Aviation's head of recruiting and employee engagement Nicole Krafchek said: "We have always focused on attracting top talent and team members with a passion for their careers. Western Tech's mission, together with its academic programmes that align with the aviation industry's needs, make this partnership a perfect fit."

Head of work force development Jim Yarborough added: "The instructors, the outstanding curriculum and the programme's high standards lend themselves to creating skilled technicians with outstanding earnings potential in a meaningful career."

Western Tech's CEO Brad Kuykendall said: "Our curriculum fits seamlessly with expectations for future generations of aviation technicians, preparing students so they immediately can transition into the field using the knowledge they've just developed. It's a remarkably small commitment for the dividends that are paid."

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Julie Dickerson

Julie Dickerson
Chief Executive Officer

SES Fly Certain

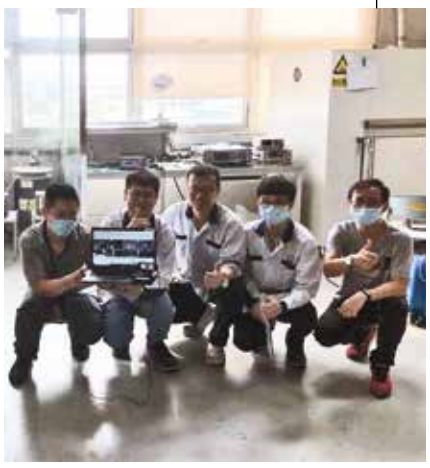
01

Trend **watch.**

New solutions, partnerships and investments are driving innovation in the MRO industry

02

03



01
All in one place

Lufthansa Technik is expanding its digital 'AVIATOR' platform with a new 'MRO Management' solution. Customers can now use one solution for asset sourcing, monitoring of their MRO events and accounting functionalities.

Accessibility independent of location and time, as well as the visualisation of all details in a structured and standardised form, enable users to take immediate action, the company said. "By digitalising the entire process in one place, we simplify and streamline the information and communication flowing between an MRO and the aircraft operator."

02
MRO support

Mammoth Freighters has made a strategic investment in a widebody maintenance and modification facility to support its 777-200LR and 777-300ER passenger-to-freighter conversion programmes.

The company is embarking on a long-term partnership with GDC Technics, which has expertise in engineering and technical services, modifications, electronic systems, R&D and MRO services.

GDC is located at Alliance Airport in Fort Worth, Texas, and has six widebody hangar bays for modification and maintenance work on 777 aircraft.

03
Product approval

Lufthansa Technik Shenzhen, Meggitt's MRO partner for China, has been certified by the CAAC for the repair of Meggitt fire detector products. The repair station also holds certifications from the FAA in the US and EASA in Europe.

Meggitt said this was the first product group to be established at the Lufthansa Technik Shenzhen facility with future approvals anticipated for valves, heat exchangers and fire extinguishers.

The Lufthansa Technik Shenzhen facility will also act as a dedicated warranty centre, working closely with Meggitt's Services & Support team in Singapore, in order to enhance the support for customers in Mainland China.

04

05

06

07

04
Engine of growth

HAECO Engine Services (Xiamen) is celebrating the recent delivery of its 700th GE90 engine output, and has also completed an engine test cell upgrade, which it says marks a "significant milestone" in its longer-term development.

The company operates an engine test cell rated to 150,000 pounds of engine thrust, capable of testing GE90 series engines. "We are progressing towards capability for servicing the GE9X, supporting the company's long-term growth and enhancing our competitiveness," said HAECO group director components and engine services Angus Barclay.

05
Agile addition

AAR has signed an exclusive distribution agreement with Arkwin Industries. The agreement covers Arkwin's line of engine actuation and commercial aviation products for the commercial aviation aftermarket.

AAR's SVP of OEM Solutions Eric Young said: "We are thrilled to add Arkwin's products to our portfolio and look forward to working with its team to provide market intelligence and grow its footprint. This agreement provides meaningful growth to AAR's OEM Solutions business and the CFM56, CF34 and CF6 products complement our existing offering."

06
Extra capacity

Boeing and Guangzhou Aircraft Maintenance Engineering Company (GAMECO) have signed an agreement to create additional capacity for the 767-300 Boeing Converted Freighter (BCF).

GAMECO will open two new 767-300BCF conversion lines next year, driven by "continued strong market demand", according to the partners.

GAMECO will be the first MRO in China to convert the 767-300BCF and the only MRO converting both the 767-300BCF and the 737-800BCF. Earlier this year, GAMECO announced plans to open a third 737-800BCF conversion line.

07
Streamlined processes

Azul Linhas Aéreas has restructured its parts purchasing and tracking processes using SkySelect's aviation material purchasing system.

SkySelect uses smart algorithms and robotic process automation to power its system, which has delivered efficiencies to Azul Linhas Aéreas, saving both time and money.

"What makes SkySelect such a vital partner to us is their unique blend of transformative technology and supreme customer service," said Leonardo Zerbone da Costa, Azul Linhas Aéreas' head of supply chain.

A transformation JOURNEY

DAE company Joramco has transformed over the past four years – and the pandemic has forced even more change. In such a heavily regulated industry the management of change is not just a business strategy, it's a regulated requirement. Newly appointed CEO ***Fraser Currie*** reflects on the process and takes a look into the future

In order to transform, you need to understand where you are and where you want to be. The key is managing the 'how', in terms of what to transform and when. In hindsight, a successful transformation can be shown on a timeline which pictorially suggests that one element finished before another started. In reality, a complex transformation is multi-faceted with elements of change running in parallel, no different to any other project. Joramco was crying out to be transformed; a sense of urgency which is key to any such project was already established and just needed the right coalition to guide it.

The leadership of that coalition and the sense of urgency commenced when DAE appointed Jeff Wilkinson as CEO in October 2017. Jeff set about a process that would see the company experience tremendous success and growth over the subsequent years. At the heart of the transformation was our strategic roadmap, which clearly focused on all our employees and on our goal to be 'The global independent world class MRO and technical aviation services partner'.

Embedded within the roadmap are our four key mandates: people, process, customer and finance. Each mandate is then broken down into strategic objectives, which will ensure long term sustainable growth that will also provide our business and its customers with the continuous improvement that is so essential in any operation. The strategic objectives clearly focused on: safety, quality compliance, process, productivity, customer service, TAT (turnaround times) and capacity utilisation.

The vision of our transformation was clear, and the next step in the journey was to clearly communicate the vision and engage the staff to ensure everyone was part of the journey. A few short weeks into the process we had made key strategic hires, identified key agents of change within the business, and launched communication platforms, not least our in-house magazine.

The scene was set, the vision was communicated, and key personnel were empowered to act on the vision. Some might argue that the process and guiding principle of the transformation were well established business tools that managers and leaders have used for years. They are correct, and this is a strong lesson for any change – many companies have successfully transformed and the case studies

MILESTONES

2016 – Became part of Dubai Aerospace Enterprise (DAE)

2017 – Appointment of Jeff Wilkinson as Joramco CEO

2017 – Transformation journey started

2018 – Addition of 737 MAX capability

2018 – Addition of 787 capability

2019 – Addition of A320neo capability

2019 – Addition of 777 capability

2019 – Fleetcycle (EmpowerMX) launching

Left: Joramco has managed a process of change and is ready to face the future

are out there, of course you have to use them for guidance and not blind obedience. This is where the key specifics of transformation apply, in terms of 'planning for and creating both short- and long-term wins'. Short-term wins can be as simple as improving a workspace or giving someone a better tool that makes the task easier and more efficient. Long-term wins can be more strategic in terms of adding new capabilities or approvals.

Now you are fully into transformation with many individual projects running, you're consolidating improvements, and ironically this creates more change. The key here is to stick to the vision and communicate this again and again. At the heart of the change and one of the key mandates is the people and giving them continuous encouragement to implement the vision. Watching people develop and grow through this process is one of the ways to gauge your success.

Finally, change is good and as I hear a lot 'change is a constant' – but for change to be sustainable it must become institutionalised and allow everyone to see that the new behaviours that come from change provide corporate success.

Having personally been on our transformation journey for over three years, I am sure that 'one size doesn't fit all' and your transformation will be different and will need to be tailored to your vision. But what I would say is that you don't need to reinvent the wheel, look to best practice and follow a clear overarching process and roadmap.

The scene was set, the vision was communicated, and key personnel were empowered to act on the vision

2019 → 2020 → 2020 → 2021 → 2021

EN9110 certification

Expanded parking to accommodate more aircraft (35 aircraft)

Appointment of Fraser Currie as Joramco CEO

First 777 aircraft induction

Appointment of Jeff Wilkinson as CEO of DAE Engineering

FRASER CURRIE
Joramco's CEO

Streamlining MRO support for component OEMs

The relationship between OEMs and MROs is changing as the old ways of doing business unravel and new strategies emerge, says AMETEK MRO's divisional vice president Europe & Asia ***Alan Harding***

Not so very long ago, the aviation aftermarket was perceived as such a lucrative sector of the industry that many OEMs introduced a variety of compelling ways to bind customers to their own after sales 'care' programmes. Such a move was seen as a logical way to increase income and build reliant loyalty. In a buoyant global market, the fact that such reassurance inevitably came at a price was not an overriding issue.

Although appealing in principle, even before the pandemic had struck many airlines started to feel constrained by the cost implications, and the OEMs themselves began to discover that running a cost-effective MRO operation alongside their core business of design and engineering innovation was not as straightforward as they envisaged.

As Covid-19 continues to disrupt the aviation environment, and any kind of forecasting is fraught with 'what ifs', operators, manufacturers and MRO providers alike are examining new ways to work together. Words like diversification, flexibility, cost optimisation and bundled services are re-shaping how the industry does business today. It may have taken words like 'unprecedented' and 'exceptional' to describe the catalysts for change that the entire MRO supply chain is now reacting to, but the emerging picture is not all doom and gloom – far from it.

Unwinding the clock

It is becoming increasingly evident that component and systems OEMs are less willing to invest in bricks and mortar and headcount. Top level initiatives are seeing airlines and OEM organisations dismantle the distractions (and costs) of running MRO shops, and concentrating on building lean, fit, nimble businesses that can sustain their primary focus on new technologies and high-quality services. This back-to-basics culture may seem like rewinding the clocks but, in reality, it is an opportunity for both OEMs and independent MRO providers to unravel the old ways of doing business and build new levels of outsourced MRO that benefit all parties, especially airlines and – increasingly – lessors.

Diversification within skilled parameters

When maintenance is a variable cost, everything is closely scrutinised and new alliances will be forged as the recovery throws up new challenges. Changing from an environment of single component repair sales to value-added supply management solutions brings a new meaning to the word 'partnership' between OEMs and outsourced MRO providers. Aside from a highly experienced workforce that operates under strict approvals processes, there are opportunities to utilise knowledgeable salespeople under representative agreements. Not only do these appreciably trim overheads, they do so under a 'guaranteed quality' banner. So the OEM is confident that the features, capabilities, reliability and benefits of their products are explained by experienced professionals.

