

MRO

Aerospace Magazine



MRO Outlook 2024

Challenges but light at
the end of the tunnel

Artificial Intelligence

Can AI help managing
MRO schedules?

Industry Insights

Interview with Tommy Hughes,
CEO of VAS Aero Services

AOGs

The secrets about
preventive maintenance



2024 to become turning point for full industry recovery

As we bid farewell to the year that was, our gaze shifts toward the horizon of 2024, seeking insights from industry experts. In a world where the commercial aviation industry continues to navigate challenging skies, the Maintenance, Repair, and Overhaul (MRO) sector finds itself at the heart of ongoing turbulence.

Though the aviation industry has shown resilience in recovering from the multifaceted disruptions wrought by the COVID-19 pandemic, the MRO sector remains on a gradual ascent to full capacity, with projections pointing toward 2024 as the turning point. Yet, this journey is not without its share of formidable obstacles.

A recurring concern adds to the MRO sector's challenges—a fragile supply chain for aircraft, materials, and parts. This vulnerability extends beyond the realm of aircraft manufacturing, with particular ramifications for MRO services. The ripple effect of supply chain disruptions reverberates through the industry, warranting vigilant attention.

As we stand at the cusp of 2024, the MRO sector remains poised for transformation, navigating through a complex web of global dynamics and supply chain intricacies.

I wish all of you an enjoyable holiday season and a successful year 2024.

Peter Jorsen
Publisher

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N3 Engine Overhaul Services starts extensive expansion



N3 expansion in Germany

© N3 Engine Overhaul Services

N3 Engine Overhaul Services (N3), the collaborative venture between Lufthansa Technik and Rolls-Royce, specialising in the overhaul and repair of Rolls-Royce Trent aircraft engines, is undergoing a significant expansion of its facility at the Erfurter Kreuz in Germany. Over the next two years, the complex will witness the construction of new factory areas, extensions to existing buildings, procurement of machinery and equipment and the implementation of new, flexible working methods in office spaces. Furthermore, the workforce will grow from the current 900 to 1,200 skilled workers. Lufthansa Technik and Rolls-Royce, the parent companies, are jointly investing approximately €150 million into the site (£129 million). The State Development

Corporation of Thuringia, the Ministry of Economics and local authorities from the city of Arnstadt and the Ilm district are supporting the expansion. This endeavour aims to solidify N3's position as a crucial European hub in Rolls-Royce's global maintenance network for aircraft engines and generate hundreds of new job opportunities. The company's capacity will be scaled up to overhaul 250 engines annually, compared to the current capability of servicing around 160 engines, with 900 employees. N3 is expected to overhaul around 140 engines in 2023, with projections rising to almost 200 by 2024. To navigate the expansion challenge seamlessly, Behrens mentions the establishment of a dedicated project organization with around 50 internal

and external experts. Markus Siptroth the previous Production Manager at N3 now overseeing the entire project, emphasised the importance of close coordination with local authorities and institutions for swift project realisation. The groundwork for the expansion project commenced in November, including the expansion of the car park for the existing workforce. Actual construction is slated to begin in early 2024, starting with the expansion of the cleaning line for engine components and the extension of the factory hall. The ground-breaking ceremony for the new logistics campus, featuring a high-bay warehouse and delivery centre, is scheduled for the third quarter of 2024. Simultaneously, the canteen will undergo expansion and office areas will undergo remodelling.



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American awarded US\$22 million from State of Oklahoma for Tech Ops – Tulsa

American Airlines (American) has been awarded US\$22 million from the State of Oklahoma's Business Expansion Incentive Programme. The funds, to be received over the course of three years, will be used to further grow and improve the airline's maintenance base and engine repair and overhaul facility in Tulsa, Oklahoma (Tech Ops – Tulsa). With this investment, the airline has announced more than US\$400 million in enhancements at the maintenance base over the last three years. The funds are in addition to American's recent US\$31.6 million capital investment in the engine shop to modernise machinery and an ongoing multi-million-dollar improvement project at Tech Ops – Tulsa. Tech Ops – Tulsa has served as the principal location for airframe and engine maintenance and overhauls for American's aircraft since 1946 and is one of the largest commercial aviation maintenance bases in the world. Located on 246 acres of land at the Tulsa International Airport, Tech Ops – Tulsa includes approximately 3.3 million ft² of building space, six hangars with 24 aircraft bays, and 22 support facility buildings. Nearly 5,000 team members are currently employed at the base and more than 800 of the



© Engine mechanic at Tech Ops – Tulsa © American Airlines

airline's aircraft visit the facility annually. As a direct result of these new investments, the airline is hiring more than 300 new team members at Tech Ops – Tulsa to boost existing engine repair and overhaul work. Positions include licensed airframe and powerplant mechanics, engineers, machinists, welders, maintenance planners and more. (£1.00 = US\$1.28 at time of publication).

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MAAS Aviation proud of new Embraer E195-E2 'Tech Eagle' livery



E195-E2 'Tech Eagle'

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MAAS Aviation, a global leader in aircraft painting and coatings, has revealed the recently painted Embraer E195-E2 'Tech Eagle' – the latest Profit Hunter in Embraer's line-up. Completed at MAAS' flagship facility in Maastricht, The Netherlands, this repainting project involved a dedicated team of 38 painters working around the clock for 15 days. The unique livery was unveiled at the Dubai Airshow 2023. The project's success reflects the seamless

collaboration between Embraer, MAAS and AkzoNobel Aerospace Coatings. Richard Marston, MAAS Aviation CCO, expressed gratitude to all involved, stating, "The end result speaks for itself; you should all be very proud. I also extend my gratitude to our partners at Embraer for entrusting us to deliver this spectacular and iconic design." Embraer's Tech Eagle joins the ranks of predator-themed liveries, following designs inspired by sharks, lions and snow leopards. Darragh Hall, Jnr, Graphics Manager at MAAS, highlighted the exciting yet challenging nature of the project, emphasising the shared problem-solving approach between Embraer and MAAS. MAAS Production Coordinators Andrzej Calus and Adam Buczek underscored the complexity of the detailed paint job, with Calus noting the meticulous planning required, and Buczek highlighting the challenges of applying flat design drawings to the curved surface of the aircraft. Despite the difficulties, the team is thrilled with the final result.

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ADE achieves milestone with 100th C-check



Asia Digital Engineering staff members with the 100th C-check aircraft

© ADE

Asia Digital Engineering (ADE), a wholly-owned subsidiary of Capital A Berhad specialising in aircraft maintenance, repair, and overhaul (MRO), has marked a significant accomplishment by successfully completing its 100th C-check within a timeframe of

two-and-a-half years since its establishment in September 2020. A C-check, recognised as a meticulous examination involving critical aircraft components and systems, is a comprehensive maintenance inspection crucial for ensuring the airworthiness and safety of an aircraft. ADE's achievement underscores its steadfast commitment to maintaining top-tier safety and operational standards in aviation maintenance, solidifying its position as a leading MRO player in the region. ADE's commitment to maintaining the highest quality and safety standards in aircraft MRO is highlighted by various milestones, including the recent acquisition of EASA Part 145 approval from the European Union Aviation Safety Agency (EASA). This approval complements an extensive range of existing maintenance certifications and authorisations. As part of its expansion strategy, ADE is strategically increasing its facilities footprint, with a new hangar at Kuala Lumpur International Airport (KLIA) set to be operational by the third quarter of 2024. This facility will significantly enhance base maintenance capacity, accommodating up to 14 narrow-body aircraft simultaneously. Expansion plans also include advancing line maintenance operations in Thailand, Indonesia, the Philippines and Cambodia in 2024.



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China Airlines partners with GE for services on 747-400F fleet

China Airlines has entered into a services agreement with GE Aerospace for its 747-400F fleet, as announced by GE Aerospace. Under this long-term agreement, China Airlines will rely on GE's OEM solution for high-pressure compressor air foils, with GE managing the repair and replacement of these components for the carrier's CF6-powered Boeing 747-400F aircraft during shop visits. Russell Stokes, President and CEO of Commercial Engines and Services for GE Aerospace, expressed gratitude for China Airlines' trust in GE's OEM solutions. He emphasised the goal of delivering competitive and cost-effective solutions, drawing on over 475 million flight hours of experience with CF6 engines to enhance the product and extend time on wing. A loyal customer of GE Aerospace since 1999, China Airlines initially purchased 13 GE CF6-80C2-powered Boeing 747-400F aircraft. Presently operating a fleet of 83 aircraft, including 14 747-400F powered by GE CF6-80C engines, China Airlines highlights the importance of the CF6-80C2 engine in their operations. The service agreement is seen as a means to ensure optimal performance and reliability standards to meet customer needs. The TrueChoice services suite, offered by GE, provides a comprehensive range of services and



CF6 engine

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materials, allowing the company to address various needs and operational priorities. Whether for operators, lessors, or maintenance, repair, and overhaul

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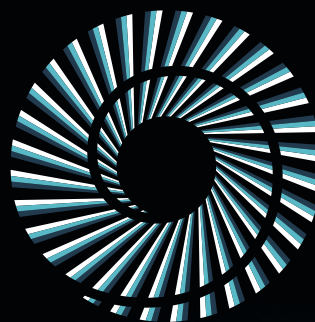


**Digital Technical
Asset Management**



flydocs, a leading digital records and asset management solution provider for the aviation industry, has signed a five-year deal with **Etihad Airways**, the national carrier of the United Arab Emirates, to digitise the records and asset management of its fleet. In addition to providing Etihad Airways with market-leading digital records management solutions, flydocs will implement its latest digital solution Lifecycle Asset Management (LAM) and support the technical records department with outsourced services. With LAM, Etihad will have the ability to track the live technical status of its assets against lease conditions, predict maintenance events, cost and exposure under various flight profile scenarios, and manage maintenance reserves. Mohammad Al Bulooki, Chief Operating Officer at Etihad Airways commented; "With Etihad's mission to digitally transform its operations and with flydocs' innovative approach to digitisation of aircraft maintenance records and their LAM solution, the airline is optimistic that this partnership would enable its organisational growth with the highest levels of efficiency. Etihad looks ahead to tracking its lease conditions against real-time aircraft.

