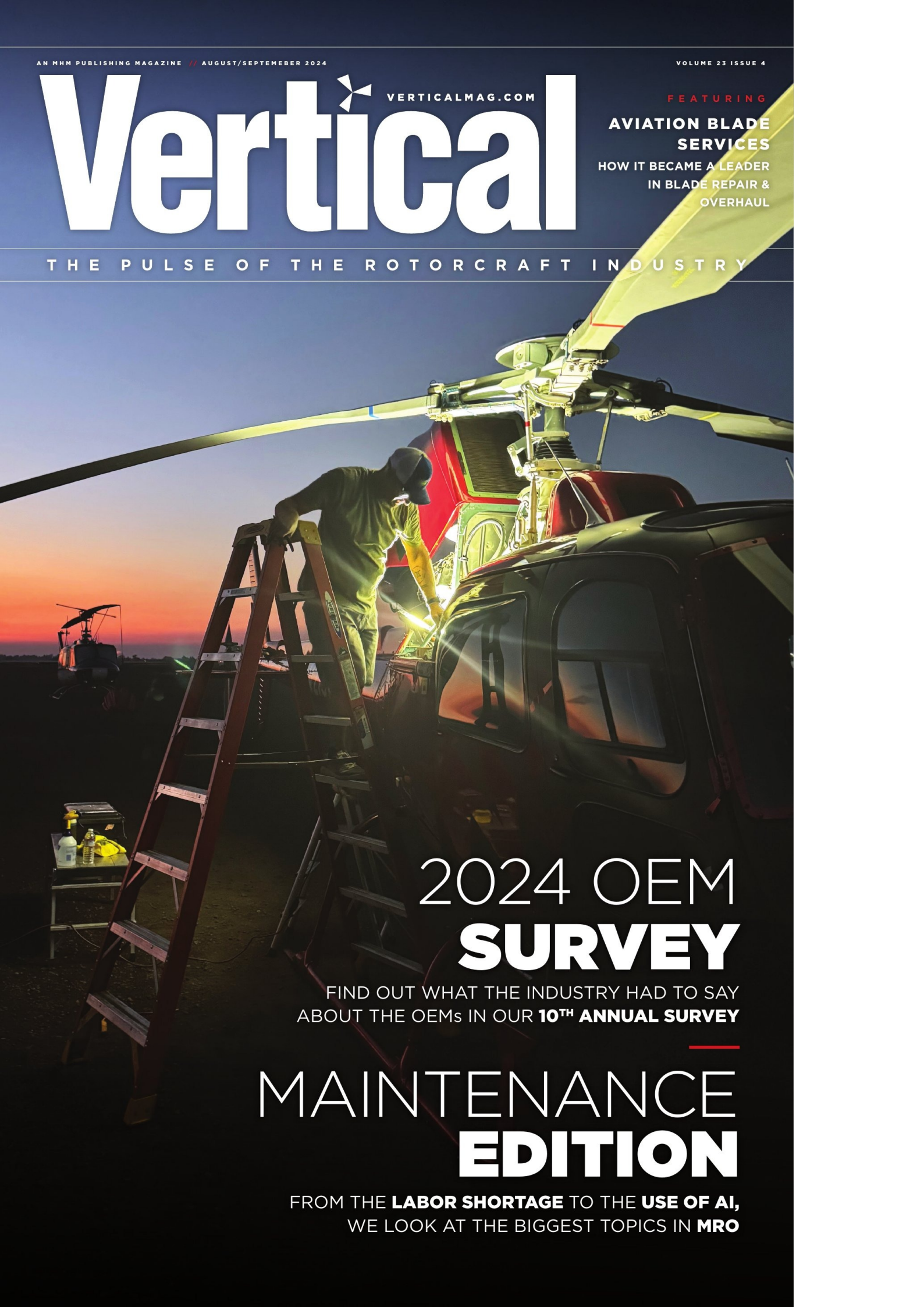


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THE PULSE OF THE ROTORCRAFT INDUSTRY



2024 OEM **SURVEY**

FIND OUT WHAT THE INDUSTRY HAD TO SAY
ABOUT THE OEMs IN OUR **10TH ANNUAL SURVEY**

MAINTENANCE **EDITION**

FROM THE **LABOR SHORTAGE** TO THE **USE OF AI**,
WE LOOK AT THE BIGGEST TOPICS IN **MRO**



ARTIFICIAL INTELLIGENCE APPLICATIONS ARE CHANGING THE AVIATION MAINTENANCE INDUSTRY. MACHINES ARE PLAYING AN EVER-INCREASING ROLE, BUT EXPERTS SAY THERE WILL ALWAYS BE A PLACE FOR HUMAN TECHNICIANS.