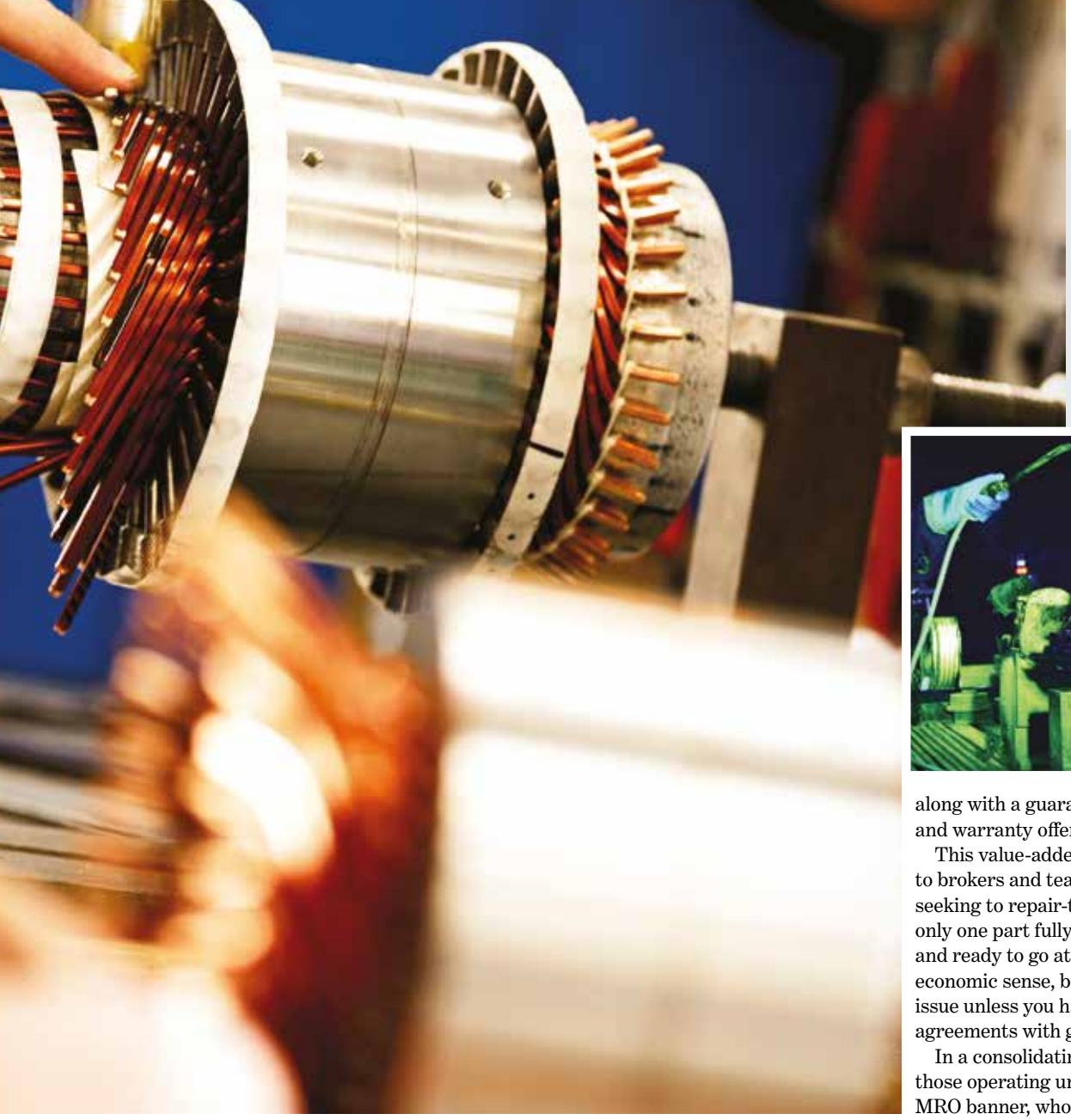
At a time when the sales of OEM-new parts are struggling to perform well, this is a mutually beneficial solution. In a changing aviation landscape, OEMs will increasingly choose to partner with those MROs who perform as an integral part of their team.

Niche is nice

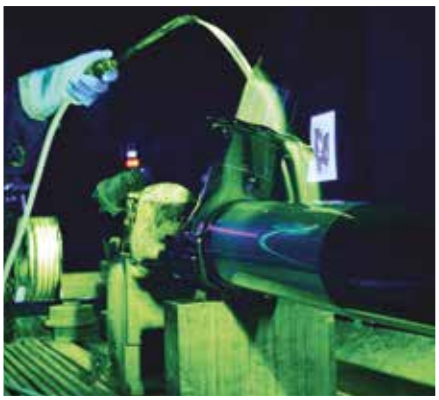
Interestingly, another area seeing a renaissance is the appreciation for niche service providers. The one-size fits all solution or multi-specialist consolidated service has a place of course, but it is not right for every customer. Suppliers of niche services such as escape slides, specialised surface treatments, reverse engineering MRO and testing, or landing gear support for aerial firefighters for example, know what they are doing and have invested over time in terms of equipment and training to streamline their operations for maximum efficiency. Likewise, the teardown and salvage specialists are also feeding the growth of the spares parts market.

Transformation and transitions

Whilst regional and domestic travel is recovering, commercial international business travel remains suppressed. Those MROs whose business models embrace a variety of sectors have been



Left: AMETEK MRO's capabilities are varied and include the ability to reverse-engineer components and produce new and improved repair schemes
Below: Fourteen strategically placed locations around the world feature under the AMETEK MRO banner



Expect a new approach to partnerships

cushioned somewhat from the impact of Covid-19. However commercial fleets are transforming, and the next 12 months will see some interesting trends emerge.

Parked commercial aircraft will return to service but, irrespective of high book values and good remaining economic life, evidence seems to indicate that the costs of this activity have been seriously underestimated by operators and lessors. Where this type of aircraft has been stored for 1-1.5 years it bears significant reactivation costs, so the owner will either have to pay the expensive bill by investing even more money, or sell for part-out.

Acceptance of used service material (USM) and green time engine management has been a discernible trend over recent years, with significant current asset levels sat in 'as-removed' or 'unserviceable' condition globally; it is unlikely there will be a step-change in the take-up of USM until mid-late 2022.

The global view

Mid-life aircraft at the end of lease will more frequently become the lessors' problem, as operators look to change or 'right-size' their fleets. The redistribution and geographical spread of aircraft will encourage a new approach to partnerships in different markets and those MROs with a genuine global footprint will be able to bundle services along with a guaranteed surety of quality and warranty offering.

This value-added service will appeal to brokers and tear-down specialists seeking to repair-to-order. Having only one part fully certified on the shelf and ready to go at any one time makes economic sense, but it's a logistics issue unless you have just-in-time MRO agreements with global reach.

In a consolidating market, MROs like those operating under the AMETEK MRO banner, who have a global footprint and service offering and can provide nose-to-tail solutions (rather than a 'part-number' approach), will succeed. They will be able to partner with OEMs and work in a non-threatening, value-added supply chain, delivering OEM quality and reliability, backed by the OEM and with turnaround times that match and exceed best-in-class performance.

ALAN HARDING
AMETEK MRO's divisional vice president Europe & Asia

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Fast & flexible

AerFin's 'Major Assets' division – which encompasses APUs, landing gears and engine nacelles – features an established and extensive inventory of assets providing tailor-made support solutions, says director asset sales ***Nick Filce***, but has had to adapt in response to the Covid-19 crisis

Over the past 21 months, airlines have had no choice but to park large portions of their fleets, with demand for maintenance plummeting across all airframe components. This includes the APUs (auxiliary power units), landing gears and engine nacelles (including inlet/nose cowls, thrust reversers, fan cowl doors and common nozzles) that are covered until AerFin's Major Assets division.

Unlike engine nacelles and APUs, an aircraft's landing gear is a calendar-controlled asset, whereby the overhaul of the asset is scheduled and undertaken regardless of the reduced flying time the aircraft has done.

While airlines are not terminating their contracts with MROs for this maintenance, they are desperately trying to extend the removal/maintenance schedule due to the aircraft 'parked' status. As a result, we are seeing an increase in enquiries coming from the lessor and banking community as operators of older generation fleets are exploring the potential hand-back of these assets. However, single-aisle short-haul aircraft appear to be less affected and are making a quicker return to the skies.

AerFin supports several global operators with the lease or sale of engine nacelles. Ensuring the traceability and previous repair history of the nacelle are of paramount importance to guaranteeing the integrity and quality of the asset. For each transaction, AerFin provides a comprehensive sales pack detailing this history.

AerFin has a flexible pool of APUs which are available for lease, exchange or sale. APUs are the small gas turbines that provide electrical power to the aircraft for starting engines, running the air conditioning, and providing electrical power whilst the aircraft is on ground. For the sale, lease or exchange of an APU, full 'back-to-birth' traceability is required since APUs often include life limited parts (LLPs).

APUs are generally supplied 'On Condition' and operate to failure unless the LLPs become 'Due' to their cycle limits. However, we are noticing that more airlines are 'trend monitoring' their operations to determine when these units are likely to fail in an attempt to predict costly workshop visits.

The preference should always be to remove the APU before a catastrophic failure occurs, in order to mitigate significant costs and extended lead times.

Left: Airlines are desperately trying to extend the removal/maintenance schedule for landing gears
Far left: AerFin's 'Major Assets' division is adapting to new realities

Alliances will include access to costly assets to support exchange programmes

Bespoke trend monitoring is being offered that collects data automatically and can be sent in real time to operators and MROs to assist with APU performance and monitoring.

More recently, we are noticing that operators are favouring our flexible pool of major assets available for exchange or lease instead of owning the major asset outright, allowing them to avoid the significant up-front investment and ongoing maintenance and overhaul costs. We have therefore developed a 'just in time' approach – with our partnership with MROs and OEMs – which allows us to increase our current stock locations and reduce the supply chain complications of holding bulky and expensive inventory.

We are continuing to see much more collaboration between the MROs/OEMs and asset providers due to the cost of holding stock, the idea being that the organisations specialise in their main expertise and develop areas vital to their own business strategy. Alliances will include access to costly assets to support exchange programmes or MROs managing certain repairs where the OEM may have surplus work. The OEM may also be concentrating on developing new products and capability, therefore wishing to partner with MROs and asset owners to assist with overcapacity and older generation support.

AerFin's reputation is of paramount importance, which is why we have teamed with reputable OEMs and MROs to provide the customer with the confidence that 'on wing' reliability and technical support is of industry best practice and standards.

Transportation and logistics with these major assets can be difficult and expensive – so AerFin has units stored strategically in the UK, Europe, Asia and the USA. Our 24/7 coverage ensures we can ship any time of day or night through our experienced logistics department. As with all our major assets, airframes covered include 737, A320, A330, E170/E190 and 777 families.

NICK FILCE
AerFin's director asset sales

All systems go

Integrating consignment stock allows operators and lessors to focus on core priorities, says APOC Aviation's VP airframe acquisition & trading ***Jasper van den Boogaard***

Instant access to a depth of premium quality components will support MROs and fast-track the spares market as the narrowbody sector starts to recover. At APOC, we have strategically added three consignments ready to be incorporated into stock at our warehouse in the Netherlands, with advantages for consignors and customers alike.

APOC acts as the experienced conduit for airlines and lessors eager to derive revenue from aircraft components at a time when the industry is struggling with bringing parked assets back into service whilst facing escalating MRO costs. The consignor still owns all the parts but APOC does all the work, so it's a win-win for both parties.

Currently prices for spare parts are more competitive and owners are reluctant to sell outright if they foresee an upturn and can wait for a more buoyant market. By placing consignments with a professional organisation like APOC they can put their parts to work, generating income via flexible sales/exchange/lease/loan options that they might not be geared up for themselves while volume builds. There is also the fact that APOC has its finger on the pulse regarding market trends and access to a rapidly expanding global customer base. The organisation has recently opened stock hubs in Singapore and Miami and is trebling the size of its warehouse facility in the Netherlands.

APOC can manage the part-out if a complete aircraft is being retired. This includes all stripping down, repairs, storage, logistics and sales. Alternatively, we can bring in shipments of parts and conduct the repair, re-certification and tagging on behalf of partners. Or we can simply integrate stock that's ready to go. However, we do have some strict criteria that underpin the calibre of our inventory overall.

APOC strategically selects the parts that have the highest intrinsic value within our scope of specialism, that is the Airbus A320 family and Boeing 737NGs. These narrowbodies make up about 50 per cent of the market so we have focused our energies and honed our expertise in this sector alone. We know what is commercially valuable and it is not down to age alone. It depends on modifications, for example – you need to look past the MSN number.

100%

APOC's 'Alicanto' system is updated in real time every five seconds and this provides consignment customers with 100 per cent visibility on the movement of their inventory at all times

Trust and transparency are essential between consignor and consignee. Our 'Alicanto' system is updated in real time every five seconds, and this provides consignment customers with 100 per cent visibility on the movement of their inventory at all times. There is no discrimination between a consignor's stock and APOC's own components. Stock is carefully managed with just-in-time accuracy to maximise values. We adjust availability of key components with fluctuating market demand.

Parts are sent for repair/certification on a revolving basis to ensure that everything that leaves APOC has the latest tags. We do not simply send parts out for 'bulk repair'; everything is assessed individually, following the market trend. For example, avionics from an older aircraft may have been upgraded – that affects value and desirability, and thereby repair priority.

Managing narrowbody core spares on behalf of consignors requires a willingness for both parties to be flexible because every project/requirement is different. Opportunities come up on a daily basis, so we have to work out what makes the right deal for the customer and for the consignor; that is how APOC adds value to the service.