Swiss-AS has officially announced the signing of a strategic agreement with the emerging Saudi Arabian airline **Riyadh Air**, for the implementation of its aviation maintenance and engineering software solution AMOS. As a national carrier, Riyadh Air will play a significant role in promoting Saudi Arabia's economic and cultural interests globally, aiding in the development of Riyadh as a major destination in the Middle East. The signing ceremony took place in Dubai, with representatives from both Riyadh Air and Swiss-AS present to celebrate the occasion after their extraordinary debut at Dubai Airshow 2023 and the unveiling of several commercial agreements with leading companies such as IBM, Lucid Motors, Lufthansa Systems and Saudia. The newly signed partnership will involve aligning AMOS's capabilities with Riyadh Air's strategic goals, such as enhancing customer satisfaction, improving operational reliability and driving innovation in maintenance operations. AMOS will be covering all aspects of the maintenance, engineering and logistics processes required by airlines and the software's modular structure will provide Riyadh Air with a tailored and scalable system to meet the carrier's specific needs and challenges. Renowned for its cutting-edge features, AMOS is set to optimise Riyadh Air's maintenance and engineering activities, enabling it to become a leading player at the forefront of the ever-evolving aviation landscape.



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Air Serbia selects LHT for component support



Air Serbia Airbus A320neo

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Air Serbia, the national airline of the Republic of Serbia, and Lufthansa Technik have signed a minimum five-year contract to provide Total Component Support (TCS®) for its current and future Airbus A320neo-family fleet. The contract includes comprehensive MRO (maintenance, repair and overhaul) services as well as spare parts pooling and home-base services for the required components in Belgrade, Serbia, starting in January 2024. Jiri Marek, CEO of Air Serbia, commented: "We

have ambitious goals for our airline, and if we look toward the end of the next decade, our airline could have more than 50 aircraft. This requires a reliable partner that supports us with the best possible services - also at our home base in Belgrade. The partnership with Lufthansa Technik will therefore contribute to the operational excellence for Air Serbia." Lufthansa Technik has been supporting Air Serbia with Landing Gear and other Services for its Airbus A320 fleet since 2020.

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easyJet collaborates with Collins Aerospace to enhance operations

Collins Aerospace is working with easyJet to activate GlobalConnectSM connected aircraft services on more than 330 Airbus aircraft in its fleet. easyJet will become the largest A320 operator to deploy GlobalConnect. This new capability enhances safety oversight, pilot training and operational efficiencies. The Collins GlobalConnect solution enables the already-installed flight operations and maintenance exchanger system

(FOMAX), jointly developed with Airbus, to provide easyJet valuable insights into its fleet operations, enabling proactive decision-making and more efficient airline operations. The adoption of this data exchange and analytics capability also brings the potential to simplify the avionics architecture, leading to further fuel efficiency gains through the gradual removal of quick access recorders. The airline projects that cutting this additional

weight could save up to 500 tonnes of carbon per year when rolled out fleet wide. GlobalConnect services across easyJet's fleet will be progressively activated in the coming months, starting before year-end 2023. This marks a significant milestone in easyJet's digital transformation journey and underscores the airline's dedication to embracing cutting-edge technologies that benefit its passengers and the environment.

AAR deepens MRO relationship with Alaska Airlines in Oklahoma City



AAR will add additional MRO space in Oklahoma City to accommodate all Alaska Airlines' Boeing 737 variants © AirTeamImages

AAR CORP. has signed an agreement to extend the company's existing airframe MRO services with Alaska Airlines through 2030 and expand its heavy maintenance partnership in Oklahoma City. AAR has committed to growing its dedicated airframe narrow-body capacity to provide Alaska Airlines with a minimum of six lines of maintenance support. To support this, AAR plans to add a new three-bay hangar adjacent to its existing seven-bay facility at Will Rogers World Airport in Oklahoma City, pending final approval by the Oklahoma City Airport Trust. The proposed new hangar will provide AAR an additional 85,000 ft² of MRO space to accommodate all Boeing 737 variants, including the 737-10. The project is anticipated to be funded by a grant from the State of Oklahoma, as well as rent concessions over time from Will Rogers World Airport. The facility expansion is projected to create more than 200 additional careers at AAR in Oklahoma City, which the company expects to fill through its robust workforce development initiatives.

CDB Aviation enters into inaugural sustainability linked loan for US\$625 million

CDB Aviation, a wholly owned Irish subsidiary of China Development Bank Financial Leasing (CDB Leasing), has released that the lessor entered into its inaugural sustainability linked loan (SLL) on December 1, 2023, anchored with a US\$625 million (£496 million) syndicated term loan facility. The SLL parameters of the facility are contingent on the satisfaction of sustainability performance targets (SPTs), based on the lessor's three key performance indicators (KPIs), including two strong environmental and one social KPI related to reducing the carbon intensity of the CDB Aviation's fleet, focusing on the most fuel-efficient aircraft; increasing the share of new-generation aircraft in the lessor's fleet, pursuing its target to reach 60% of new-generation aircraft (by number of aircraft) by the end of 2025 and increasing the level of diversity, equity and inclusion (DEI)-related training for the workforce. Moody's Investors provided the second-party opinion as to the appropriateness of the KPIs and SPTs, confirming the conformity of the facility with the sustainability linked loan principles (SLLPs), with a best-in-class SQS2 rating.



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Divestiture of LHT off the table, Lufthansa Group keeps sole ownership

The Lufthansa Group has officially announced its decision to maintain sole ownership of Lufthansa Technik (LHT). This decision comes as the aviation industry anticipates a dynamic period of growth and innovation and Lufthansa Technik positions itself as a pivotal player in this transformation. The aviation landscape has seen its fair share of challenges in recent times, with ongoing manufacturer issues and the evolving demands of a rapidly changing industry. Amid these complexities, Lufthansa Technik has stood as a steadfast pillar of support, providing essential maintenance, repair and overhaul services to a global network of airlines. As the technical backbone of the Lufthansa Group, its strategic value has only grown more pronounced in recent months. The decision to retain sole ownership of Lufthansa Technik is an embodiment of Lufthansa Group's confidence in its own capabilities and the expertise of its subsidiary. It underscores the belief that Lufthansa Technik possesses the vision, resources and determination to navigate the evolving aviation landscape successfully. The move reaffirms Lufthansa Group's unwavering commitment to fostering growth and innovation

within its own ecosystem. Under the banner of "Ambition 2030," LHT is poised for a remarkable journey of expansion and innovation. The ambitious growth programme includes substantial investments in core business expansion, the establishment of new global locations, potential acquisitions and a deeper foray into digital business models. This strategic vision reflects LHT's dedication to meeting the growing demands of the aviation industry. In 2022, LHT achieved a revenue of €5.6 billion with a workforce of approximately 22,000 employees worldwide. Building on this solid foundation, the company is targeting a revenue of over €6 billion for the current year, marking a significant milestone. Furthermore, 2023 is poised to be yet another record-breaking year for the company, further affirming its role as a leader in aviation technical support. The future growth of Lufthansa Technik will be driven by its technical support services for engines and aircraft components, capitalising on new propulsion technologies and innovative mobile service offerings. Additionally, the company intends to expand its presence in the United States and enhance its global footprint. (£1.00 = €1.16 at time of publication).

Watch our video interview with

Austin Willis, Chief Executive Officer, Willis Lease Finance Corp.

Watch interview on YouTube





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Can AI help managing MRO schedules

AviTrader spoke to Simon Miles, Head of AI at Aerogility

What are the key components of aircraft maintenance that can benefit from AI applications?

AI, such as Aerogility's model-based AI, empowers aviation organizations to make safe and trusted, data-driven decisions about how to efficiently and cost-effectively maintain their aircraft. Key components of maintenance that benefit from AI involvement include optimal performance of fleets, enhanced predictive maintenance, resource planning, documentation processing, safety and compliance monitoring.

The integration of intelligent MRO forecasting with AI boosts efficiency and proves invaluable in navigating intricate scenarios, such as determining the optimal approach to replacing aircraft parts. The goal here is to avoid unnecessary expenses, such as disregarding serviceable parts, while minimizing operational disruptions.

How does predictive maintenance using AI differ from traditional scheduled maintenance practices, and what are the advantages?