By Lisa Gordon

Think of the best helicopter maintenance intern you've ever had in your hangar. Imagine that you only have to correct their mistakes once — and they will never make the same errors again.

Now, imagine that intern isn't a real person at all — it is an artificial intelligence (AI) application designed to increase your team's maintenance proficiency, efficiency and productivity.

According to Faizan Patankar, CEO and co-founder of Amygda, a U.K. company specializing in AI-led health monitoring and troubleshooting solutions for both rotary-wing and fixed-wing aircraft, that's precisely where we sit today.

"Between one unique expert and AI, I would trust the expert because they've spent their life acquiring specialized knowledge," he told *Vertical* during a recent interview. "But between AI and any ordinary worker right now, I would trust AI. A lot of these technologies are now at an engineering intern level. At the moment, take their learnings as a first drop — our job [as AI engineers] is to refine that learning and support the human with validated data they can trust."

Amygda was founded in 2021 in response to what Patankar called the "sheer amount of data that was becoming available across the board.

MAN, MACHINES MAINTENANCE



Leonardo Image

Leonardo Photo



“Data touchpoints are growing, and what we noticed a few years ago is that there were a lot of information management solutions being developed by OEMs for their own specific systems,” he continued. “But an operator often owns equipment from multiple OEMs, which requires training on all of these separate systems.”

That’s when Patankar and his colleagues — all of them mechanical and aerospace engineers — decided they would focus on developing a platform-agnostic AI solution for aviation maintenance and engineering. Today, the company is targeting the transport ecosystem, currently working with at least one major helicopter OEM, a number of fixed-wing operators, and extending into trains.

Patankar took some time to explain the various subsets falling under the collective umbrella of AI.

“AI as a field has been around for 50 to 60 years,” he said. “Machine learning is a subset of AI, where systems learn from the data they receive. But then you have so much data — text and unstructured — which needs converting into ones and zeroes, so natural language processing converts our language into machine-speak that systems can understand. Then we have generative AI [think ChatGPT], which is where not only can it speak our language, but it can also think a bit about what to do next, like reasoning the next word. It has predictive intelligence, drawing on historical data to make its predictions. All of these subsets are relevant and

“BETWEEN AI AND ANY ORDINARY WORKER RIGHT NOW, **I WOULD TRUST AI.** A LOT OF THESE TECHNOLOGIES ARE NOW AT AN ENGINEERING INTERN LEVEL. AT THE MOMENT, TAKE THEIR LEARNINGS AS A FIRST DROP — OUR JOB [AS AI ENGINEERS] IS TO REFINE THAT LEARNING AND SUPPORT THE HUMAN WITH VALIDATED DATA THEY CAN TRUST.”

— **FAIZAN PATANKAR, CEO AND CO-FOUNDER OF AMYGDA**

they are all at different levels. The pinnacle will be when we have the capability for an AI agent to make proven, accurate decisions with little to no human intervention.”

Patankar referenced helicopter health and usage monitoring systems (HUMS), which he said provide a basic monitoring functionality.

“Some of them do give you the opportunity to do some sort of maintenance forecasting. But they only know what they are looking at,” he said.