We know that the narrowbody sector will recover quickly as soon as restrictions start to lift and many of our customers are preparing now.

Left: APOC carefully manages stock with just-in-time accuracy to maximise values
Below: Placing parts inventories on consignment with companies like APOC "relieves a burden for airlines and lessors"

Trust and transparency are essential between consignor and consignee

We are already being told that they have underestimated the work needed to get their aircraft airworthy for return to service – there is a demand for parts, but tough pressure on prices. They are facing a huge undertaking.

At the beginning of the crisis, I had several discussions with lessors that had a general expectation of a cost of around US$200-250k to return an aircraft back to service after storage. A few months later their expectations were at least US$500k, and some were predicting up to US$750k. After 1-1.5 years of storage some aircraft are awakening 'very angry' and I've heard about reactivation costs that exceed US$2million and above.

If you have a very new aircraft, circa eight years or so, the asset will have a high book value and normally a good economic life remaining. We are now in a market where if this type of aircraft has been stored for 1-1.5 years it bears significant reactivation costs. The owner will now have two choices: pay the expensive reactivation bill, or sell for part-out.

I find it quite remarkable that these young aircraft are being offered to us. This means the investors will take a hit on their book value, or they need to add more money into the investment to bring the aircraft back to service. Alternatively, they can increase the book value of the asset even further, or perhaps look at another solution. I think it will be very interesting to see how this works out in the long run.

APOC has a growth target of 12-15 parted-out airframes this year, whether through their own acquisitions, or via managed teardowns for other owners, all of which will contribute significantly to the depth and range of the parts inventory.

Although APOC Aviation is a young company and we're still small, we have a dynamic investment strategy and support is assured by our experienced and responsive team, global footprint and 24/7 AOG network. Placing parts inventories on consignment with us relieves a burden for airlines and lessors whose asset values are being eroded as their energies are pulled in multiple directions to rebuild their operations.

JASPER VAN DEN BOOGAARD
APOC Aviation's VP airframe acquisition & trading

Entering into an authorised MRO agreement

In the first of a multi-part series, Washington Aviation Group president **Jason Dickstein** highlights some of the factors that should be considered before signing an 'authorised network' agreement

Over the years, I've had an opportunity to review and advise on a wide variety of agreements, including authorised MRO agreements. I've recognised the importance of taking some time to review the agreement and ensure that the relationship will serve the long-term interests of both partners.

Companies with 'authorised networks' can include authorised MROs, authorised distributors and even authorised replacement parts manufacturers.

Mutual benefit – with you until the end

An authorised network relationship represents an opportunity for both sides to work together for mutual benefit. The agreement should be viewed in this context. At the end of the day, if you do not see benefit in the relationship then you may want to pass on the opportunity. And speaking of the 'end of the day', I like to begin my contract analysis by thinking about the end.

When beginning a new business relationship, many people don't want to think about the possibility that the relationship might end. Clients often tell me that they are planning for the relationship to last forever. It is great to enter into the relationship with optimism, but it is also realistic to think about what could happen in the event the relationship terminates.

I once advised a series of clients who were each considering authorised facility relationships with the same production approval holder (PAH). I gave them all

> **Many people don't want to think about the possibility that the relationship might end**

the same advice: we need to look at the costs of the relationship and the expected benefits and determine whether the PAH relationship made sense (or cents) over the course of the term being offered. Each of the clients performed their own cost-benefit analysis and each came to the same conclusion: the initial term being offered needed to be longer to make the relationship profitable. The PAH in this case told each client the same thing: '[PAH] is like an enormous tanker, and no one can change its course once it has set sail; so of course the company will automatically renew the contracts without a thought'. I asked for longer initial terms, but this request was denied each time. None of these clients signed with the PAH because the numbers just didn't make sense.

What makes this interesting is that other companies did sign those authorised network agreements. Several of those other companies came to me a few years later because the PAH's leadership had changed and they had a new business strategy. Their new strategy involved in-housing the same capabilities so the authorised network relationships were being terminated.

Even though the initial contracting agents 'promised' that the contracts would be renewed, they refused to put those promises in writing. When renewal time came around, the authorised facility relationship agreements were discontinued (non-renewed).

Some ending conditions to consider

It is vital to think about what happens when the agreement ends, and whether you will be able to continue doing business afterwards. This means looking at the limits that will apply after the agreement ends.

What happens to the data? Many agreements have a very broad definition of the data that is protected like intellectual property (contract protections can be broader than the scope of the actual intellectual property laws). Data might include things like manuals, drawings and

repair specifications. It is normal for the authorised facility to be required to surrender all copies of that data at the end of the agreement. This can include manuals that were purchased before the agreement, or manuals to which you would have had a legal right (like instructions for continued airworthiness that are required to be shared under the aviation laws of various countries) – so be careful to identify your rights before and after the agreement so you have a full understanding of what you may be giving up.

Also, what happens to your intellectual property? Sometimes an authorised facility relationship requires your company to share or even surrender certain intellectual property (like new repairs that you might develop). In a poorly written agreement, you may have no right to continue using that intellectual property after the agreement, even though you were the one who first developed it.

A closely related question is the disposition of your trademarks. Will you need to change your branding at the end of the agreement, and what cost does that impose on your marketing?

Personal property and inventory should also be a concern. Do you need to return or surrender tooling or other equipment at the end of the agreement? If you bought inventory that you can no longer use, then is there a buy-back provision?

Will there be limits on your supply chain? Are there purchase restrictions that might continue after the termination? Likewise, are there continuing limits on your choice of customer?

Do you need to surrender certificates? Are you restricted from doing business? If you obtained certificates or approvals during the relationship – like STCs – then who owns these, and will you be able to continue doing business if you lose these?

'Authorised network' agreements can be an important part of your relationships with your business partners, but they need to be negotiated so that (1) your business can thrive during the relationship and (2) your business can continue to thrive if the relationship ends.

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

A roadmap for expansion

AJW Group has expanded its maintenance services into Europe with the launch of a new MRO facility near London Gatwick Airport called AJW Technique Europe. Here, AJW Technique's chief executive officer ***Sajedah Rustom*** discusses the company's aims and ambitions

Congratulations on the launch of AJW Technique Europe. Could you explain the idea behind it?
AJW Technique has spent the past two years clean-sheeting process, data and technology, to allow us to optimise our workflow and unlock efficiencies. We have developed the perfect recipe to run a seamless MRO, allowing us to copy/paste our approach and extend AJW Technique into a global franchise.

The European MRO has been strategically positioned to meet the needs of AJW Group's flagship local customers, delivering the same outstanding quality and customer experience provided by AJW Technique in Montreal, right at their doorstep.

The facility now operates as a centre of excellence for batteries, given that these repairs are done locally to the carrier and will soon expand into new capabilities that fit wider needs of our European customer base.

What are AJW's aims for the facility in the short term and in the long term?
Our immediate aim is to deliver a world-class service for this product line. Our battery technicians are specialists of the units' behaviours and continuously find ways to streamline the repair process to ensure excellent turnaround times.

We intend to expand our list of capabilities to complement our state-of-the-art facility in Montreal and conduct repairs for our wider European customer base on equivalent locally repaired commodities.

> **In the long term, our aim is for the AJW Technique franchise to be the MRO of choice across the globe**

In the long term, our aim is for the AJW Technique franchise to be the MRO of choice across the globe, with the right and relevant capabilities covered regionally.

What was the thinking behind beginning with a specialisation in battery repair?
AJW Group acquired Avia Component Services, which has been AJW's preferred battery repair vendor for many years to service our European customer's battery repairs. Batteries are expensive to ship and considered dangerous goods. Although AJW Technique Montreal has in-house battery capabilities, we cannot repair battery units from outside the Americas for this reason, hence using a specialist shop has historically been the most efficient solution. The acquisition of Avia has provided a perfect opportunity for both parties, allowing AJW Technique Europe to retain Avia's skilled technicians, with over 50 years of technical expertise, permitting us to provide a turn-key full-service experience.

The suite of main batteries and emergency packs of 30 part numbers cover a wide platform of aircraft types, from Airbus A319, A320 and A321s to Boeing 727, 737, 747, 757 and 767s as well as Global Express, Challengers, CRJs and Embraer 500s, which means our customer base will be wide and varied.

How will the facility develop its capabilities?
We intend to expand our capabilities initially to other 'hard to ship' capabilities, whether due to their hazardous nature, size or regional customer needs. Naturally we will be focusing on lighting, audio, auxiliary, galley equipment and gas capabilities.

How will you measure the success of AJW Technique Europe?
We have a four-phased roadmap for the expansion of AJW Technique Europe, which are huge measures of success within themselves. We are also using the

Right: AJW Aviation turns 90 in 2022; the group is focused on business expansion and evolving its services
Below: The group's headquarters in Slinfold, England – which is near the new AJW Technique facility

same key performance indicators used at AJW Technique Montreal covering product, sales, delivery and customer experience. More specifically on the operational side, we monitor proactively our turnaround time per customer commitments, quality, reliability and competitive pricing. The franchise model benefits from all the digital MRO tools and lessons learned from AJW Montreal.

AJW Group has also launched AJW Technique Interiors. How will the two new facilities work in conjunction with the existing facility in Montreal?
AJW Technique Europe complements AJW Technique Montreal and offers our renowned repair excellence on local repairs to European operators.

AJW Technique Interiors specialises in aircraft interiors, specifically innovative materials for seat covers, manufacture and supply of head rest covers, life vest pouches and carpet kitting. We see AJW Technique Interiors as a complementary service that we are now able to offer our customers, giving them a one-stop-shop with design, development, testing and production all housed under one roof to drive sustainability and efficiency for their interior requirements.

AJW Technique signed a 10-year lease renewal for the Montreal facility earlier this year, what are the plans here going forward?
The 10-year lease renewal secures AJW Technique's commitment to continued growth and acceleration of our repair business in Montreal. Over the past year we have expanded our safety cell to meet our customers' demands and added an additional 320 part numbers to our capabilities. In addition, we have recently been awarded Airbus Approved Supplier status and are a licensed facility for many tier one OEM component manufacturers.

Having positioned the company to emerge from the Covid-19 crisis stronger, how are those plans playing out and how do you see the state of the MRO and spare parts markets now?
The industry is still disrupted, and we are seeing 60 per cent of pre-Covid volume and value. The pandemic gave us the opportunity to reset, accelerating our business and digital transformation. It has been a tremendous period of growth for the company, with a number of notable highlights.

For example, we retained all our contracted customers and onboarded six new power-by-the-hour customers, including Aer Lingus, while extending our easyJet contract for another 10 years.

We also negotiated a US$100m joint venture investment with Arena Investors, and opened, staffed and stocked a new EU hub in Italy at the height of the global lockdown.

Another highlight was developing and launching a fully automated sales platform called 'AJW eventory'.

What are your expectations for the future in terms of trends and innovations?
As part of AJW's digital and innovation roadmap, we are looking into the eVTOL and drone market, positioning ourselves to become service providers, logistics, parts suppliers and strategic partners in such new endeavours. The expansion of AJW Technique into a franchise will enable AJW Technique to offer repair and engineering services with a proven model that works, offering products that iterate with market trends and changes.

Next year, AJW Technique turns 10 and AJW Aviation turns 90 – is there a 'philosophy' or set of business principles that has underpinned the company's growth and longevity?
Since 1932, for almost 90 years, AJW Group has been transforming aviation efficiency adapting dynamically and flexibly, through recessions, global unrest and now a pandemic.

AJW's greatest strength is its independence and agility which gives it the freedom and fluidity to move with

Left: AJW Technique signed a 10-year lease renewal for its Montreal facility earlier this year, with the company committed to "continued growth" there

the market's needs and develop tailored solutions for its customers. As a company we embrace change and work hard to provide an unrivalled expertise and customer experience.

What are the main challenges that you see the business needing to respond to?
The main challenges we witnessed over this period are businesses' ability to maintain their cost structure, requiring them to divest parts of their businesses, especially those with heavy lease payments, and reducing the workforce to level with reduced work volumes.

Businesses have also had to adopt flexible working hours in line with volumes of work and accelerate their digital transformations to eliminate administrative burden and manual intervention that comes from legacy aerospace processes. The adoption of these new digital solutions has also been a major challenge in the industry, as major disruptions occur on culture and processes at the same time. It is important that businesses focus on change management culture and people just as much, if not more than, on the technology.