Predictive maintenance's proactive approach minimizes downtime, reduces operational costs, and maximizes the overall efficiency of maintenance operations. While scheduled maintenance adheres to fixed timetables irrespective of actual equipment conditions, predictive maintenance leverages real-time data and advanced analytics to forecast optimal timing. This data-driven approach enhances precision, cost efficiency, and operational continuity. Moreover, by analyzing specific equipment data, AI contributes to equipment longevity, as interventions are based on the actual health of the system, avoiding unnecessary wear and tear. Overall, predictive maintenance



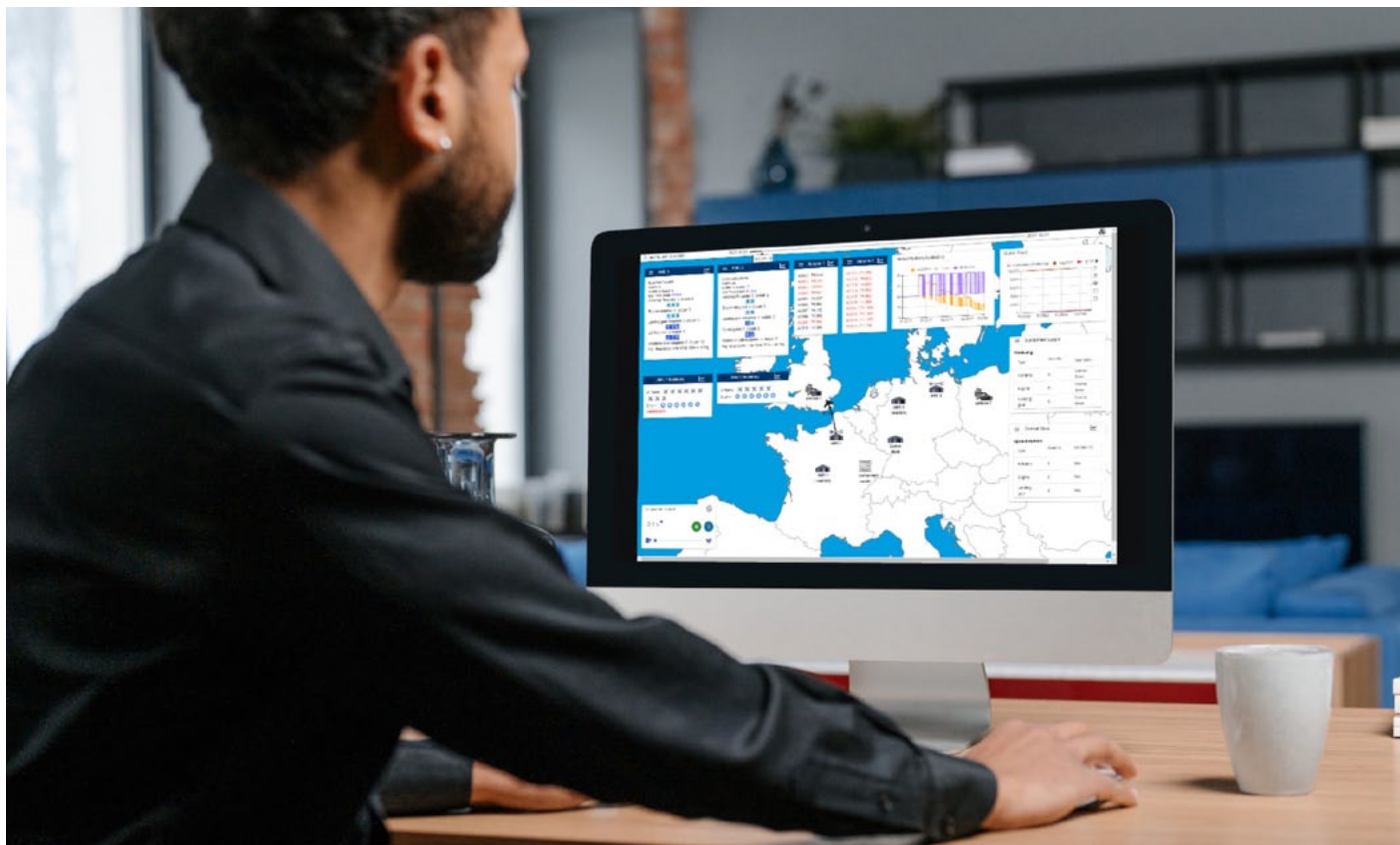
Simon Miles, Head of AI Aerogility

with AI not only improves cost-effectiveness but also enhances safety by identifying and addressing potential issues before they escalate.

Can you provide examples of AI-powered tools or systems that have been successfully implemented in the aviation industry to improve maintenance processes?

AI and digital enterprise technologies grant users the ability to create virtual replicas of their operations, generating insights for swift and strategic

“AI and digital enterprise technologies grant users the ability to create virtual replicas of their operations.”



AI helps scheduling MRO activities

© Aerogility

operational decisions. Achieving confidence in these outputs requires a thorough understanding of how the AI has reached its conclusions.

For instance, low-cost airline group easyJet can proactively anticipate evolving maintenance needs and plan accordingly through the implementation of Aerogility's multi-agent software.

With Aerogility, the airline conducts various simulations projecting its fleet's flying activities, corresponding maintenance, and engineering responses. This approach identifies optimal timing for maintenance events, involving a comprehensive analysis of major systems such as airframe, power plant, and landing gear.

This technological integration has led to heightened aircraft utilization and increased cost efficiency for maintenance at easyJet. The team has refined the forecasting and has enhanced visibility of crucial

maintenance activities across its operations.

Are there any specific safety or regulatory considerations when implementing AI in aircraft maintenance, and how are they addressed?

Implementing AI in aircraft maintenance entails careful adherence to safety and regulatory considerations. This requires a holistic approach that prioritizes compliance, transparency, and collaboration with regulatory authorities and industry stakeholders.

Transparency and explainability are crucial for regulatory approval and building trust. Safety, data privacy and security must also be diligently addressed, and collaboration with OEMs and third-party providers should align with safety and quality standards.

Can you provide insights into the future trends and developments in AI for aircraft maintenance,

including any emerging technologies or research areas?

Looking ahead, we foresee the development of autonomous maintenance systems, advanced analytics for more precise predictions, and increased collaboration between AI systems and human maintenance crews. We can expect further advances in AI applied to recognition and detection of faults, and predictive digital twins, connecting digital representations of individual components up to enterprise-level models of supply chains, personnel recruitment, and training. This will provide connected, strategic insights that can further optimize maintenance processes.

“Transparency and explainability are crucial for regulatory approval and building trust.”



AviTrader MRO interview with Tommy Hughes Chief Executive Officer, VAS Aero Services

All photos: © VAS Aero Services

Tell us about the key capabilities at VAS Aero Services.

VAS Aero Services is a leading provider of aftermarket services in the aviation industry and a highly experienced provider of nose-to-tail Used Serviceable Material. We source, warehouse, and market aftermarket components across a broad range of aircraft and engine platforms and provide related logistics and program management services to airlines, MROs and OEMs around the world.

VAS maintains state-of-the-art warehouses as well as a global sourcing and sales network, optimizing the

distribution of aviation material by positioning our employees close to our customers and partners around the world. We have a presence in the Americas, the UK, Europe, Southeast Asia, Australia and now China, through the expansion of Satair Chengdu, a powered-by-VAS USM end of life facility.

With over 40 years of experience, VAS has one of the largest portfolios of any provider of quality aviation assets in the aftermarket. Here are just a few of our milestones:

- Over 500 airframes & 700 engines managed through end-of-life

disassembly/ recycling

- More than \$4B in new and used parts sold through program activities
- \$3.7 billion in engine/airframe/ component assets currently under management
- Major supplier to over 2500 Airline and MRO customers, many on a preferred basis
- Over 400,000 square feet of inventory storage warehousing via four facilities (Florida, Washington State, London, and France).
- State-of-the-Art advanced IT capabilities (powered by SAP) tailored



VAS Headquarters, Boca Raton, Florida

specifically for aftermarket trading, re-distribution of assets, and program management reporting.

What do you think made the company successful over the years?

VAS's commitment to innovation and our willingness to invest in the training, resources and technologies necessary to meet growing demand in a constantly changing aviation aftermarket have been our hallmark. Our skilled workforce possesses expertise across every ATA Chapter and aircraft platform. We are an agile company, ever adapting to an ever-evolving marketplace. We may be over 40 years old, but we treat every day as the start of a new business.

As an example, VAS has invested over \$30 million in dedicated IT infrastructure and enhanced capability for aftermarket business solutions. Our customized SAP system seamlessly integrates with customers' systems for aftermarket programs, automated

quotations and inventory management, and program management.

And our commitment to geographic expansion has resulted in our singular ability to efficiently manage aircraft/engine teardowns, parts repairs, and re-distribution -- while optimizing cost and speed to market for customers, no matter where they may be.

I remember in previous years VAS being a subsidiary of Volvo Aero. Since last year you are now part of the Airbus family. What are the synergies of being part of the Airbus group?

VAS has a lengthy aviation industry heritage. We were originally founded in 1979 as the AGES Group by three aviation industry veterans. In 1999,

AGES was acquired by Volvo Aero Corp, followed by America Aero Group in 2015, and in 2022 we became part of the Airbus Group of companies when VAS was acquired by Airbus's Satair USA subsidiary. We are now a wholly owned, independently operated subsidiary of Satair.

Frankly, the timing of this acquisition could not have been better. We all were just coming out of the Coronavirus pandemic and the global aviation industry was feeling the pain of a worldwide economic slowdown. People and goods just were not flying and that rippled throughout the industry. Combining forces and resources was the smart thing to do, providing the expanded Satair with economies of scale, a deeper and richer service

“ We are an agile company, ever adapting to an ever-evolving marketplace. ”

offering, and a broader global reach.

VAS's capabilities in aviation lifecycle management, aircraft transition and teardown, and USM serviceability readiness are a perfect complement to Satair's extensive aftermarket logistics, distribution and materials management expertise – while our global network for parts sourcing and distribution augments Satair's client base. In a time of OEM supply chain gaps, VAS's USM offerings are filling the void. As the industry's go-to source for quality USM, the Satair-VAS collaboration is in lockstep with Airbus's overarching commitment to sustainability through the utilization of USM parts.

Used serviceable material is an important part of the overall supply chain in the MRO industry. Are there enough aircraft for tear down available currently?

