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MRO Management

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MAKING AN IMPACT

Mario Pierobon finds out how new technologies are impacting productivity and safety in the MRO sector through digitalisation, AI, robotics and 3D printing

1. Pratt & Whitney's 'cobot' is able to capture more consistent images with its extendable arm

"ONE APPLICATION WE ARE NOW USING IS AN INSPECTION 'COBOT' FOR AN ENGINE PRE-INDUCTION PROCESS"

Gilbert Sim, director of aftermarket global operations technology and CORE, Pratt & Whitney

'New' tech is already impacting the MRO sector, and there are multiple real-world examples showcasing these breakthroughs.

According to Lee Hui Fung, senior vice president and head of innovation and continuous improvement at ST Engineering's Commercial Aerospace business, one of the more significant impacts of new technology can be seen in productivity improvement given how labour-intensive MRO work can be.

"Some of the applications can be seen in the digitalisation of maintenance processes for more efficient data flow and collection, and the implementation of robotic solutions to minimise repetitive and/or dangerous labour," she says.

'NEW' TECH IMPACT

Companies in the MRO sector heavily rely on information derived from various data sources such as OEMs, their customers and their internal sources, affirms Saravanan Rajarajan, director of aviation solution consulting at Ramco Systems. He says: "This data is often available in different formats, such as aircraft maintenance manuals (AMM), which are generally in XML, SGML and PDF formats, as well as customer work packages and task cards, which are generally in the PDF format."

He adds: "Generative AI (Gen AI) is well poised to deliver efficiencies and accuracy by enabling a conversation with this data. One of the key factors to consider is the fencing of these data around which the conversation is happening, so that the data source is highly controlled, thereby ensuring authenticated responses. Gen AI can assist a mechanic with questions by leveraging the OEM documents and previous repair history, as well as operational and reliability data of the equipment they are working on."

Pratt & Whitney is leading a dedicated effort across its worldwide manufacturing footprint to modernise and transform its operations, including digitalisation and investments in Industry 4.0 technologies, affirms Gilbert Sim, director of aftermarket global operations technology and CORE at Pratt & Whitney.

"Our approach to Industry 4.0 transformation is powered by two key thrusts," he says. "One is the industrialisation of MRO processes with robotics, connected factory and shop digital twin innovations to speed up turn times without compromising operational quality and safety.

"The second focal point is on material restoration through cutting-edge technology such as additive repairs, and process automation from digital inspection, adaptive processing and coating and masking of parts."

AI AND 3D PRINTING

ST Engineering has integrated advanced AI into its Engine Health Monitoring solution in order to yield deeper insights that better help with informed data-driven decisions, says Lee.

"These include predictive maintenance capabilities to optimise maintenance schedules and identify critical engine issues without the need for off-wing inspection, freeing up shop floor labour and reducing disruption to operators' business plans."

Lee continues: "In the same vein, with additive manufacturing, we are able to quickly produce spare parts on demand to resolve aircraft-on-ground (AOG) situations, enabling airlines to minimise the operational downtime of their aircraft while avoiding the need to maintain costly inventory."

The MRO process typically generates a wealth of data pertaining to the defects, parts consumed, labour hours, time elapsed, etc. that – accumulated over time – can be converted into a competitive advantage by leveraging artificial intelligence/machine learning (AI/ML) tools, says Rajarajan. "The machine learning capabilities of Ramco's Aviation Suite leverage data and advanced algorithms to derive insights. For example, when mechanics report the defect, the system leverages the historical records pertaining to the type

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▲ Digital twins enable technicians to build a broad understanding of assets

of aircraft and ATA code to suggest a list of similar defects that were resolved in the past," he says.

Pratt & Whitney is leveraging AI for MRO processes. Taking inspiration from the semiconductor industry, it is using AI-based computer vision to manipulate a system of robotic arms to manipulate high-pressure turbine vanes, dispense highly toxic filler materials and fill cooling holes with them, all previously done by hand, explains Sim. "Apart from reducing the time required for each component by 13%, we have minimised the level of human contact and time spent interacting with the toxic filler material, hence improving productivity while increasing safety for our employees," he says.

3D printing is another area that is a gamechanger for MRO, and Pratt & Whitney is applying 3D printing beyond the additive manufacturing of parts. "We use 3D print reusable masks to protect parts during the grit spraying and thermal spray coatings processes," explains Sim. "Currently, the masking is done manually using tapes. With the 3D printing, we are able to apply masks on more geometrically complex components that could not previously be done by hand."

DIGITAL TWINNING, ROBOTICS AND BLOCKCHAIN

In the domain of aviation MRO, innovations are also being experienced with regard to digital twinning, robotics, predictive maintenance and blockchain.

By creating a digital model of the facility, Pratt & Whitney learned a new set of skills including data cleaning, data entry, modelling the processes and interpreting the results of the simulation, observes Sim. "Planning sessions like these were previously done with a physical mock-up, which takes two weeks or longer to create as compared to a digital twin," he says. "A physical mock-up also only allows for one variant to be tested, while digital twins can generate endless possibilities and iterations of the space, with each new simulation taking just four days to create."

Robotics is another area in automation the aircraft MRO sector is leveraging, explains Sim. "For instance, one application we are now using is an inspection 'cobot' for an engine pre-induction process. Previously, photos of the engine were taken manually, and the quality of the photos will vary from technician to technician, especially for tricker angles."

Sim adds: "The cobot is able to capture more consistent images with its extendable arm and automatically include it in the pre-induction report documents. The use of robotic arms is another automation example to support technicians in automatically removing and installing sleeves for the front case from engines undergoing MRO. Now only one technician is required to operate the machine, halving the manhours and process time while eliminating fatigue."

For blockchain innovation to yield tangible benefits, it needs the network effect for information sharing, highlights Rajarajan. "Currently, the challenges are with siloed blockchain networks, which limit the potential, or when the chain includes all the supply chain players, including the MRO tier 2 & 3 suppliers, etc. Arriving at the standards for the industry to adopt is a challenge," he says. "We are working on a proof-of-concept to demonstrate the use of blockchain to digitally track and record the movements and maintenance history of parts across airlines, lessors, logistics suppliers, maintenance providers and original equipment manufacturers such as engine producers."

According to Lee, for these innovative technologies to become mainstream, they would need to navigate obstacles to implementation such as complexity, investment costs and long lead times. "Nonetheless, we have been implementing many of these technologies into our solutions and processes, while we continue to look out for more potential use cases and develop solutions that meet our and our customers' needs. For example, as conditions in workshop environments are more controlled (indoor, air-conditioned), we have found that they are more conducive for robotics solutions," she concludes.

"GEN AI CAN ASSIST A MECHANIC WITH QUESTIONS BY LEVERAGING THE OEM DOCUMENTS"

Saravanan Rajarajan, director of aviation solution consulting, Ramco Systems