Can you outline your progress on digitisation?
Digital transformation has been critical, especially in MRO environments where tribal knowledge of the workforce is extensive. With the goal of maximising technicians' component touch-time, we have investigated tools to enable a digital shop floor. Examples include productivity trackers, automated payables and receivables, credit control automation, turnaround time gaming systems, performance management dashboards, piece parts provisioning models, and dynamic pricing algorithms. We have also tested asset location tracking using RFID and Bluetooth technology as a proof of concept. This allows technicians to have a full view of high value assets at their fingertips, facilitating traceability and workflow management. Beyond RFID technology, we have also investigated other hands-free systems and collaborated on predictive maintenance discoveries.

> **"The pandemic gave us the opportunity to reset, accelerating our business and digital transformation"**

At the beginning of the pandemic, we built digital tools and dashboards to closely monitor fleet recoveries by customer and by platform to ensure our operations are synchronised with flying patterns. We invested in customer-facing digitalisation which resulted in real-time monitoring dashboards and tracking tools, thereby making internal productivity fully transparent and, in turn, the customer experience seamless from end to end.

To enhance our customers 24/7/365 needs we launched a responsive, interactive and mobile customer portal, ensuring clients can access orders, view status on the go and extract any related documents. It also enables interaction with support teams, regardless of location, with no transaction delay, full data and process integration. Our new e-commerce platform for parts trading, 'AJW eventory', enables users to browse and purchase from our extensive inventory, with easy access to full paperwork trace, chat functionality and the ability to ship via any chosen method and track the shipment in a few clicks.

What about progress on sustainability?
Sustainability comes in two forms – creating longevity of people, process, data and technology to drive continued success, as well as the physical side of investing in environmental sustainability via green approaches to production and repair.

Some transformations lead with a focus on generating value for the business in the short-term and neglect the long-term effects on the business, especially the ability for a business and the people to sustain the changes. At AJW Technique, we ensure that the people are at the core of the transformation.

We start with clean-sheeting data and resetting consistent processes across the board. The final step is to then introduce technology built in partnership with the business, spending 80 per cent of the time on change management and successful adoption. Customer journeys are not only for the customer!

In terms of the product roadmap, AJW Technique has a robust training and qualification process which ensures successful deployment of any new capability launched operationally. In parallel, customer experience and procurement work to ensure a proper sales push is in place with secured contractual volumes and replenishment rates in line with work inflow.

At AJW Technique Interiors our most innovative product is 'SkyLeather' – which is a lightweight synthetic material that has the possibility to significantly reduce the carbon footprint of an aircraft – leading the way for sustainability. For example, an A320 operator could save nearly 16,000kg of fuel and reduce their carbon footprint by over 50,000kg per year, per aircraft, using SkyLeather. With a weight of 460g/sq m, operators can save 0.86kg per seat compared to hide leather, as well as being extremely durable, anti-microbial, easy to clean and eco-friendly.

Complex MRO vendor network?

Let us be your single point of contact

AJW Group is a world-leading, independent component parts, repair and supply chain solution provider, transforming efficiency in **commercial**, **business** and **defence** aviation.

NEW - AJW Technique Europe, your local centre of excellence for battery repair and overhaul.

NEW - AJW Technique Interiors, delivering revolutionary synthetic materials for seat covers, carpet kitting, headrest covers and life vest pouches.

ajw-group.com

MROs & OEMs:

A CHANGING DYNA

Sometimes partners and sometimes competitors, the relationship between OEMs and MROs has changed over the years and has not been without controversy. ***Jason Holland*** investigates whether the balance of power is now shifting once more in the wake of Covid-19

The way in which MROs and OEMs have worked together – or indeed separately – has evolved over time. Prior to the early 2000s, with the notable exception of engine OEMs, the roles of the two types of company were quite clear and distinct – OEMs "largely left the MRO market to aftermarket independent and airline-affiliated MROs", as Joshua Ng, director at Alton Aviation Consultancy, puts it.

From the 2000s up to the present day, airframe, aircraft system and component OEMs have made strategic efforts to compete with the independent and airline-affiliated MRO suppliers, having "realised the value [in terms of] revenue and profitability of the aftermarket", Ng says. "Given the outsized advantage OEMs have with intellectual property, design data and manuals, many of the larger MROs have elected to partner with OEMs rather than competing. Examples are material agreements, authorised service centres and distribution agreements."

Singapore-headquartered SIA Engineering Company (SIAEC), for example, says it has set up a total of 23 subsidiaries and joint ventures across seven countries with OEMs

and strategic partners including Rolls-Royce, Pratt & Whitney, GE, Safran, Collins and Jamco to develop a range of MRO capabilities.

"The customer is at the centre of strategic partnerships and for SIAEC and our partners, building an MRO ecosystem enables us to better serve our customers whether in Singapore or at our overseas locations," the company says, when asked to reflect on the benefits of such partnerships. "Through strategic partnerships, SIAEC and our partners can leverage respective expertise and jointly deliver to customers a wider and deeper range of services, including capabilities on the latest generation of aircraft."

US-based MRO StandardAero does business exclusively as an OEM-approved MRO provider to ensure "the highest levels of support, in terms of OEM training for our technicians, OEM auditing of our facilities, access to OEM repair schemes and rental pools, support of OEM warranties, and use of OEM parts", says Alex Youngs, director of sales and marketing business intelligence, airlines & fleets at the company.

But StandardAero's relationship with several OEMs goes beyond MRO licences. "We provide offload support to multiple OEMs, whereby the OEM is able to use us to support its own MRO workload as capacity requires," explains Youngs. "We also have partnerships to provide life-of-type services for several engine programmes, including the Rolls-Royce RB211-535 turbofan and the Pratt & Whitney Canada JT15D's pay-per-hour support programme.

"Our StandardAero Component Services (SACS) business provides component repair services to a large number of OEMs, and on a wide range of engine platforms that include several outside of our regular MRO activities, such as the CF6, PW1000G, PW2000, PW4000 and V2500. Finally, our OEM relationships also include a partnership with GE Aviation on the Testing, Research and Development Centre (TRDC) in Winnipeg, in support of GE's work on the LEAP, GENx and Passport engine families."

Above: MTU Maintenance's "three-pronged" aftermarket strategy includes work within OEM networks, co-operations with airline partners, and independent business acquisition Photo: MTU Aero Engines
Below: StandardAero says it does business exclusively as an OEM-approved MRO provider

As well as ensuring high levels of quality and support, Youngs says "the trust engendered through a strategic partnership with an OEM may also lead to additional opportunities presenting themselves, as the OEM becomes familiar with the MRO and its capabilities". OEMs may also come to formally adopt repair schemes developed by MROs, he notes, "thereby reflecting the two-way nature of OEM-MRO partnerships".

Such strategic partnerships are thoroughly vetted by both parties prior to finalisation, Young affirms, "which helps ensure their success by ensuring that the obligations involved are fully understood. The enduring nature of these partnerships, which regularly run into decades, confirms that they work well in practice."

"OEMS WILL TAKE LONGER TO RECOVER; MROS SHOULD BE IN GOOD POSITION TO SURVIVE AND THRIVE"

Engine exception

As noted, engine OEMs have a longer history of aftermarket involvement than their airframe and component counterparts. Germany's MTU Aero Engines launched its MRO business, MTU Maintenance, in 1979 to provide aftermarket services for commercial engines. That gives the MRO company an interesting perspective on the relationship between OEMs and MROs.

MTU Maintenance says it has a "three-pronged" aftermarket strategy that includes work within OEM networks (via RRSPs from MTU Aero Engines), co-operations with airline partners such as with its joint venture facilities with Lufthansa Technik and China Southern, and independent business acquisition. "As such, we both work with and compete against OEMs," explains Martin Friis-Petersen, SVP MRO Programs for MTU Aero Engines. "We typically work with Pratt & Whitney on narrowbody engines, GE on widebody engines and Pratt & Whitney Canada on regional jets."

Assessing the benefits of forming a strategic partnership with OEMs, Friis-Petersen says: "Our collaboration with OEMs ensures market access to newer generation engines. This includes licences to perform MRO and access to manuals, for instance. As part of the OEM network, we perform engine MRO according to OEM guidelines and on behalf of the OEM. OEMs tend to benefit from more flexibility, both in terms of the packages they offer customers as well as network flexibility without investing in their own capacities.

"We have very good relationships with OEMs, for instance on the PW1100G-JM programme, for which we have complete DAT capabilities at three facilities worldwide: EME Aero (a 50/50 joint venture with Lufthansa Technik), MTU Maintenance Hannover and MTU Maintenance Zhuhai. And we carry out parts repairs at two further locations: MTU Aero Engines and MTU Maintenance Berlin-Brandenburg.

"MTU Aero Engines' RRSP share on the PW1100G-JM programme is 18 per cent; we were one of the first worldwide to induct and perform initial maintenance on these engines in 2016. We have amassed a wealth of knowledge on

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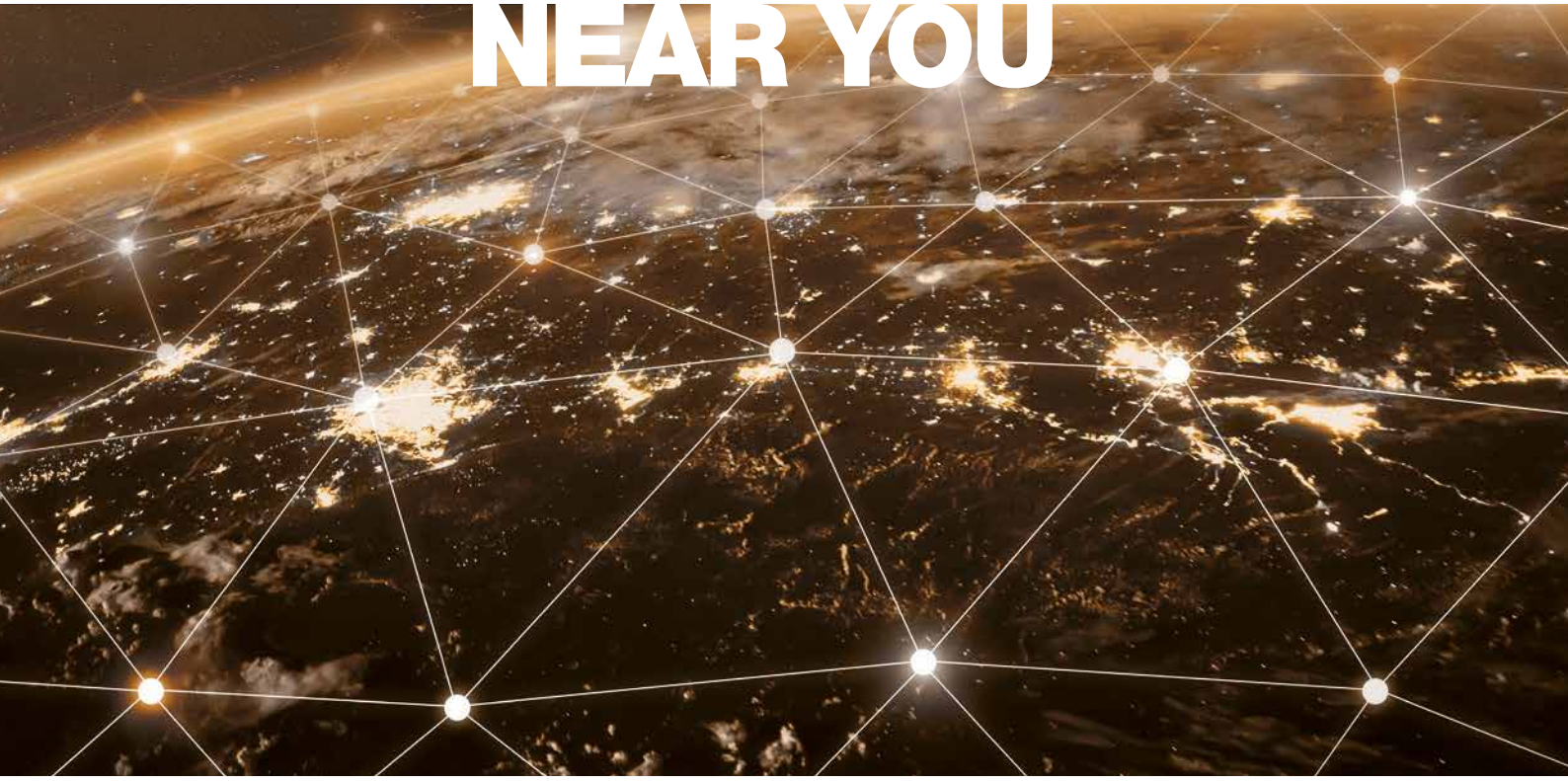

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*The ACJ Service Centre Network comes in addition to the Airbus Worldwide Support Network.