VAS's vast network of airline operators and lessors affords us a distinct advantage in sourcing aircraft for teardown and USM parts harvesting. As a specialist in aircraft transition management, we work directly with airlines and fleet owners to oversee the retirement of aging assets. The emphasis on more fuel-efficient, lower-emission aircraft is certainly in our favor as operators look to meet new environmental and operational requirements. Many are de-commissioning aircraft sooner rather than later to modernize their fleets. This is leading to a larger pool of end-of-life aircraft for us to draw from for our USM business; however, in the current environment, we are experiencing some delays in delivery of aircraft for retirement and disassembly, which correlates with the increased



Tommy Hughes - PR Interview-China

demand of USM we witness today.

What is your forecast for the near future in commercial aviation and the changes that you foresee?

The global outlook for the aviation industry is far better today than it was just 12 to 18 months ago. There is a greater acceptance of and reliance upon USM to keep aircraft flying. This confidence in the quality and reliability of USM parts is leading to a lower cost of ownership for operators. Projections for increased passenger traffic and cargo transport are trending

upward. Major airlines worldwide have signed large, multi-year deals to acquire new aircraft to upgrade their fleets, and most are resuming their routes to pre-pandemic levels. Keeping current aircraft airworthy and producing revenue will be the key to profitability for many operators. And that plays to VAS's strengths in lifecycle management, aircraft transition and USM parts sourcing and distribution. We feel the future is bright.

To learn more about VAS Aero Services, visit www.vas.aero

“Frankly, the timing of this acquisition could not have been better.”

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MRO – the challenging outlook for 2024

Engine removed from aircraft
© Shutterstock

By David Dundas

As the commercial aviation industry gears itself up for another challenging year, the MRO sector is far from shielded from ongoing problems. Having seen the industry as a whole recover well but not fully from the myriad problems created by the COVID-19 pandemic, globally, the MRO sector is not expecting to return to full capacity until 2024, while other hurdles remain which have the potential to have a major effect on the MRO sector. First there is global unrest with two major conflicts occupying much of the news space, both of which are having an impact on the commercial aviation industry. Second, there is what is becoming an almost perennial problem – the supply chain for aircraft, materials and for parts, not just for aircraft manufacturing, but the latter particularly having a direct effect on MRO services.

Just looking into the engine MRO market, it has been forecast that 2024 MRO shop visit numbers could well exceed 8,800, which in itself will present its own challenges. In an environment where aircraft demand is constantly outpacing production, both the average age of aircraft in service and retirement age of these aircraft has reached approximately 12 and 22 years, respectively. The more sobering thought is that this burgeoning demand for MRO services will see this sector of the market likely reach a value of approximately 45% of the commercial aftermarket.

The knock-on effect of the increased life of an aircraft means that MRO providers will have little option but to increase operational efficiencies, a challenge in itself when dealing with global supply chain problems. At the heart of this challenge, you will most likely find

agile asset management,

The leveraging of advanced technologies and a global supply network, combined with optimised inventory management, cutting-edge data analytics and minimising an aircraft's downtime, should help to result in extending the life of an aircraft, cutting operational costs and enabling an MRO supplier to be competitive and win capacity.

The International Air Transport Association (IATA) released in December this year its outlook for the airline industry with an optimistic trajectory and an anticipated US\$964 billion in total revenue – an unprecedented figure. However, IATA's Director General, Willie Walsh, was keen to point out that ongoing challenges such as regulatory burdens, fragmentation, high infrastructure costs, and oligopolies within the supply chain will remain.



Louis Mallette, SVP Operations, AJW Technique

However, there is the forecast of strong fleet growth over the next ten years from 31,000 to 42,700 aircraft, driven primarily by demand in North America and Europe. Narrow body jets should take a larger share of the fleet as the midsize aircraft market transitions. For the MRO sector, over the next ten years demand will be sustained around the US\$112bn to US\$139bn mark. This will be driven primarily through the need to keep older aircraft in service, additional maintenance required for new-generation engines, and cabin modifications (connectivity, etc.).

One of the greatest problems facing the MRO industry is staffing and IATA predicts that as human capital is one of the most important resources within the MRO sector of the industry, the pursuance of digital strategies, whilst paramount, should be done in such a way that it is complementary to any workforce.

Getting a clearer picture of what key trends lie ahead in 2024

To help us get a better understanding of the MRO landscape for 2024, we decided to approach some of the key MRO industry players to get their perspectives on a number of critical MRO issues. In particular, we wanted to know what key trends and developments they foresaw that would shape the aircraft maintenance industry in 2024.

Louis Mallette, SVP Operations at AJW Technique was keen to point out that: "Industry analysts are predicting a full recovery for the aviation sector in 2024 and the latest air travel outlook released by Airports Council International (ACI) predicts passenger traffic will reach 9.4 billion passengers globally next year. While this will increase flight schedules and no doubt fleet expansion for operators, the continued impact of labour shortages is still a factor to consider and will continue to affect the MRO sector. Recruitment and training of skilled Technicians to support the expected volumes will therefore be one of the key priorities."

He also identifies OEM supply chain problems as a major pain point for MROs: "...the continued flying of older aircraft due to the required downtime of the newer fleets related to the P&W GTF required engine inspections will support a higher volume of repair activity with the component MROs, and indirectly reduce the availability of used serviceable material due to resulting delays in aircraft retirements.

Adam Brammer, Divisional Vice President – Business Manager at AMERON AMETEK MRO sees the introduction of new technology in aircraft safety and sustainability and a continued improvement in parts availability,

growth in automation usage inclusive of artificial intelligence (AI), immersive technologies in repair, and new technologies in flight use will require new maintenance capabilities, and new eco-friendly systems. He has noted at AMETEK MRO that: "...the overall lead time for parts has improved as either repair operations have been able to plan for the longer lead times, or the parts manufacturers have been able to ramp up demand. But critical supply chain problems still exist for most repair operations. Additionally, some repair stations are making use of AI in their support processes to optimise what needs to be repaired or taken off aircraft and when, as well as increase availability of the parts needed for repair. Since this technology is new, the effects are still not fully incorporated in most operations, but this will grow."



Adam Brammer, Divisional Vice President - Business Manager at AMERON AMETEK MRO

Justin Daugherty, Sr Director, Sales & Marketing at TRAX sees embracing AI as a critical move. "For example, TRAX eMRO software utilizes Machine Learning to take maintenance planning to the next level by offering predictive insights. Analyzing historical data and external factors, Machine Learning algorithms foresee trends and outcomes, providing a foundation for informed decisions, which empowers our users to respond promptly

“ Industry analysts are predicting a full recovery for the aviation sector in 2024. ”

Louis Mallette, SVP Operations at AJW Technique



Justin Daugherty, Senior Director,
Sales & Marketing, TRAX

to shifting conditions, adapt strategies, and allocate resources optimally. Our solutions incorporate predictive analytics to anticipate maintenance and materials requirements. By analysing historical maintenance data and usage patterns, we can help our clients foresee maintenance needs before they arise, allowing for proactive planning and reduced downtime. This predictive capability ensures that maintenance customers

experience minimal disruption and a higher level of service.” He adds that: “The use of mobile apps continues to be a key industry trend. For years operators lagged behind in leveraging the potential of mobile solutions for their maintenance operations, mainly from lack of budget and resources, and not from lack of foresight. Often it was due to the airlines’ technology funding being funnelled more toward IFE and operational software than toward their aircraft maintenance departments. The TRAX’ slogans over the past few years are “Mobilizing Maintenance” and “Work Anywhere, Work Paperless”, which strongly resonates with our clients. They recognize the benefits of having real-time information and real-time transactions.”

Mansoor Janahi, Managing Director and Group CEO, Sanad sees that to meet the projected fleet growth MRO service providers are having to embrace digitalization for data-driven decision-making, fostering an interconnected ecosystem for increased efficiency, sustainability, and competitiveness. He also sees that in tandem with technological advancements, the rise of electric and hybrid aircraft is expected to reshape the MRO landscape, necessitating



Richard Marston, Chief Commercial Officer,
MAAS Aviation

adaptability in skillsets and infrastructure. Janahi says to: “expect increased collaboration within the industry, promoting exploration of new markets, broadening capabilities, and facilitating knowledge exchange across the aviation supply chain. These collective efforts underscore the industry’s commitment to adapting and thriving in the dynamic aviation landscape. The aviation MRO industry in 2024 will navigate persistent supply chain challenges, embrace technological evolution, invest significantly in talent, and foster collaborative initiatives. These transformative forces signal a revolution, reshaping critical operational aspects and setting a new standard for excellence in customer experience worldwide.”

Richard Marston, Chief Commercial Officer at MAAS Aviation sees AI as likely to have the biggest impact on the overall MRO sector. He also sees that: “automation of certain parts of the painting process is likely to be the next big jump forward. Possibilities for 3-D printing and aircraft wrapping are being explored by all the OEMs as they look at how the process can be enhanced. But this is still a long way off in my opinion as there are many challenges ahead, not to mention huge investment needed, before these advances become economically viable and a reality in the mainstream.”



Mansoor Janahi, Managing Director & Group CEO, Sanad



Oscar Torres, President and CEO,
Kellstrom Aerospace Group

Oscar Torres, President & CEO, Kellstrom Aerospace Group points out that during the early part of the recovery of the industry from the pandemic, operators managed to use serviceable aircraft and engines that had been placed into temporary storage to meet demand and to defer costly maintenance events. However, the inventory of serviceable aircraft and engines then decreased significantly and therefore owners and operators dramatically increased their demand for maintenance events. However, it is the supply chain that causes him considerable concern. "... the supply chain continues to be a challenge for maintenance providers. These supply chain issues include reduced availability of technical labour, reduced availability of used serviceable material, and longer lead times from parts manufacturers. The combination of these factors is likely to result in maintenance organizations continuing to operate at or near capacity, with long lead times and significant backlogs. As a company that is solely focused on supporting MROs and Operators with parts and services that are essential for completing maintenance events in an efficient and cost-effective manner, Kellstrom Aerospace is very well positioned to support the maintenance industry as it manages through an

environment of significant demand offset by lead time and supply chain issues."

How the aircraft maintenance industry intends to address environmental concerns and make aviation more environmentally friendly

Currently, the airline industry is responsible for 3% of global carbon dioxide emissions. Reducing carbon footprints and carbon emissions, ideally to a carbon-neutral level is the objective of the industry. IATA has set 2050 as the target date for airlines to achieve net zero carbon emissions. For carriers, some of the changes needed to be made are easy to identify, such as the introduction of SAFs. However, that will only reduce CO₂ emissions by 80%, necessitating the use of carbon offsetting to mitigate the remaining 20%. Interestingly, United Airlines is taking a different approach to the situation by concentrating on an alternative to carbon offsetting, in particular, direct air capture (DAC) capture. Currently United has invested in 1PointFive Inc, a Texas-based project which has a capacity to remove 1 million tonnes of CO₂ from the air. Hydrogen technology is yet another area being explored as a means to fuel aircraft in a more environmentally friendly way. However, for MROs, the road to carbon neutrality is less straightforward, bearing in mind the complex nature of MRO operations. However, as an example, operational-optimising software is making huge inroads into achieving such a target.

Amada Martinez Jaco, VP of Sales, SkySelect makes it clear that: "By leveraging new technologies and better understanding data, airlines will become more efficient and less wasteful all the

way from operations and maintenance to commercial functions and airside tasks. Specifically looking at aircraft maintenance, airlines and MROs can optimize their parts procurement process to be more efficient. For example, by having a better understanding of the market and knowing what parts are available and where they are located, components can be sourced from suppliers closer to the location of where the part is needed, and purchase orders can be optimized to reduce the number of orders (i.e. being from one supplier instead of three). Or by better understanding their operations, MROs and airlines can carry less unused parts and cut down on the need to expedite shipping, which will lead to a significant reduction in waste.

Louis Mallette, SVP Operations at AJW Technique happily points out that AJW is dedication to the environment and sustainable business practices forms one of the cornerstones of Group business practices and reinforces its commitment to the UN Global Compact. "Our eco-friendly headquarters exemplifies responsible resource management with rainwater harvesting systems and solar panels. Our Facilities and Operation teams are expanding our solar panel initiative, which has resulted in an annual reduction of 425 tonnes of CO₂ emissions to date." When it comes specifically to MRO activities, he states that: "For component MROs, the majority of our efforts are at a local level through energy reduction programs for our facilities, and through our commitment to aircraft teardown activities to ensure as many components as possible can be economically repaired and returned to service. We ensure the parts that cannot be returned to service are correctly recycled and reprocessed to minimise the

"... the supply chain continues to be a challenge for maintenance providers.

Oscar Torres, President & CEO, Kellstrom Aerospace Group

environmental impact, which also ensures we maximise their value.”

Justin Daugherty, Sr Director, Sales & Marketing at TRAX sees going paperless as a major contribution to reducing carbon footprints. “One of the biggest contributions mobile and paperless maintenance software such as TRAX eMRO and eMobility can do for sustainability and environmental concerns is to create a paperless environment. Technical compliance record keeping requires massive amounts of paper with associated printing costs and required equipment. In addition, document storage takes up tremendous amounts of physical space. One of our customers reported a 60% reduction in offsite physical



Amada Martinez Jaco, VP of Sales, SkySelect

storage after implementing our eMobility eContent Control app which provides a centralized platform for storing and organizing task completion records. Once the tasks are finished, they are signed off electronically, and the work record is archived into the eMRO software and made accessible through the eContent Control web-based application.”

Where Sanad is concerned, the Group’s

“More people flying on more aircraft leads to more aircraft which need to be served for maintenance and more aircraft being ordered.”

Amada Martinez Jaco, VP of Sales, SkySelect

CEO Mansoor Janahi pointed out that such a robust recovery, coupled with a growing need to address next-generation engine maintenance requirements and increasing pressure to reactive parked fleets, has led to an escalating demand for world-class aviation MRO services. He added that: “Sanad has strategically leveraged the industry’s rebound, consistently servicing engines in our workshop during and after the pandemic. This increase in demand for our services has earned us over 30 global customers, including prominent airlines like Etihad Airways, Emirates Airline, Ethiopian Airlines and Wizz Air Abu Dhabi, along with partnerships with all major global Original Equipment Manufacturers (OEMs). In 2022 alone, Sanad serviced 120 engines, and following our recent inauguration of the first LEAP Engine MRO Center in the South Asia, Middle East and North Africa (SAMENA) region, the number of units to be serviced by the end of 2023 is expected to reach an impressive 140 engines.”

Oscar Torres, the Kellstrom Aerospace Group CEO remarks that ESG initiatives will continue to be a vital component to the long-term success and viability of any organization, irrespective of the industry or geographic location. He sees sustainability and environmental concerns at the forefront of any initiatives. He points out that: “of any organization. Sustainability and environmental concerns

are at the forefront of those initiatives. Aircraft maintenance organizations, including Kellstrom and Vortex Aviation, continue to look at every opportunity to improve their sustainability and environmental impact through the use of: 1) increased training and awareness of employees, customers and suppliers to eliminate processes that adversely impact the environment, 2) increased use of technologies that improve operational efficiencies and reduce consumption of power and carbon fuels, 3) increased use of Used Serviceable Material, 4) re-assessing lighting, HVAC and high power consumption machinery and equipment with a goal of moving towards more energy efficient alternatives, and 5) evaluating carbon offsetting arrangements. Over both the short and long term, sustainability and environmental concerns will continue to be an area where the aircraft maintenance industry will work together to identify opportunities for improvement.”

Most commercial carriers are coming close to operating at pre-COVID-19 capacity, but does this automatically mean the MRO sector has recovered to the same degree?

In October this year Bloomberg reported that global airline capacity was poised to surpass 2019 (pre-pandemic) levels. This has had an immediate knock-on effect on the MRO sector, but that does not automatically mean it has fully recovered too. One of the biggest challenges facing the sector is the supply chain, and it is felt that it could be two or three more years before supply-chain problems are resolved. When added to

staff shortages and a rise in prices of approaching 7% expected over the next year or two, this is also proving to be a challenge for MRO operators who are looking to reduce costs to become more competitive.

Adam Brammer at AMERON AMETEK MRO feels that the industry has most definitely not recovered, but that it is getting closer. As he points out: Total flights in the US are still down ~6% from 2019 and ~5% worldwide. Additionally, parts availability continues to be a problem. The ramp up in demand, together with a lack of technicians to manufacture the parts, and the increase in raw material lead time has caused situations whereby some parts are not available for many months longer than pre-Covid standards. The team at AMETEK MRO predict that this will last well into 2024.

Amada Martinez Jaco at SkySelect feels this is not a simple question to answer as there is much to be taken into consideration, such as geographical location, the type of air travel the MRO operation is geared towards, the aircraft type, or even the parts required. However, she still feels positive about the situation. "More people flying on more aircraft leads to more aircraft which need to be served for maintenance and more aircraft being ordered. For example, at the Paris Air Show, leading manufacturers Airbus and Boeing had 1000 aircraft ordered combined only in the first two days of the event. The Airbus order set a new record for the manufacturer. According to Visiongain Reports Ltd, the global top 20 commercial aircraft maintenance, repair & overhaul (MRO) market was valued at US\$83.0 billion in 2022 and is projected to grow at a CAGR of 4.3% during the forecast period 2023-2033. We're certainly heading in the right direction as an industry with our brightest days still ahead.

Louis Mallette at AJW Technique was quick to identify the biggest concern for the MRO industry and as a whole – the supply chain. "We are seeing growth in active fleets and a general increase in flying hours across all regions. Barring



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any geopolitical effects, which could upset air travel, we expect the component repair shops such as AJW Technique to be operating at close to maximum capacity. In terms of demand, most MROs are back to pre-covid levels and expect to be above that level in 2024. However, the OEMs continue to struggle with their post-covid production ramp up and as a result, the industry continues to experience stress due to supply chain capacity."

Mansoor Janahi, Sanad's CEO notes that in relation to the global recovery from the pandemic, the Middle East has now seen both international and domestic capacity exceeding pre-COVID levels. As far as Sanad is concerned, Janahi points out that the Group "has strategically leveraged the industry's rebound, consistently servicing engines in our workshop during and after the pandemic. This increase in demand for our services has earned us over 30 global customers, including prominent airlines like Etihad Airways, Emirates Airline, Ethiopian Airlines and Wizz Air Abu Dhabi, along with partnerships with all major global Original Equipment Manufacturers (OEMs). In 2022 alone, Sanad serviced 120 engines, and following our recent inauguration of the first LEAP Engine MRO Center in the South Asia, Middle East and North Africa (SAMENA) region, the number of units to be serviced by the end

of 2023 is expected to reach an impressive 140 engines."

MAAS' CCO Richard Marston notes that "whilst there has been strong recovery in the market, there are still many difficulties to face post-pandemic. Escalating operating costs, supply chain and production issues as well as recruitment and workforce challenges, are all putting pressure on the sector." He adds that these problems are not exclusive to the MRO industry, or even the broader aviation industry, but they are far-reaching business issues that everyone must all adapt to.

In Conclusion

While multiple challenges still remain in the MRO sector, the overall outlook for 2024 is positive, without question. With carriers now operating at near-to pre-pandemic levels and demand for MRO services correspondingly being ramped-up, the worst would appear to be behind both. However, there still remains the legacy of supply-chain problems and this, above anything else, is likely to have the greatest short-term impact.

To end on an optimistic note, one only has to look, and you will see that order books for MROs and parts manufacturers are full, and the demand for used serviceable material is high.