ACJ CORPORATE JETS

AIRBUS

photo: Singapore Aero Engine Services

SIAEC has set up a total of 23 subsidiaries and joint ventures with OEMs and strategic partners

"WE PARTNER WITH SPECIFIC MROS TO DEVELOP SOLUTIONS AIMED AT INCREASING THE OVERALL EFFICIENCY OF AIRFRAME MAINTENANCE"

repair processes and share this with the OEM, and this can lead to our processes being adopted into the OEM manual."

Developing relationship

On the airframe OEM side, companies have taken different approaches to the aftermarket, whether as a pure integrator or by taking a more active role.

Airbus has developed packages like Flight Hour Services, covering components and aircraft based on a contractual fixed hourly-rate payment, ensuring maintenance services from qualified suppliers.

In a recent agreement, in April, Airbus signed a long-term component pool agreement with Turkish Technic for the A350 aircraft fleet of Turkish Airlines. The OEM will provide A350 aircraft parts with guaranteed availability facilitated by pool access service, on-site stock at Turkish Technic's main base in Istanbul, and component repairs.

Airbus said that to service this contract along with future Flight Hour Services business in the Europe, Middle East & Africa (EMEA) region, it would extend its existing pool in Europe to cover A350 aircraft components.

Boeing too has extensive partnerships with MROs to deliver lifecycle services. The company's GoldCare programme was initially developed in support of the 787.

"Customers have access to MRO facilities around the world that deliver technical engineering services when and where it is needed to meet growing demand as the industry continues to recover," Boeing says of its offerings.

"Commercial operators can access our internal commercial MRO capability and an extended network of third-party global MRO providers. This network provides the proactive solutions and immediate customer support resources required for airplane-on-ground situations. We partner with specific MROs to develop solutions aimed at increasing the overall efficiency of airframe maintenance for our airline customers."

Looking at component programmes, Boeing leverages a variety of MROs including OEMs and independent or large integrators for its repair network. "Boeing also has strong, established relationships with highly capable MRO suppliers to complete modifications, line maintenance, heavy maintenance, and on-call service for our customers, as well as passenger-to-freighter conversions for cargo operators and lessors. These relationships are focused on ensuring safe and efficient operations for our customers."

The exact approach taken by an OEM to the aftermarket will force MRO companies to act – or react – in different ways. "Where an OEM seeks to act as an integrator, there will almost always be a margin impact on MRO providers, offset to some degree by the scale economies associated with what effectively turns into an offload programme," explains StandardAero's Youngs. "Such approaches are also typically more complex, and can be less flexible as a result.

"By comparison, OEMs which engage directly with airlines will typically find it easier to tailor their offerings to meet the specific needs of the airline, albeit at the downside of having to manage multiple disparate service offerings. Airlines themselves are often able to negotiate with OEMs to set up their own internal maintenance facilities, though market shocks such as Covid-19 do typically lead to a portion of airlines making the decision to refocus solely on passenger operations, reassessing their appetite for auxiliary services such as MRO."

Then there is the question of MRO companies who choose to remain independent of OEMs. Alton Aviation Consultancy observes that there is a "market niche" for such organisations. "The key for success is identifying the right value proposition for the airline customers," says Ng. "Some independent MROs have chosen to go down the intellectual property route, leveraging PMA and DER repairs as an alternative cost savings solution for their airline customers.

"Others have chosen a more conservative route and prefer to collaborate, leveraging used serviceable material (USM) usage with OEM approved parts repairs to develop economical solutions for their airline clients."

At the turn of the year, Alton Aviation Consultancy predicted that OEMs would begin to exit many of their airframe and component MRO investments this year, as they would see the importance of MROs as valuable suppliers and reassess their business models "with a back-to-basics theme focused on their core competencies of engineering design and manufacturing".

"In general, I believe our predictions have been solid," says Ng. "Airbus has exited its airframe MRO venture with Singapore Airlines Engineering Company. Boeing appears to have scaled back its previously aggressive aftermarket ambitions and vertical integration efforts. And moreover, we have not seen any recent announcements of new aftermarket initiatives. Time will tell."

> THERE IS A "MARKET NICHE" FOR MRO COMPANIES WHO CHOOSE TO REMAIN INDEPENDENT OF OEMS

Youngs observes that if OEMs can make more money by focusing on their core competencies "then it stands to reason that they will do so". He adds: "One interesting factor now facing OEMs is the strength of lessors, which now account for 60 per cent of deliveries: as such it is likely that lessors will be attempting to maximise their leverage with OEMs."

Competition and Covid-19

In any competitive industry, of course, there will always be some form of tension between manufacturer and supplier given the dependency for parts and data – and this is not unique to the aviation industry, according to Ng.

The OEM-MRO industry is notorious for 'coopetition' – a combination of cooperation and competition – according to Boeing. "This healthy collaboration not only benefits the OEMs and MROs, but also the airlines and the flying public," the company says.

"We're focused on creating a space for cooperation where it leads to innovation, but we also require competition to encourage investment and innovative thinking. The goal is finding the right balance that is critical for all of the participants in the MRO value stream."

And it seems competition has been put on hold for now, as the aviation industry struggles to recover from the Covid-19 pandemic, says Ng. "In the engine MRO space, there is more collaboration between MROs and OEMs, especially in light of recent IATA-brokered agreements," he states. "In the component MRO space, we continue to see significant consolidation and M&A activity in an effort to shore up balance sheets, reduce competition and increase buying power."

Photo: MTU Aero Engines

Left: Engine OEMs have a longer history of aftermarket involvement than their airframe and component counterparts. Pictured is a PW1100G-JM engine in the test cell at MTU Maintenance Hannover

SIAEC believes the Covid-19 crisis has emphasised the need for all stakeholders within OEM-MRO networks to work closely together "as we jointly determine how best to navigate the post-Covid aviation landscape. We believe this will only help to strengthen the relationships making up the aftermarket networks."

StandardAero's Youngs expects that the market's recovery over the coming years will see OEMs ramp-up deliveries, "which will in turn emphasise the importance of strong global support networks to keep operators flying.

> WHEN OEMS AND MROS WORK TOGETHER TO COMMON GOALS A POSITIVE RESULT IS MORE LIKELY

"OEMs themselves typically generate higher margins from parts sales than MRO work, and from a comparative advantage perspective it therefore makes more sense for them to focus on the former."

Youngs says the impact of Covid-19 on OEM aftermarket networks was primarily one of reduced demand as airlines suffered from a large fall in passenger numbers.

"Some MROs will also have inevitably seen OEM offloaded business fall as the OEMs' own available capacity rose," he notes. "While Covid-19 has not had any fundamental impact on the rationale behind OEM aftermarket networks, there will likely be some degree of consolidation due to the financial fallout of the pandemic."

New trends and technologies

As OEM-MRO partnerships continue to evolve, they will need to consider new trends and technologies. While parts and data remain the primary reason for partnership, the data element has expanded somewhat, according to Alton Aviation Consultancy's Ng. "Data would have traditionally referred to component repair manuals or technical information," he explains. "However, data today would also refer to airline-generated data for predictive maintenance and data analytics. OEMs and MROs are in the midst of positioning themselves in this space, and having the data helps test and develop these new applications."

He sees predictive maintenance partnerships as "nascent and slowly evolving, but not with the same sense of urgency in terms of investment and resource allocation as pre-pandemic. It's just not a priority right now, which is completely logical given the industry situation."

For its part, Boeing says it continues to invest in digital solutions. "We offer a portfolio of predictive analytics tools which help convert potential unscheduled maintenance events into scheduled ones using in-flight real-time and prognostic alerts. We have changed our focus to become more flexible in the services we provide by offering a suite of engineering services with targeted solutions. This helps customers improve technical reliability and reduce repair costs by providing customised predictive and prescriptive analytics solutions for their maintenance needs."

Is the balance shifting?

This article has shown how OEM-MRO partnerships have and continue to evolve. Although competitive tensions exist beneath the surface, relationships between companies have now often got to the point of seamless co-operation and efficiency. The question of whether the balance of power is now shifting from OEMs to MROs in light of the Covid-19 crisis remains.

"OEMs have been doubly hit during this crisis, with production rate cuts and aftermarket contraction, compared to MROs [who have suffered] aftermarket contraction only," says Alton Aviation Consultancy's Ng. "Given the expected slower recovery of production rates, coupled with a probable slowdown in new aircraft platform development, OEMs will clearly take much longer to recover from this crisis. Whereas financially stable MROs with solid access to capital should be in good position to survive and thrive in the near-term."

That means MROs' bargaining power should improve. But the best approach might not be to see these relationships in terms of a power struggle. When OEMs and MROs successfully work together to common goals – along with all other stakeholders – then a positive result becomes much more likely. "MRO-OEM partnerships are here to stay," as SIAEC puts it, "and we will continue to nurture our ties with our OEM partners as these are mutually beneficial relationships which ultimately allow OEMs and an MRO like ourselves to better serve our customers across different regions."

Boeing agrees that relationships between OEMs and MROs will continue to evolve. "To think of them as purely channels for sharing, providing or gathering data or as a delivery stream for parts is limited and not the primary function of any MRO," the company says. "We're focusing on collaborative ways of driving standard work, efficiency and safety into the global delivery of MRO services and encouraging MROs to share advancements in safety and efficiency that will benefit the operators."

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TAKE OFF TO TOUCH DOWN

Landing gear overhaul is a critical MRO activity that involves a complex variety of chemical, machining, plating, non-destructive inspection and other processes, all of which must be performed in exactly the right order. Specialised skills and techniques are required, so only certain companies provide the service. ***Chris Kjelgaard*** reports

No aircraft that isn't a floatplane or that uses skids or skis when landing can operate safely without using some form of wheeled landing gear. Every modern commercial aircraft and almost every modern business aircraft has a wheeled landing gear system installed.

These systems have to withstand high compression and other stresses every time the aircraft on which they are installed fly. Because landing gears come into contact both with the ground and also the climatic conditions through which the aircraft fly, they are also exposed to potential corrosion to a greater degree than most other parts of the aircraft.

Modern landing gears make use of pneumatic, hydraulic and electrical systems to operate as intended. They also bear other systems – wheels, brakes, landing lights, actuation sensors and steering sensors – which are vital for the safe operation of the aircraft. In most cases, landing gears have to retract and extend repeatedly, day after day and – in commercial aircraft – several to many times daily. So landing gear systems have to be extremely robust, and they have to be maintained very carefully.

The structural and functional characteristics of landing gears, and the high stresses they must bear, make landing gear overhaul a specialist area of MRO. Landing gear maintenance involves a variety of different chemical, metallurgical, inspection and repair processes. These call for a substantial number of different techniques to be used to identify potential areas of stress and corrosion in landing gear legs and other components, and then to repair any problems found.

The hydraulic, pneumatic and electrical systems and connections that landing gears require all need to be inspected, repaired as needed, and tested to ensure they are working properly when each overhauled landing gear leaves the MRO shop to return to the aircraft operator.

The need for a landing gear MRO shop to offer most or all of these capabilities means that substantial investment in specialist equipment is required. As a result, a relatively small number of companies provide landing

Left: A Safran engineer works on an ATR-72 main landing gear. Photo by Adrien Daste/Safran

LANDING GEAR MAINTENANCE INVOLVES DIFFERENT CHEMICAL, METALLURGICAL, INSPECTION AND REPAIR PROCESSES

gear MRO. Some of these specialist companies are owned by the large aerospace manufacturers which make most commercial and business aircraft landing gears, such as Safran Landing Systems and Collins Aerospace.

However, first-tier aircraft manufacturers, such as Boeing, are often the official vendors of the landing gears on their aircraft, even though those landing gears are actually made by sub-vendors. The aircraft OEMs develop the maintenance and inspection techniques required to overhaul their landing gears properly and they provide the maintenance and technical manuals which detail the MRO processes and testing techniques needed.

Some landing gear MRO specialists are not manufacturer-owned. One such is AAR Corporation, which is not only an MRO industry giant generally but has the largest non-OEM landing gear MRO facility in the world in terms of overhaul volume. Located about five miles west of Miami International Airport, AAR's 250,000sq ft landing gear MRO facility employs around 450 people to overhaul the landing gears of some 43 different civil and military aircraft types. It handles about a 60-40 mix of civil aircraft and U.S. Air Force business, according to Scott Ingold, vice president and general manager of AAR Landing Gear Services.

Overhaul scheduling

Landing gear MRO is a calendar-and-flight cycle-based activity, according to Ingold. The maintenance manuals for most current-generation commercial and business aircraft types require their landing gears to be overhauled every 10 years or every 20,000 flight cycles, whichever occurs sooner.

Most mainline single-aisle and widebody aircraft will reach the 10-year calendar limit before accumulating 20,000 additional flight cycles. However, many regional aircraft, and narrowbodies operated intensively by ultra-low-cost carriers, accumulate 20,000 cycles in less than 10 years. The landing gears of such aircraft may need to be overhauled every eight years on average, says Ingold.

The manufacturers of some current-generation commercial aircraft such as the Boeing 787 and the Embraer 190 are working through inspection programmes intended to culminate in the landing gears of those aircraft being certificated for overhaul every 12 years, according to Ingold. Additionally, various business aircraft types which are not operated anything like as intensively as commercial aircraft, such as the Boeing 737-based Boeing Business Jet, are certificated for their landing gear overhauls to be performed on a 12-year basis.

250K

Located about five miles west of Miami International Airport, AAR's 250,000sq ft landing gear MRO facility employs around 450 people to overhaul the landing gears of some 43 different civil and military aircraft types

Landing gear overhaul usually involves an entire shipset of gear bogeys and cylinders being sent for overhaul at the same time. This is because each individual bogey should have accumulated the same amount of cycles and calendar time on the aircraft as each of the others, unless one particular bogey or cylinder assembly has required removal individually for damage inspection and repair at some intermediate point.

The downtime required

Overhauling a set of landing gears is a fairly lengthy process and the time required for the task can vary. The downtime period required depends both on the size of the aircraft from which the landing gear set comes – the larger the aircraft, the larger, heavier and more numerous its landing gear cylinders and bogies will be – and whether or not the operator of the aircraft decides to conduct a forward exchange or loan of a replacement landing gear set in order to keep the aircraft in service while the original gear is being overhauled.

Purely in terms of the time required for the overhaul of the landing gear set from a narrowbody aircraft (which typically consists of two main-gear bogeys and one nosewheel bogey on a regional jet and a single-aisle aircraft), Ingold reckons the overhaul will take from 30 to 60 days. The time needed depends on the condition of the landing gear in terms of corrosion and stress found, and the repairs required. If a forward exchange of a replacement landing gear set is performed with the aircraft's operator in advance of overhaul, then the overall process – including shipping and installation of the replacement set, as well

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Left: Ametek subsidiary AEM performs its landing gear overhauls at a facility in Ramsdale, Kent in the UK
Below: AAR handles about a 60-40 mix of civil aircraft and U.S. Air Force landing gear business

BOEING IS NOW REQUIRING A NEW CADMIUM-PLATING TECHNIQUE FOR THE LANDING GEAR OF THE BOEING 737 MAX

as removal of the original set to go for overhaul – can take from 45 to 75 days.

Alan Doherty, vice president of sales for Safran Landing Systems' MRO programmes, estimates that, in terms of overhaul downtime only, overhauling the landing gears from a small regional aircraft will take about 30 days, while overhauling gear sets from an A320 family or a 737 family aircraft will take about 40 to 45 days. Overhauling gear sets from medium-sized widebodies such as A330s and 767s will take from 60 days to two full months, while overhauling the gear sets from large widebodies such as 747s and 777-300ERs can take up to 90 days.

Andy Wheeler, managing director of UK-based company AEM – an Ametek subsidiary that makes and supplies various specialised equipment items for commercial aircraft, in addition to overhauling 737 family and military aircraft landing gears – offers a detailed estimate of the time required to overhaul a 737 landing gear set. "For the most part, we would recommend our customers plan around 50 calendar days for overhaul and should they opt to support the event with an AEM loan shipset for the duration, an option often taken by airlines to ensure the aircraft retains revenue-earning capacity throughout the process, we suggest 70 days, which clearly gives a sufficient window for shipping and change over," he says.

While Wheeler says AEM has available for loans to customers "a considerable portfolio" of landing gear sets for 737 Classic models such as the 737-400 and 737NG-family aircraft when their original gears go for overhaul, both AAR and Safran Landing Systems mainly offer permanent forward exchanges of landing gears at overhaul. One important reason for this is that a forward exchange involves just one removal of a landing gear set and one installation of another set, but a loan involves two full removal-and-installation sequences – first at the beginning of the loan and then again when the loan ends.

According to Doherty, Safran Landing Systems usually provides loans only when the customer specifically wants its original gear back after overhaul to re-install on the aircraft or, similarly, when the operator of the aircraft is leasing it and the lease terms are "arduous" – the lessor requiring that the aircraft is returned at the end of the lease with the original landing gear in place.

The overhaul process

The landing gear overhaul itself is performed as a fixed sequence of events. First, each component is cleaned of any accumulated grease and oil. Wheeler says AEM – which performs its landing gear overhauls at a facility in Ramsgate, Kent – prefers to see landing gears come in for overhaul in an oily, greasy condition because the oil and grease will have protected them to some degree from corrosion. Clean, shiny landing gears are more vulnerable to corrosion from airborne sand, de-icing and water forced into the gears during pressure washes.

Each landing gear in the set for overhaul is disassembled into its major components and the bushings in each component – the bolts that tie the various components together into full assemblies – are removed. Ingold says AAR inspects each disassembled component and scraps any parts which cannot be repaired. (AAR's practice is to scrap all the original bushings on each landing gear and replace them with new ones when re-assembling the landing gear bogey.) AAR then sources new replacement parts from the relevant manufacturer and uses those when rebuilding the landing gear after it has overhauled and repaired all of the reusable components.

60

Purely in terms of the time required for the overhaul of a landing gear set from a narrowbody aircraft (which typically consists of two main-gear bogeys and one nosewheel bogey on a regional jet and a single-aisle aircraft), a landing gear overhaul will take from between 30 to 60 days

After the landing gear is disassembled, all of its major components, including the inner and outer cylinders of the landing gear leg, are stripped of their cadmium and chrome protective coatings. (The inner cylinder is the hydraulically damped, movable piston at the bottom end of the leg and the outer cylinder – which is pneumatically damped with nitrogen – is the larger-bore cylinder at the top, inside which the piston moves up and down.) Machining of each component then takes place, to clear any defects such as burrs and corrosion from the metal base material of the component.

AEM (and AAR) next performs a chemical etch inspection of each component using a high-pressure, high-temperature spray of a nitric acid solution to clear part of the component's surface area, in order to verify that the machined base material under the surface of the component is clear of defects. After that, each component undergoes a non-destructive testing (NDT) inspection. The type of inspection for different components varies according to the specific instructions for each component contained in the landing gear's component maintenance manual.

NDT and plating

Several types of NDT are commonly used in inspecting machined landing gear components for cracking and other evidence of stress or potential metal fatigue. Ingold says NDT techniques used by AAR to inspect machined landing gear components include fluid (dye) penetrant inspection, magnetic particle inspection, eddy current inspection and Barkhausen inspection.

Barkhausen inspection is a stress-identification technique which "involves inductive measurement of a noise-like signal generated when a magnetic field is applied to a ferromagnetic sample", according to the website of NDT Sales. "In most commonly used steels the Barkhausen signal will increase with the presence of tensile residual stress and decrease in the case of compressive stress states," it states.

Following the NDT inspection of each machined landing gear component, components in which areas of potential stress have been found are subjected to shot peening to reduce the stress profile. Shot peening involves using blasts of high-pressure air to shoot small pellets (often made of metal) on to the surface of a component to generate multiple indentations. This encases the component in a compressive stressed surface layer and thus increases the resistance of the component's metal material to fatigue, helping prevent the propagation of cracks in the metal.

Left: Landing gears are mechanical marvels; keeping them in good working order is a complex and specialised task
Below: Safran Landing Systems operates five landing gear MRO facilities of its own, including at Cheltenham in the UK. Photo by Luca Sage/CAPA Pictures/Safran

The next step in the landing gear overhaul process is for each component to undergo chrome or nickel plating, where necessary, according to Wheeler. Cadmium plating is then performed to provide a fresh layer of protective coating to the surface of each component, after which it receives a final NDT inspection. The landing gear bogey is rebuilt with new bushings and the gear is painted to help protect the gear components from corrosion.

In addition to all of these activities, landing gear MRO facilities such as those operated by AAR and AEM also extensively test the pneumatic, hydraulic and electrical systems associated with each landing gear unit to ensure they are working properly. According to Wheeler, AEM performs full testing of all landing gear hydraulic LRUs in accordance with the manufacturer's specification. It pressure-tests each gear unit's hydraulic hoses and pipes and carries out electrical testing of wiring looms, sensors and connectors. The company also performs condition checks on the conduits which contain the electrical wiring and those which protect pneumatic and hydraulic lines.

Landing gear overhaul involves various different plating processes for different components, according to Ingold. These processes include plating with sulfamate nickel; electroless nickel (using chemical reduction to plate the component, rather than electricity); hard chrome; low hydrogen-embrittlement cadmium; bright cadmium; Iridite/Alodine to plate aluminium and magnesium parts; and chromic, boric, and titanium anodizing.

HVOF plating is the future

Ingold says Boeing is now requiring a new cadmium-plating technique for the landing gear of the Boeing 737 MAX and the U.S. Air Force is also requiring that the same technique be used for the aircraft it operates. This technique is known as high velocity oxygen fuel (HVOF) plating. It is a thermal spray coating process which involves mixing fluid fuel and oxygen and feeding the mixture into a combustion chamber, at which point the mixture is ignited.

The resulting gas is of extremely high temperature and pressure and it is ejected through a nozzle in the combustion chamber at supersonic speeds. Powder of the desired metal coating material is injected into the high velocity gas stream, causing the metal powder partially to melt. The stream of hot gas and powder is sprayed on to the surface which is to be coated. This creates a dense coating of very low porosity and high bond strength, improving corrosion resistance. The coating provides "much better performance" than traditional cadmium-plating treatments, says Ingold.

Few landing gear MRO facilities are equipped as yet to provide HVOF spray plating. Safran Landing Systems uses HVOF in its landing gear manufacturing operations, according to Doherty. However, the huge provider of landing gear MRO – which operates five landing gear MRO facilities of its own (at Queretaro in Mexico, Toronto in Canada, Cheltenham in the UK, and Dinard and Molsheim – its largest facility – in France) as well as three joint venture facilities – does not yet have any HVOF capabilities of its own.

"HVOF is for the future [in landing gear MRO] and it will be quite a factor in MRO economics," says Doherty. This is because "quite a significant investment is required" to install HVOF plating capability. Smaller landing gear MRO companies might not be able to afford it. Additionally, "the volume [of demand for HVOF in landing-gear MRO] is not there yet", he notes, so the decision whether or not to install the capability "is hard to calculate from an investment point of view".

Doherty says Safran Landing Systems plans eventually for its landing gear MRO operation to offer HVOF capability, and to do so at more than one of the company's facilities. "The idea would be to have HVOF in three regions, to avoid shipping [landing gear] rotables round the regions," he says.