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Engineers studying performance data
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Unlocking the Secrets of Preventive Maintenance

Ensuring reliability through preventive measures
By Swaati Ketkar

Preventive maintenance, simply means “to maintain an aircraft to prevent further damage.” However, a little bit more research and reading into the topic seems to have opened up a whole new chapter on the subject. Many questions arise, like ‘Who actually is authorised to perform preventive maintenance on aircraft?’ and ‘Is scheduled maintenance the same as preventive maintenance and if not, what is the difference?’ These and many other associated questions sprung up during my research for this topic. So, let us deep dive into the technical intricacies of preventive maintenance to protect your aircraft from unforeseen problems in new year.

What is Preventive Maintenance – Airline, OEM, MRO explains

In simple terms, preventive

maintenance is any maintenance tasks like for example – inspection, repair or replacement that are carried out at particular intervals either as recommended by the manufacturer (OEM) or based on the airline’s in-service experience. These works are planned before they occur and then executed at a previously scheduled time.

Usual preventive maintenance tasks include:

- Running tests
- Inspecting and checking for any wear
- Cleaning and lubricating certain aircraft components
- Replacing those items allowed by EASA/FAA rules
- Application of corrosion-preventing chemicals



Oliver Boro, AMROS Global

- Removal of corrosion from the aircraft structure

To put things further in perspective, David Marty, Head of Digital Solutions Sales & Marketing, Airbus Services goes

on to say that "Preventive maintenance is a scheduled maintenance activity to help prevent failure in the future. Marty further explains the term by providing an example of Airbus' Maintenance Programme Documents (MPDs). "These are developed under a specific methodology called MSG-3, providing scheduled maintenance tasks and intervals defined on failure effect mods and in-service experiences: being preventive maintenance," Marty adds.

Thus, preventive maintenance is performed on equipment while it is still in operation to prevent unexpected breakdowns. It is a commonly used approach that falls between reactive maintenance and predictive maintenance.

All the above definitions boil down to one thing, the daily experience gained by the monitoring of the continuous operation of an aircraft helps in defining more-accurate scheduled intervals of a preventive maintenance programme and this overall experience is reflected on the constant change of the manufacturer's maintenance programmes to adjust maintenance intervals to reduce maintenance costs, such as anticipated or predictive maintenance.

Difference between preventive and predictive maintenance

There is a thin line between preventive maintenance and predictive maintenance.



Fabrizio Madonia, AMROS Global



MTU Maintenance shop.
© MTU Maintenance

"While preventive maintenance is based on a guidance material by the OEM, a predictive maintenance is more digitally evolved and is based on the real time aircraft sensor feed data correlating with the historic data available and an algorithm to marry both of them together," explains MP Sajumon, Continuing Airworthiness Manager at AirAsia, India. "In a predictive maintenance, the digital system gives an insight to the maintenance controller to replace a component before it fails." He furthers his explanation with an example: "Checking IDG oil temperatures against historic failure data will create a system that is capable of predicting the failure of an IDG prior to any fault warning being given?"

Looking at the difference from an OEM perspective, Marty stresses why a proven predictive maintenance system covering

a maximum number of part numbers is currently needed. "As airlines are ramping to pre-COVID levels, the stress on reliable operations is increasing," he states, adding that: "Predictive maintenance is a very important transformation every carrier wants to go for as it converts unscheduled maintenance into scheduled maintenance and reduces the risks of operational interruptions."

- Preventive maintenance: Focus on avoiding unexpected equipment failure.
- Predictive maintenance: Focus on avoiding unexpected equipment failure by constant data evaluation.

Let's now look at the difference from an MRO perspective. Christian Keller, Performance Engineer at MTU Maintenance explains the difference with the example of Engine Trend Monitoring

“ Preventive Maintenance is a regular planned maintenance scheduled according to usage or time-based triggers. ”

Fabrizio Madonia, Technical Consultant, AMROS Global



David Marty, Head of Digital Solutions, Airbus

(ETM) and CORTEX, its proprietary software programme used for data gathering, processing and analysis in its efforts to forecast any required future technical actions or interventions. "In preventive maintenance, service intervals are typically based on expected failure rates of the engine parts with safety margins built in, without regard for the actual condition of the part, and are typically defined during design. For predictive maintenance, the actual condition of the part or equipment is taken into account," he explains.

Keller further goes on with a scenario in a safety-critical environment such as aircraft operation. Predictive maintenance seldom replaces preventive maintenance for most parts. Instead, the two concepts run in parallel. Whenever possible, the actual condition is analysed to either predict a failure or predict and prevent further consequences based on already existing fault indicators.

In order to detect failures as early as possible, several approaches are employed. Traditionally, alert thresholds are defined as parameters (or the rate

of change of these parameters) based on statistical analyses. In some cases, machine learning (ML) can be employed to improve detection rates over time or to directly detect anomalies. The latter relies heavily on the availability of larger amounts of high-quality training data. In many cases, measured parameters need to be normalised to allow for trending, which can be achieved either with physics-based or ML models.

At MTU Maintenance, for example, to enable predictive maintenance, ETM collects engine performance data and other operational information recorded during the flight, processes them with the proprietary physics-based models, and continually updates the customer on the latest condition of their assets. "ETM is offered in conjunction with our MRO services as well as a stand-alone service as a means to increase efficiency and lower the operating cost of an engine through advanced diagnosis, analysis and prognosis," concludes Keller.

AMROS' Christian Roulin sums up the difference beautifully by saying that a solid predictive maintenance may replace a preventive maintenance concept in the future if the certification authorities are convinced about such a change.

So, is scheduled maintenance the same as preventive maintenance?

In layman's terms, we can say that scheduled maintenance aims to prevent failure, therefore the concept of scheduled maintenance is that of a preventive action. Thus, we can safely conclude that preventive maintenance is virtually the same as scheduled maintenance as maintenance is performed after a pre-determined period of time, a flight cycle, a specific number of flight hours, etc. However, David Marty clarifies

this by explaining how preventive maintenance is related to predefined intervals as stated in the MPD, while scheduled maintenance includes on top modifications, retrofits, deferred items, etc. "We rather recommend speaking about planned maintenance and unplanned maintenance," Marty aptly comments.

"When we follow the scheduled maintenance concept, we can safely say that scheduled and preventive maintenance are the same, but if we add system failure rectifications to a scheduled maintenance event, the two become mutually exclusive subsets", explains Roulin. In other words, preventive maintenance is performed while the equipment is still working to prevent unexpected breakdowns, while scheduled maintenance is performed based on a predetermined time schedule or calendar.

Breaking down the concept further, Boro adds that scheduled maintenance is preventive maintenance performed at regular intervals, such as 100-hour inspections, annual inspections and

progressive inspections, as well as preflight checks to ensure the aircraft is in an airworthy condition.

Challenges in preventive maintenance

Planning is one of the first and foremost aspect and a big challenge in



Christian Roulin, AMROS Global

“A solid predictive maintenance may replace a preventive maintenance concept in the future if the certification authorities are convinced about such a change.”

Christian Roulin, AMROS Global

“Today there is another digital arena of maintenance evolving which involves real-time monitoring of the faults.

MP Sajumon, Air Asia

correct and efficient maintenance. “Good maintenance planning coordinates the timeline for the maintenance, the location, the workforces, the material needed and related logistics,” explains Fabrizio Madonia. Further stressing the importance of planning, Madonia adds that the practise of efficient planning anticipates and sometimes avoids some of the problems created by logistics or capability.

According to Oliver Boro, one of the major challenges as finding the optimal time to perform maintenance. “This can be a delicate balance between shutting down for maintenance too soon and waiting too long,” he explains.

“Another challenge is that preventive maintenance requires regular downtime, which can be a problem for aviation business. Additionally, there is the issue of timing. Finding the optimal time to perform maintenance can be a tricky matter. Finally, there is the challenge of spares shortage. If the required spare parts are not available, it can lead to increased downtime and maintenance costs,” Boro concludes.

The role of technology in preventive maintenance

Technology has made a transition from preventive to predictive maintenance. Explaining it with an example, Marty says that Airbus’ planned maintenance engineering services are today optimizing the MPD task intervals at tail level. “However, the value of this technology is more impactful when applied for predictive maintenance,” he adds. Further simplifying the role of technology Marty says how by using Skywise Predictive Maintenance +, airlines do not just avoid hundreds of cancellations and delays, but they also save unnecessary fuel burn

representing 26 tons of CO2 per aircraft per year. Thus, new digital means, including AI are already used to optimize the preventive maintenance. “Higher standards in technology are able to better define the real status on the aircraft giving a more accurate timeline for any action,” asserts Madonia.

“As a matter of fact, preventive might be replaced by a predictive maintenance concept in the future as long as the certification authorities agree with,” adds Roulin. “The fact is that products are being designed by following Industry 4.0 principles and are being used in the overall concept of an aircraft. A predictive maintenance concept becomes more feasible as long as external factors such as environmental conditions or accidental damage are being monitored or may be considered acceptable due to the lack of monitoring as per the Certification Specification,” Roulin further adds.

Latest trends in preventive maintenance

With changing times, preventive maintenance is influenced by the usage of predictive maintenance analytics opening new opportunities for maintenance programme optimization thanks to alternative means of compliance. “Airbus is pioneering this condition-based maintenance approach thanks to the years of experience in predictive maintenance,” Marty says. “There are several use-cases under validation with operators and regulators and ongoing discussions of the MSG-3 evolution.”

Currently digitalization, AI, and robotics are playing a significant role in shaping its current trends. “By analysing data from various sources, such as sensors, machine



MP Sajumon, AirAsia India

logs, and historical maintenance records, maintenance teams can identify patterns and trends that indicate when equipment is likely to fail and take corrective action before the failure occurs. This approach can help to reduce maintenance costs, increase equipment uptime, and improve overall equipment reliability,” AMROS’ Boro comments.

Digitalization: Digitalization in the context of preventive maintenance, involves the use of digital tools and technologies to improve maintenance processes. For example, digital tools can be used to monitor equipment performance in real-time and identify anomalies that may indicate a potential problem. This can help maintenance teams to take corrective action before the problem becomes more serious, thereby reducing downtime and maintenance costs.

AI and Machine Learning: AI and machine learning are being used to automate the maintenance

process by using machine learning algorithms to analyze data and identify potential issues before

they occur. For example, AI can be used to monitor equipment performance in real-time and identify

anomalies that may indicate a potential

“In preventive maintenance, service intervals are typically based on expected failure rates of the engine parts with safety margins built in.”

Christian Keller, Performance Engineer, MTU Maintenance

problem. This can help maintenance teams to take corrective action before the problem becomes more serious, thereby reducing downtime and maintenance costs.

Robotics: Robotics is another technology that is changing the course of preventive maintenance. Robots can be used to perform routine maintenance tasks, such as inspections, calibrations, lubrications, adjustments, cleaning, or part replacements. This can help to reduce the workload on

maintenance teams and improve overall maintenance efficiency.

Thus, the latest trends in preventive maintenance include predictive maintenance,

digitalization, AI and machine learning, and robotics. These technologies are helping to improve

maintenance processes, reduce downtime, and increase equipment reliability.

The evolution of preventive maintenance

Preventive maintenance as a concept has evolved over decades to become a more proactive and data-driven approach to equipment maintenance. Primary maintenance processes can be broadly classified into three groups, namely hard time (HT), on condition (OC) and condition monitoring (CM). “Today there is another digital arena of maintenance evolving which involves real-time monitoring of the faults,” explains AirAsia’s MP Sajumon of. Further explaining the concept, he adds how the maintenance crew gets a heads-up on the potential fault on the flight before it arrives at its destination, then the

crew arranges the resources accordingly to tackle the fault, thereby minimizing the operational interruption and guest inconvenience. Examples of this include Airbus’ SHM, Boeing’s AHM, or Lufthansa’s Aviatar.

Marty dates back the evolution of preventive maintenance to 1968 when the first version of the methodology, MSG-1 was carried out, followed by the incremental evolution of the methodology: MSG-2 in the ‘70s and MSG-3 in the ‘80s.

The evolution of preventive maintenance can be separated into four main generations, states Sladjan Pekmezović of AMROS. “In the early days of maintenance, work was mostly reactive, that is the teams fixed breakdowns only when they occurred. However, as production demands increased, companies needed their equipment to be more reliable, which led to improvements in

their maintenance strategy.”

The four generations are:

1. First Generation (1940-1955):

This generation saw basic and routine maintenance activities, like fixing equipment only when it broke down.

2. Second Generation (1955- 1975):

This generation saw the introduction of planned preventative maintenance, performed at regular intervals to help prevent unexpected failures in the future.

3. Third Generation (1975-2000):

This generation saw the introduction of condition-based maintenance, involving monitoring equipment performance to identify potential problems before they occurred. Other developments included reliability-centred maintenance, computer-aided maintenance management and information systems, workforce multiskilling and team working, and proactive and strategic thinking.

4. Current Generation (2000+): This generation is characterised by predictive maintenance, which uses data analysis tools and techniques to predict when equipment failure is likely to occur. Other developments include a focus on good quality data, preventive maintenance, reliability-centred maintenance, using technology to connect systems, software,



Sladjan Pekmezović, AMROS Global

and people, and aligning operations and maintenance.

To summarise, preventive maintenance has evolved from a reactive approach to a more proactive and data-driven approach over time. The current generation of preventive maintenance is characterised by predictive maintenance and a focus on good-quality data.

The changing course of preventive maintenance post pandemic

"The pandemic taught us that scheduled maintenance needs to be thought of ahead of schedule," Boro admits. Postpandemic maintenance demand is rising due to the increased number of aircraft temporarily put out of service combined with a skilled workforce shortage.

Passenger traffic has surged post

pandemic and currently we are back again at the pre-pandemic level. Engine shop visit costs are a major element of the maintenance costs for an airline. During the pandemic, many airlines across the globe deferred the engine shop visit by removing the engines and storing them while using spare engines for the limited operational flights during the pandemic.

"The repercussion of this decision is a visible MRO slot supply shortage post pandemic. Engine MROs are not yet clear of the pandemic-induced supply chain challenge," says MP Sajumon. "To add to it an upswing on the demand side has resulted in longer lead time for the engines in shop and long waiting periods for shop slots. As a result of this, demand for spare lease engines have gone up with the industry experiencing an upswing in the lease rentals," Sajumon adds.

However, even before the pandemic,

airlines faced the need to be more efficient. David Marty tries to explain how airlines face certain severe constraints at airports or with ATM, summing up their problems in one sentence: "Due to this, the impact of an operation interruption is made worse." He adds that: "It is even more difficult to recover from an interruption. Even more than before, airlines need efficient real-time decision solutions to manage network disruptions and to cope with last-minute changes."

Conclusion

According to David Marty, all in all about 80% of aircraft maintenance activities are preventive maintenance. Technical experts from AMROS are of the opinion that predictive maintenance is the way to go to streamline preventive maintenance. Thus, increasing the level of predictive maintenance will optimize company costs.

Watch our video interview with

Matthias Düllmann, Chief Executive Officer, SR Technics

Watch interview on YouTube

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Q & A

In the hot seat...

Chap Berrier, Vice President Global Sales of Tag Aero

Tag Aero is one of the key players when it comes to APU maintenance and related services. Can you tell us a bit about Tag Aero's history?

Tag Aero is the combination of two businesses, Unique Airmotive Services & The Auxiliary Group, that were brought together in 2020. Unique Airmotive Services was founded in 2011 in South Carolina as an APU MRO while The Auxiliary Group was founded in 2012 in Florida as an APU trading company. When the two companies were acquired and merged together, the strong branding of Tag

“Most companies will focus on either APU trading or APU MRO. We make a point to do both really well.”

Aero was selected to carry the company forward. In 2022 the two company locations were consolidated and relocated to a new 40,000 sq ft facility located in South Carolina. This merger strengthened the companies MRO capabilities as well as the customer experience.

What are the different services you are providing to the industry?

Tag Aero offers APU sales, exchanges, leases, and MRO services. Most companies will focus on either APU trading or APU MRO. We make a point to do both really well.

How many lease APUs do you have in your portfolio?

We do not maintain a dedicated APU Lease pool. We maintain inventory of a variety of APUs and we use those to best support our customers' needs. In some cases, that is a lease.

What sets Tag Aero apart from the competition?

We focus on APUs and APU accessories while many others are offering multiple ATA chapters. We are a large player in the APU industry that buys, sells, and repairs APUs with a stress-free process



Chap Berrier, VP Global Sales

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to our customers. With our sole focus on APUS, we have dialed our services to address all phases of APU market needs.

How do you see the future development of Tag Aero and what are the trends in the APU maintenance and support business?

Tag Aero will always be a dominant player in the APU trading and MRO market by investing in APU Assets that support both. We aim to have APUs available in various conditions to allow customers a choice based on their needs. This is also what makes our MRO services unique to the industry by allowing flexibility in the type of unit and service that fits their need. APU demand will continue to grow as lift capacities continue to outpace new aircraft deliveries which keep aging aircraft in service longer.

To learn more about tag.aero, go to www.tag.aero



tag.aero facility
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“The dawn of aviation in the early 20th century was marked by the pioneering efforts of aviation visionaries like the Wright brothers.”

Hangar
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From Wright to the modern skies

The evolution of aircraft maintenance practices

By [Alda](#) – carefully edited by our editors

Aircraft maintenance is a vital aspect of aviation safety, ensuring that aircraft remain in optimal condition to carry passengers and cargo across the globe. Over the past century, the aviation industry has witnessed remarkable advancements in aircraft technology, safety regulations, and maintenance practices. This article takes you on a journey through the fascinating history of aircraft maintenance, from its humble beginnings to the sophisticated practices of the modern era.

Early Aviation and Basic Maintenance

The dawn of aviation in the early 20th century was marked by the pioneering efforts of aviation visionaries like the Wright brothers. In these early days,

aircraft were relatively simple machines, often comprising wooden frames, fabric coverings, and basic propulsion systems. Maintenance primarily involved basic tasks such as tightening bolts, inspecting fragile wooden structures, and repairing fabric surfaces. Mechanics relied on rudimentary tools and their hands-on experience to keep these fragile flying machines airworthy.

World War I and the Birth of Structured Maintenance

The outbreak of World War I in 1914 heralded a turning point for aviation and aircraft maintenance. The demands of the war effort led to rapid advancements in aircraft technology. Aircraft became more complex, and their engines more reliable. Consequently, maintenance procedures



Female mechanic in the early days of aviation © Shutterstock



Lockheed Super Constellation

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needed to evolve to meet these new challenges. Structured maintenance practices emerged, and standardized checklists became a fundamental part of the maintenance process.

Aircraft maintenance personnel received formal training, and hangars began to resemble modern maintenance facilities. Aviation had grown beyond its infancy, and maintenance was no longer solely the responsibility of the pilots and ground crews.

The Interwar Period and the Golden Age of Aviation

The interwar period between World War I and World War II saw the civilian aviation industry take off. Airlines were founded, and the need for scheduled maintenance became apparent. Aircraft manufacturers started to play a more active role in supporting their products, developing maintenance manuals and support programs for their customers. Aircraft maintenance crews grew in size and skill,

and hangars became more sophisticated, equipped to handle the maintenance demands of an ever-expanding fleet of aircraft.