10

Landing gear MRO is a calendar-and-flight cycle-based activity; the maintenance manuals for most current-generation commercial and business aircraft types require their landing gears to be overhauled at intervals of every 10 years or every 20,000 flight cycles, whichever occurs sooner

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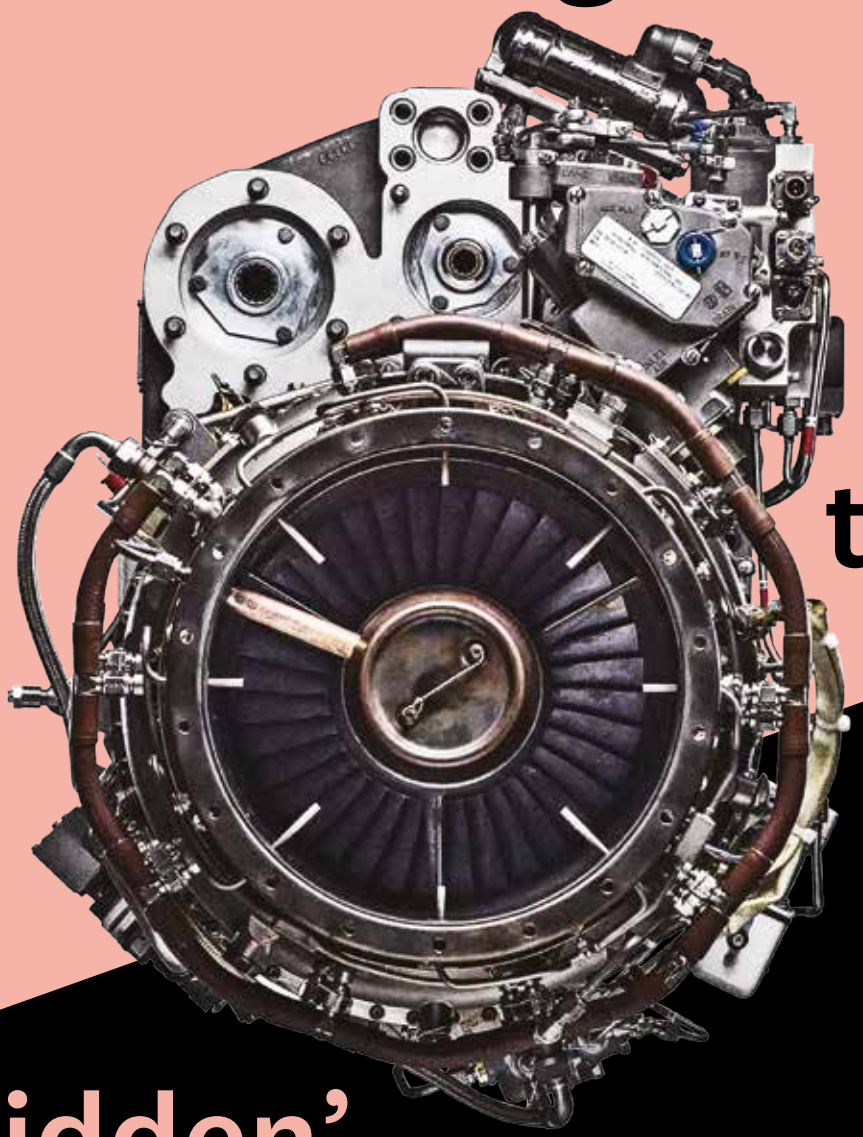

APUs deliver power to all areas of an aircraft, so keeping them airworthy is vital, as ***Bernie Baldwin*** reports

Left: Honeywell's 331 APU series can be found on many widebody applications for both Boeing and Airbus aircraft
Right: StandardAero develops new repairs every year to cut turnaround times and costs for operators

Often only recognised by the travelling public as 'that engine sound' that passengers hear as they board an aircraft after walking from the terminal across the ramp, auxiliary power units (APUs) are highly important devices on an aircraft. They are workhorses that provide energy for functions other than propulsion.

When it comes to maintaining these units, although there are similarities to engine maintenance, APUs have a different role and operating conditions, so some of the maintenance procedures required will differ.

Randy Mengel, vice-president and general manager of StandardAero's Maryville Business Unit, concurs but also believes that the overall approach to APU maintenance should match that for engines. "Being out of sight, APUs are sometimes treated as line replaceable units, only touched when they fail. However, despite being very reliable, APUs should be maintained with similar care to an engine. As such, operators should conduct periodic inspections – watching out for oil leaks or obvious parts degradation – and, if possible, make use of health monitoring tools for advance notice of potential issues," he explains.

"While APUs are far simpler than large turbine engines, they contain parts with finite component lives, so operators should also take care to keep up with maintenance requirements and parts replacement, examples including combustion assemblies, fuel pumps and starters. Finally, operators should ensure they take special care of connectors, in order to avoid unnecessary APU failures and removals."

EPCOR is the Netherlands-based, wholly-owned subsidiary of Air France Industries KLM Engineering & Maintenance (AFI KLM E&M) concentrating on the overhaul and repairs of APUs. Specialist shop engineer on APUs Boaz Kuijer argues that the maintenance process differences for APUs and aircraft engines are not that great.

"For a normal, high time APU which requires a full disassembly, it will first get an induction where we check the exterior for any abnormalities like damage, dirt, oil traces or missing parts/LRUs, then we check the fluids and filters, write down the part numbers of LRUs and, among other things, do a borescope inspection," he says. "The engineer will thereafter check all this information and determine the appropriate workscope, which then needs approval by the customer.

"With the workscope approved, the APU will be disassembled and cleaned in accordance with the workscope and manuals, after which the parts go for inspection where the findings are noted and, if necessary, sent for repair. Once the parts have been repaired, the APU can be assembled and tested. If the test is passed, the APU is certified and sent to the customer."

The difference between APUs and larger aircraft engines is the maintenance philosophy, Kuijer believes. "APUs are based on 'on-condition' which means that the APU could stay on-wing until it is not in an airworthy condition anymore, in the respect of the Maintenance Planning Document," he says. "Most operators though use preventive maintenance, where the APU is removed before it fails. They can also rely on our predictive maintenance programme, called 'PROGNOS for APU', which was developed by EPCOR."

Ray Boyd, senior director, large APU product line at Honeywell Aerospace Secondary Power Systems, picks up on APUs being maintained 'on-condition' rather than hard time maintenance intervals. "This means that the APU is able to stay on the aircraft until there is a failure or significant performance degradation due to use," he notes.

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> "TAKE SPECIAL CARE OF CONNECTORS IN ORDER TO AVOID UNNECESSARY APU FAILURES AND REMOVALS"

"For this reason, Honeywell provides the highest reliability for all of the APUs offered in the business and general aviation, air transport, defence and space markets. The 'mean time between unscheduled removal' (MTBUR) is almost double the reliability of the next best alternative," Boyd claims.

Although aircraft size can vary, Boyd says there are no differences in the maintenance practices related to their size. "It is more that the differences in maintenance practices are aligned to the market requirements for the business vertical that the aircraft serves," he says. "As an example, for narrowbody and widebody applications, these APUs and aircraft support the air transport market, so a higher MTBUR is required as airlines typically fly 2,000-3,000 hours annually. For business and general aviation aircraft, lower annual utilisation means the MTBUR can be lower."

According to Kuijer, the biggest difference between smaller and larger APUs is the number of parts and modules, with larger APUs found on large narrowbodies and widebodies usually having a separate load compressor module which is otherwise integrated in the power section for smaller APUs. "This affects the maintenance in that it takes a longer time to clean and inspect parts, but it does give the engineer more options to, for instance, disassemble only the load compressor if the power section and gearbox are still in serviceable condition," he reports. "Larger APUs also usually contain multiple compressor and turbine stages due to the larger power output required for the aircraft. This does, however, increase the number of parts that need to be cleaned and inspected."

Kuijer notes that the APU for the A220 is "very similar" to that in both the A320 and 737 and can therefore also be considered large.

StandardAero's Mengel observes two main differences affecting APU maintenance due to aircraft size, relating to usage and operating environment. "APUs in regional aircraft are likely to be used more often, due to the shorter trip times and higher flight cycles compared with large jets," he says. "This means that their APUs will have higher cycle counts, and different cycle-to-hours ratios than APUs on larger mainline aircraft.

"In addition, regional jets may have different operating environments, both in terms of their reliance on APUs (for example, due to operation from smaller airports without reliable GPU access) and also in terms of the potential for operation in sandy or salty environments (again due to regional jets being operated from a wider range of airports than larger jets). As such, regional jet APUs may require more frequent maintenance than units used in mainline jets."

Whether an APU is large or small, new repair techniques are introduced all the time to enable swifter turnaround, better repairs, lower costs or, indeed, any positive combination of those benefits.

Highlighting StandardAero's efforts in this area, he says: "Our focus is on developing repairs. This has a multi-faceted benefit to all in the supply chain. It mitigates the risk of the supply chain and need for new parts. It also saves operators money by enabling the repair of parts/components as an alternative to replacement with new parts. Finally it helps us drive down turnaround times by avoiding delays associated with incoming parts.

"StandardAero develops new repairs every year, to achieve the benefits mentioned. We are also deploying 3D printing technology for use with developing fixtures, coverings and hardware protection during the repair cycle.

"In addition, StandardAero has recently added support for two new APU types: the Safran SPU300, which equips the Bombardier Global 7500, and the Pratt & Whitney Canada PW901A/C, which equips the Boeing 747-400 and 747-8 and which was introduced through StandardAero's recent acquisition of H+S Aviation."

StandardAero is a Honeywell GTCP36 and RE220 APU authorised service centre

At the sharp end, EPCOR has invested in a fuel nozzle test bench, generating significant timesaving in the process, according to Kuijer. "We started working with a CNC lathe and a CNC milling machine, increasing our in-house machining and repair capability, which also reduces the turnaround time of repairs and the manufacturing costs of tooling," he notes.

"We continuously develop our 3D scanner capabilities and are able to measure parts with the greatest precision. The result is a significant drop in scrap parts resulting in cost savings for customers. Next on the list is a cold spray

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machine that will further increase our repair capabilities on parts and is our first step into metal spray and additive manufacturing."

Not a repair technique per se, Honeywell has just released a 'High Efficiency Mode' upgrade for the 131-9A APU on the Airbus A320. This enables the customer to purchase a software encryption key that, once enabled, improves fuel savings by one to two per cent, and creates an average of 1,200 hours additional time-on-wing for the APU.

"These savings are offered as part of the Honeywell Maintenance Service Agreement (MSA) for airlines. If the customer is not on a Honeywell MSA, they can purchase the high efficiency mode as a one-time purchase, or as a three-year subscription," Boyd reports.

As Honeywell's MSA shows, backing up all the repair work are the support programmes the companies offer on APUs, covering parts provision, operational monitoring and analysis, preventive maintenance, and so on.

"We actually offer a variety of maintenance plans that are suited for different customer needs," Boyd says. "On the business and general aviation side, Honeywell offers a Maintenance Service Program (MSP) for fleet owners or individual owners of aircraft. This offers a 'power by the hour' fleet rate for such customers, enabled by a global network of over 110 licensed channel partners to which customers can send their APUs for maintenance.

"On the air transport side, we offer the aforementioned MSAs directly to each specific airline. These agreements are also tailored 'power by the hour' programmes based on each airline's fleet and utilisation needs. They are supported by Honeywell's major R&O facilities worldwide, along with specific airline MROs licensed to perform APU maintenance. These programmes provide 'Predictive Trend Monitoring', enabling weekly tracking of APU health and performance which is then delivered to the airline.

"Finally, in addition to these maintenance programmes, Honeywell offers other programmes, such as 'Not to Exceed' maintenance cost agreements, that tailor pricing to the airline's or customer's needs."

As a Honeywell authorised service centre and a Pratt & Whitney Canada authorised repair facility (ARF), StandardAero offers a full range of APU support programmes, from troubleshooting to full repair and overhaul. "The services offered include component repair, LRU support and field service," Mengel explains. "We also offer Total Engine Asset Management (TEAM) programmes, which provide flexible solutions based on the customer's specific requirements."

Kuijer conveys that EPCOR believes APU support programmes are vital to have an optimal APU performance lifecycle. "Depending on operator region and the operational use of the APU, EPCOR provides adaptive programmes. For instance, cleaning programmes for airlines operating in harsh environments," he remarks. "When it comes to parts provision, as a licensed airline MRO we maintain a very close relationship with our OEMs, Honeywell and Pratt & Whitney. We have a stocked warehouse with new parts or serviceable parts to be used in the APUs of our customers."

Finally, for monitoring and preventive maintenance, EPCOR's APU engineers continuously monitor the performance of a growing number – already more than 1,000 – of APUs. "They use the data and combine it with our predictive maintenance algorithms of PROGNOS for APU. Customers' powerplant engineers have online access to this and are able to monitor the APU health 24/7 and manage their fleet accordingly," Kuijer explains.

So while APUs may indeed be 'out of sight', they are clearly not overlooked in terms of their care.