World War II and the Demands of Modern Warfare

World War II marked another pivotal moment in aircraft maintenance history. The global conflict demanded even more advanced aircraft technology, leading to the development of powerful, high-performance machines. With the increased complexity of aircraft came a corresponding increase in maintenance requirements. Routine inspections, preventive maintenance, and comprehensive overhauls became standard practice.

The military's experience with aircraft maintenance had a profound impact on civil aviation practices after the war. It led to the development of maintenance procedures that emphasized safety and efficiency, setting the stage for the

modern era of aviation maintenance.

The Jet Age and the Challenges of Jet Propulsion

The 1950s ushered in the era of jet propulsion, introducing a new set of challenges for aircraft maintenance. Jet engines were significantly more complex than their piston-engine predecessors, and maintenance practices had to adapt accordingly. Regular engine inspections, the introduction of sophisticated diagnostic tools, and specialized training for maintenance personnel became essential. Airlines established maintenance bases around the world to support their growing fleets of jet-powered aircraft.

The Modern Era: Technology, Regulations, and Safety

Today's aviation industry operates at a level of sophistication that would have been unimaginable to the early aviation pioneers. Aircraft have become marvels of technology, featuring computerized

systems, advanced avionics, and lightweight composite materials. The complexity of modern aircraft requires rigorous maintenance practices to ensure safety and reliability.

Stringent regulations set forth by aviation authorities like the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) ensure that safety remains paramount. Comprehensive maintenance manuals, stringent inspection schedules, and detailed record-keeping are all integral parts of modern aircraft maintenance.

Airlines employ large teams of highly skilled engineers, mechanics, and inspectors who work tirelessly to ensure the airworthiness of their fleets. Third-party maintenance providers offer specialized services, including component repair and overhaul.

The Future of Aircraft Maintenance

As we look to the future, aircraft maintenance will continue to evolve in response to emerging technologies and changing industry needs. Innovations such as 3D printing hold the potential to revolutionize the way spare parts are manufactured and replaced, reducing downtime and costs. Drone-based inspections are becoming more



Today technology is key in aircraft maintenance

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commonplace, allowing for safer and more efficient inspections of hard-to-reach areas of an aircraft's structure.

Predictive maintenance, enabled by data analytics, is another frontier in aircraft maintenance. Aircraft will communicate real-time performance data to ground crews, allowing for proactive maintenance and minimizing unplanned downtime.

Sustainable practices are also a growing focus in the aviation industry, with efforts to reduce the environmental impact of aircraft maintenance processes. This includes the development of more environmentally friendly materials and processes.

The history of aircraft maintenance is a testament to human ingenuity and

dedication to ensuring the safety and reliability of flight. From the early days of aviation, when mechanics relied on basic tools and hands-on experience, to the modern era of computerized diagnostics and predictive maintenance, the industry has made remarkable progress.

Aircraft maintenance has evolved in response to the growing complexity of aircraft, the demands of warfare, and the ever-present focus on safety. The aviation industry's commitment to rigorous standards and regulations ensures that every flight is as safe as it is technologically advanced.

As we continue to push the boundaries of aviation technology, aircraft maintenance will remain at the forefront, adapting and innovating to keep our skies safe for generations to come.

It will be intriguing to observe the evolution of aircraft maintenance in the near future, driven by AI and emerging technologies. However, one constant factor persists: aircraft maintenance remains a human-centric, hands-on endeavor.

About this article

Rapid technological developments are changing our work environment. We at AviTrader also do not want to ignore these developments and trends. Therefore, we have decided to launch *Alda*, an AI based article writer. However, *Alda*'s drafts are thoroughly fact-checked by our editors.

“However, one constant factor persists: aircraft maintenance remains a human-centric, hands-on endeavor.”



Despite technology - no aircraft maintenance without mechanics

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»»»»→ *on the move*



Christopher T. Calio

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In a planned leadership transition, RTX has announced that President and Chief Operating Officer **Christopher T. Calio** will succeed **Gregory J. Hayes** as Chief Executive Officer (CEO) at the 2024 RTX annual shareowners meeting scheduled for May 2, 2024. Hayes will continue to serve as Executive Chairman of RTX. Calio has also been appointed to the company's Board of Directors effective December 14, 2023. As

President and Chief Operating Officer of RTX, Calio, oversees the company's three business units, as well as its functions for technology, engineering, enterprise services, digital, operations, quality, supply chain and environment, health and safety. In 2023, Calio oversaw the realignment of RTX from four to three business segments: Collins Aerospace, Pratt & Whitney and Raytheon. Prior to his current role, Calio was President of Pratt & Whitney, where he led the business that designs, manufactures and services aircraft engines and auxiliary power units. He joined the company in 2005 and held various leadership roles and drove significant transformational change throughout his tenure.



Florian Guillermet

Florian Guillermet has been named the prospective Executive Director of the European Union Aviation Safety Agency (EASA), following a decision by the Agency's Management Board. Currently serving as the Director at DSNA, the Air Navigation Services Provider designated by the French State, Guillermet brings over 26 years of aviation experience, with a focus on air navigation and air traffic management. He served as

the Executive Director at SESAR Joint Undertaking from 2014

to 2021, joining in 2012 from EUROCONTROL, where he held various roles since 2004. Earlier in his career, he held positions at the French DGCA and Air France. Guillermet, a graduate engineer from Ecole Polytechnique, holds a specialised Master in Air Transport Management and Aeronautics. The nomination follows an open and transparent procedure launched by the European Commission and a preliminary selection to identify the candidate best suited in terms of merit, competence and experience relevant for civil aviation. A shortlist of candidates was then proposed to the EASA Management Board to make its selection.



Stephanie Pope

Boeing has named **Stephanie Pope** as the Executive Vice President and Chief Operating Officer of The Boeing Company. Effective January 1, 2024, Pope will report directly to Boeing President and Chief Executive Officer **Dave Calhoun**. In her newly established role, Pope will oversee the performance of Boeing's three business units, driving excellence in supply chain, quality, manufacturing and engineering across the company.

As Boeing COO, Pope will have direct reports from the business unit Chief Executive Officers, the Boeing Chief Engineer and the President of Boeing Global. Senior corporate functional leaders will continue reporting to Calhoun. The successor to Pope for leading Boeing Global Services will be announced at a later date. Prior to her new role, Pope served as President and CEO of Boeing Global Services since April 2022. In that position, she led the development and delivery of aerospace services for commercial, government, and aviation industry customers worldwide. Pope's focus included global supply chain and parts distribution, aircraft modifications and maintenance, digital solutions, aftermarket engineering, analytics, and training. She previously held the position of Chief Financial Officer of Boeing Commercial Airplanes.

»»»»→ *on the move*



Paul Ashcroft

AerFin has announced the appointment of **Paul Ashcroft** to the newly created role of Senior Vice President - Asia Pacific. With an extensive career spanning over 30 years in diverse technical and commercial capacities, Ashcroft brings a wealth of industry experience to his new position. Beginning his career at GE Wales, where he took a lead role in powerplant technical support for CFM56 engines with Asia Pacific

customers and earned certification as a Six-Sigma Black Belt, he subsequently held leadership positions at Cathay Pacific, Hong Kong. There, Ashcroft played a pivotal role in the aircraft trading team, overseeing the engineering aspects of lease transitions. During his tenure at Rolls Royce Civil Aerospace as Chief of Service Engineer, he led a substantial team focused on improving operational reliability, enhancing customer technical support and optimising life cycle costs for the global RB211 and Trent fleets. He also contributed to the expansion of operations into Singapore. In his most recent role as Head of Engineering Services at Rolls Royce Defence, Ashcroft led international teams, ensuring the fulfilment of customers' in-service requirements. In his new role at AerFin, he will be tasked with expanding the company's presence across the Asia Pacific region. His responsibilities include fostering a high-performance culture, developing and implementing the company's revenue objectives and contributing to the formulation of AerFin's growth vision and long-term partnership opportunities with existing and prospective clients.

Kellstrom Aerospace Group has appointed **John McKirdy** as its Chief Commercial Officer. In his new capacity, McKirdy will leverage his extensive expertise and proven track record in delivering cost-effective aviation aftermarket services. This strategic move aims to provide Kellstrom's customers with enhanced visibility and access to the diverse array of products and services offered by the company. **Oscar Torres**, CEO of



John McKirdy

Kellstrom Group, emphasized the expansion of their commercial aviation aftermarket solutions and the significant growth witnessed in recent years. McKirdy brings valuable experience to his new role, having previously served as Senior Vice President of the Technical Services Group at Kellstrom. His background includes executive and senior roles in commercial and operations at renowned organisations such as

Wencor Group, Chromalloy and Air Canada. McKirdy holds an MBA from The John Molson School of Business at Concordia University in Montreal, Canada.



Vincent Metz

Vincent Metz is joining SR Technics as VP Business Development Europe. In this role, he will leverage his experience in the aviation industry to grow SR Technics' market share in Europe. With over two decades in aviation, Metz held key roles at Air France KLM, including VP of Strategy, Marketing and Communications. He possesses extensive experience in MRO, with positions such as Director of Component Repair

at KLM and Product Sales Director for Air France Industries. In 2020, he worked on building sustainable aviation solutions with Smart Airport Systems and later founded his consultancy firm Strategy2Fly. Beyond aviation, he made significant contributions in the train sector as interim CTO at Ermewa SA, restructuring its MRO operation. Metz holds a master's degree in Industrial Engineering and Management Science, along with a bachelor's degree in Aeronautical Engineering, showcasing his comprehensive grasp of the technical, managerial and human dimensions of the aviation business.