1,200

Honeywell's 'High Efficiency Mode' upgrade for the 131-9A APU on the A320 enables the customer to purchase a software encryption key that creates an average of 1,200 hours additional time-on-wing for the APU

1,000

EPCOR's APU engineers continuously monitor the performance of a growing number – already more than 1,000 – of APUs, combining this data with predictive maintenance algorithms

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NEW FEATURES & FUNCTIONALITIES FOR GROWTH

Changing market demands are boosting MRO software innovation, according to *Kevin Rozario*, who spoke to a range of providers about their latest advancements

Though devastating for aviation, the Covid-19 pandemic helped to shake up some of the industry's support segments – including the MRO market – as companies moved towards more digitisation and greater efficiencies.

In some cases this was a direct result of the forced shutdown of flight. Software companies such as WinAir have reported seeing their MRO clients experiencing an "uptick in activity". "We believe this was a direct result of the downturn in commercial flights. It was an opportunity for many of these businesses to address maintenance on their fleets," says WinAir's managing director Kyle Vergeer.

Other demands have come as a result of depleted manpower. David Purfurst, global pre-sales director at Rusada, says that while the functionality users require of MRO software "has not changed much since before the pandemic, there is greater focus on efficiency as people look to keep operations running with reduced resources".

Supporting the remote workforce, efficiency and digital transformation were priorities during the pandemic, according to Component Control's senior vice president Daniel Tautges. "Working from home while meeting the needs

Like other providers, Rusada's mobile applications have been a big part of its output this year

of the business and moving away from paper processes were transformational pre-Covid-19, but became even more important during the pandemic," he says.

But implementing these changes has not been easy given the complexity of running an MRO business during lockdown. Chris Reed, managing director at Trax, explains: "The industry is experiencing severe labour shortages, disruption of the supply chain and fluctuating demand. All these aspects impact operations and put a premium on efficiency and planning for maintenance and repairs."

A general recovery is now being seen in aviation, although it is very uneven globally, and MRO solutions providers are naturally ramping up their marketing having refined, or added new, software services to appeal to changing demands. Airlines have streamlined operations and overhauled older jets and technologies, making for an increasingly competitive MRO market, especially for independent providers.

So how have software companies adapted to new MRO needs, and which products and technologies are they banking on?

Latest developments

WinAir has focused on challenges surrounding predictability and has continued to evolve the planning capabilities of its 'WinAir Version 7' software by building on structural components already in place to improve how businesses manage, forecast and assess the workforce.

THE PANDEMIC HAS ACCELERATED PRE-COVID TRENDS AND ENCOURAGED SOFTWARE ENHANCEMENTS

As part of this enhancement, the company has released a management tool for tracking and managing staff authorisations, qualifications and personnel requirements relative to aircraft maintenance, travel approvals and medical records. It also released the initial phases of its task assignments and hangar space management functionalities to support its vision of a comprehensive management, planning and decision-making tool for handling all aspects of production planning.

"When the pandemic first hit in 2020, predictability reached an all-time low and this made it difficult for businesses to efficiently plan and manage maintenance projects and handle conflict resolution," says Vergeer. "Our planning enhancements will allow MROs to do all of this and more, through the end-to-end management of people, hangar space, tools and parts."

The company will also be releasing a new rostering functionality. The objective is to provide businesses with the ability to define shifts, set schedules, view when

specific people will be working, make changes to shifts when required and link assigned work to shifts for personnel based on their schedules.

At Component Control, its 'Quantum Control' enterprise resource planning (ERP) software suite baselines and controls performance to help customers meet airworthy requirements. In the near-term, innovations are geared to new access-from-anywhere Quantum NexGen user interfaces. The company is also building on its API stack to add more plug-and-play third party tools. "As the recovery takes hold, our customers will need to continue to maximise their labour resources and skills," comments Tautges.

Ramco Systems is building out its software in multiple areas such as mobility applications, electronic publications (enabling customers to manage digital content from OEMs in XML and SGML formats), inventory technical management (ITM), and also defence compliance.

The company's ITM software is able to address the complex processes of aviation rotable management including pooling, exchanges, part reliability and repairs. "We are one of the few providers of this end-to-end solution, globally," says Saravanan Rajarajan, director of aviation consulting at Ramco Aviation Software (part of Ramco Systems). "Our 'Advanced Planning & Optimization' module delivers value by optimising the inventory cost. We have released a fully fledged ITM solution and successfully gone live at one of the world's largest MROs."

THE MRO SECTOR WILL EXPAND ALONGSIDE AND GROW THROUGH CONTINUED SOFTWARE INNOVATION

Clockwise from above: WinAir has continued to evolve the planning capabilities of its software; Rusada's 'Envision Stock' module allows warehouse and stores personnel to conduct inventory tasks on-the-go; Ultramain Systems has added new modules including one for optimising labour scheduling

On the upgraded management of digital content, Rajarajan adds: "These capabilities, along with mobility, have made digital transformation of shop floors a reality. It has also had an exponential impact on cycle time, data accuracy, decision-making quality and operational agility/scalability."

Like other providers, Rusada's mobile applications have been a big part of its output this year. "We have created three fully native mobile applications for tablets and phones, all with full approval from Apple and Google," says Purfurst. The latest is 'Envision Stock', which allows warehouse and stores personnel to conduct multiple common inventory tasks on-the-go, removing the need for paper printouts and hand-written notes. "This is vital for organisations as so much time is wasted and effort duplicated when users are required to perform an activity, record it on paper in situ, go back to a desk and then update a system," he points out.

The company has also streamlined the back end of its 'Envision' software by updating elements of its technology stack, simplifying user interfaces and shortening load times. "This has reduced the time required to complete many common tasks by a minute or more," Purfurst notes. "This doesn't sound like a lot, but if you multiply this by the number of occurrences across all users over one year, it adds up to huge amounts of time saved and major increases in productivity."

On the fully paperless 'Ultramain' intelligent M&E/MRO/ELB software platform, which addresses and integrates

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General Manager of Maintenance and Engineering Department, HK Express

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a broad spectrum of aviation maintenance needs, new application modules have been added, according to Ultramain Systems' vice president of product management John Stone.

One of the latest involves optimisation for labour scheduling, hangar planning, maintenance scheduling, check execution and materials stocking and ordering.

"In each of these processes Ultramain algorithms optimise the outcome based on operator inputs," he says. "'What-if' modelling is used to allow comparisons to help MROs select the outcome they desire. Optimisation allows MROs to know in advance what they should be doing and how to achieve it."

Another software platform, 'AMOS' from Swiss AviationSoftware, has benefitted from new mobile solution apps, adding greater efficiency to the maintenance process. Work assignments can be directly communicated to the technician allowing for more flexibility in planning the efficient use of resources.

"With these resources in mind, capacity planning is an area that has seen advances in AMOS," says Swiss AviationSoftware's sales representative Chris Clements. "We have improved the staff capacity planning solutions for line and base maintenance. AMOS can be configured to automatically generate work packages and event assignments using rule-based logic with variables such as expected ground-time, type of work, staff qualifications and staff availability. Optimisation of labour and aircraft ground-time is achieved by matching demand and capacity. This automation enables planners to focus on solving exceptional situations such as operational disruptions."

Trax has taken specific measures to address industry flux around the number of aircraft in a fleet that will be deployed based on the lifting of travel restrictions. The company has adapted the software to manage planning for grounded aircraft – to enable customers to keep 'automated' control over these essential maintenance items. "We understand that other operators must use manual and time-consuming Excel sheets to manage the grounded aircraft inspections that our enhanced software functionality has automated," says Reed.

Aircraft redelivery services are integral to fleet management, which is Trax's speciality, and with the very fluid market situation in the leasing sector, the need to reduce redelivery times is paramount. "Enhanced digitisation via the new 'eContent Control' app we developed has streamlined the process by providing accurate and easily accessible data, eliminating the need to scan documents, and facilitating the extraction of printed reports," Reed says.

The company claims that, according to some customers, the app led to 60-80 per cent savings on the lease return process, representing US$100,000 per aircraft in savings. Additional savings include a 60 per cent reduction in off-site physical data storage, and an 80 per cent reduction in human errors due to digital records and better auditing.

$82
BILLION

MRO players typically expect the market to bounce back, but estimates of the size and growth potential of the global civil aviation MRO market vary. Statista points to a business worth US$82 billion by 2023, while Global Market Insights says the segment "exceeded $70 billion in 2020" and is expected to grow at a CAGR of over 4.9 per cent from 2021 to 2027

60%

A new Trax app has resulted in savings including a 60 per cent reduction in off-site physical data storage, and an 80 per cent reduction in human errors, according to the company

Capacity planning and task management have seen advances in Swiss AviationSoftware's 'AMOS'

Continuous innovation

It seems that like other aviation sectors, the pandemic has accelerated pre-Covid trends in the MRO market and encouraged software enhancements to manage new scenarios faced by airlines and supply chains.

MRO players typically expect the market to bounce back, but estimates of the size and growth potential of the global civil aviation MRO market vary. Statista points to a business worth US$82 billion by 2023, while Global Market Insights says the segment "exceeded $70 billion in 2020" and is expected to grow at a CAGR of over 4.9 per cent from 2021 to 2027.

Looking ahead, Ramco's Rajarajan believes the "confluence of artificial intelligence, machine learning, advanced analytics, mobile and 5G will be game changers and enable MROs to achieve higher operational efficiencies. This may involve bringing together ERP systems, EFBs, mobile and wearable technologies, embedded IOT and external systems and seamlessly interlinking them. By embracing these advances, MROs are well positioned."

Hopefully he is right. More immediately, with aviation opening up to international travel including the crucial transatlantic market, as well as strictly Covid-controlled markets like Australia and Singapore, the MRO sector will be able to expand alongside and grow through continued software innovation.

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CUTTING THE CARBON FOOTPRINT

AAR and Fortress Transportation and Infrastructure Investors have introduced a joint initiative associated with their CFM56-5B and -7B partnership to help customers achieve sustainability goals

Carbon offsetting is not without its critics, but has become a vital means for the aviation industry to make a positive contribution to sustainability.

Such initiatives must be robust and verifiable – and aviation services provider AAR says a joint initiative with Fortress Transportation and Infrastructure Investors (FTAI) is exactly that.

Their 'Sustainable Aerospace Material Program' aims to highlight the environmental benefits of recycling used serviceable material (USM) to help customers achieve industry-wide sustainability goals aimed at reducing CO_2 emissions in international aviation.

The initiative is associated with AAR and FTAI's seven-year partnership to distribute CFM56-5B and -7B engines USM, which was signed in December 2020. Through its worldwide network, AAR manages the teardown, repair, marketing and sales of spare parts from FTAI's CFM56 engine pool totalling over 200 engines. FTAI and AAR expect to teardown between 20-40 CFM56 engines per year, resulting in one of the largest independent inventories worldwide.

The companies are now committing to contributing on average one per cent of all USM sales generated through their CFM56-5B and -7B partnership towards the purchase of verified carbon credits for customers at no additional cost.

"We are proud to announce that AAR and FTAI teamed up to provide CFM56-5B and -7B customers with carbon offsets for all USM purchases through this partnership," says AAR's president and chief executive officer John Holmes. "We are committed to helping our customers reduce their carbon footprint and USM is a low-cost, green alternative to purchasing new parts. The goal of our initiative is to help operators address the opportunity for commercial aviation to make a positive impact on climate change."

> **"USM is a low-cost, green alternative to purchasing new parts – the goal of our initiative is to help operators address the opportunity"**

FTAI's chairman and chief executive officer Joe Adams believes the initiative reflects a "commitment to a sustainable future for the aviation industry". He adds: "We know there is a positive environmental impact from recycling engine material. We want customers to experience the benefit of that impact. One of our goals is to stay at the forefront of sustainable solutions in the aftermarket."

The donated offsets will meet 'Carbon Offsetting and Reduction Scheme for International Aviation' (CORSIA) standards. CORSIA offers a way to measure, collect and verify carbon emissions growth in international aviation. With a standardised emissions calculation, CORSIA outlines the purchase and retirement of offsets which allow operators to neutralise their carbon emissions growth. Operators are required to purchase and cancel 'verified emissions units' to offset the increase in CO_2 emissions on a periodic basis.

Carbon offsets contributed to customers under the AAR and FTAI initiative never expire and can be used to offset emissions as-needed now or any time in the future, the partners said. Customers will receive a quarterly report with their total CO_2 offsets.

With a wider commitment to sustainability at AAR and FTAI, this carbon offset initiative is another step on the road to reducing carbon emissions.

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