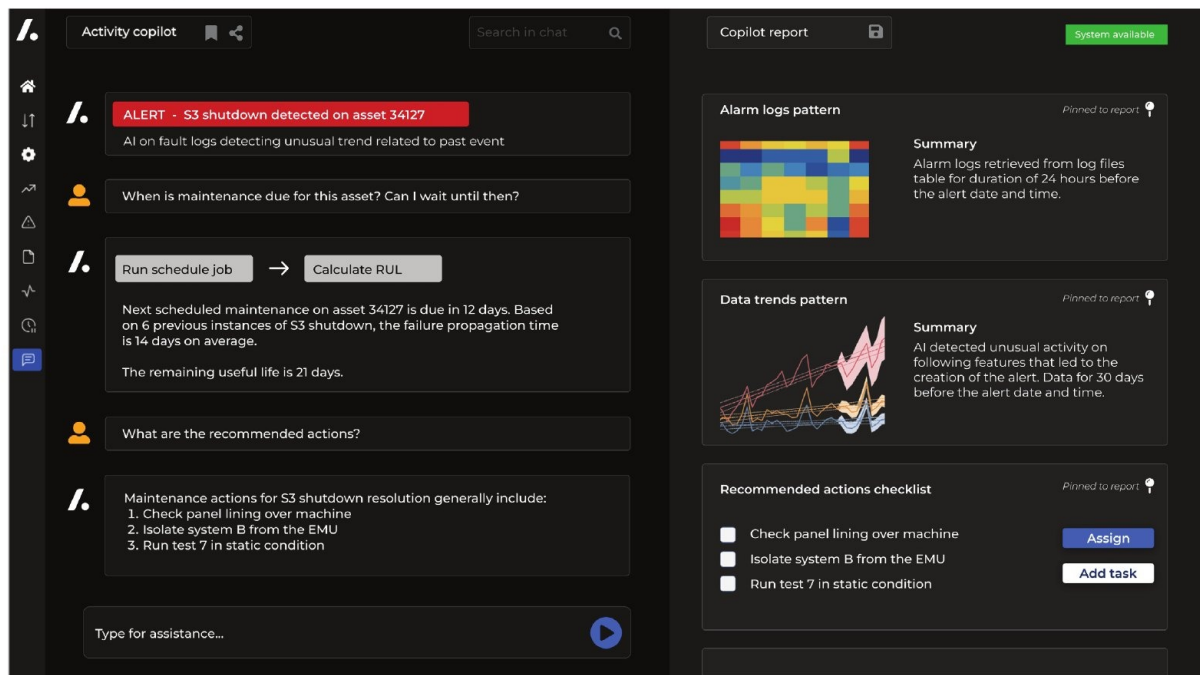
“At Amygda, we think that’s great, but no one makes a decision in a silo. In order to make the right maintenance decision for any given situation, we need to have the right aircraft in the right place, with the right parts and the right people to do the job. So, we are focused on integrated solutions, where everything — parts, people, aircraft — are all in one place at the right time.”

Amygda’s solution allows customers to see their entire fleet on one common customized platform, with instant AI-based troubleshooting and knowledge transfer capability.

Leonardo Photo



Amygda Image



When a customer signs on with Amygda, the team reviews their typical maintenance challenges and works with their existing OEM-generated data, feeding it through an AI engine containing over three terabytes of proprietary operational data, trained and validated on several systems.

“We can look at customer data and we can pick out the 20 or 30 data points that are very important,” said Patankar. “We onboard them by taking some of their historical data to predict how operations would look over a six-month period. Then we can detect the things that have historically been missed.”

He added that 80 percent of information is hidden.

“We have companies with tons of data not being used. By bringing the tech and capturing all of this knowledge, we can now make sense of it with our Maintenance AI agent. The key thing is, if the industry wants to attract good young talent and not lose engineers, we need to provide them the tools

and capabilities they are used to using in their personal lives.”

However, while AI applications are becoming ever more powerful, Patankar said the human element is still very important in the hangar.

“Nobody is saying to blindly trust AI,” he emphasized. “There is a human in the loop and the final decision will be made by them. We are supporting the human with data.”

However, Patankar said we are reaching a point where the AI agent understands what needs to be done and can potentially feed that into a robot. Validating side by side is the best way to build absolute trust in the system, he said.

“I think the helicopter industry is quite cautious,” he said thoughtfully. “That’s why we are doing a huge validation project right now, testing our software thoroughly. We are probably only a couple of years away from machines talking to other machines — it will happen in the defence world first. Right now, companies like Amygda are creating these solutions.”

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THE BEGINNING OF AN ERA

Italian helicopter OEM Leonardo began bringing aftermarket helicopter diagnostic systems in-house about six years ago, developing its own proprietary HUMS system.

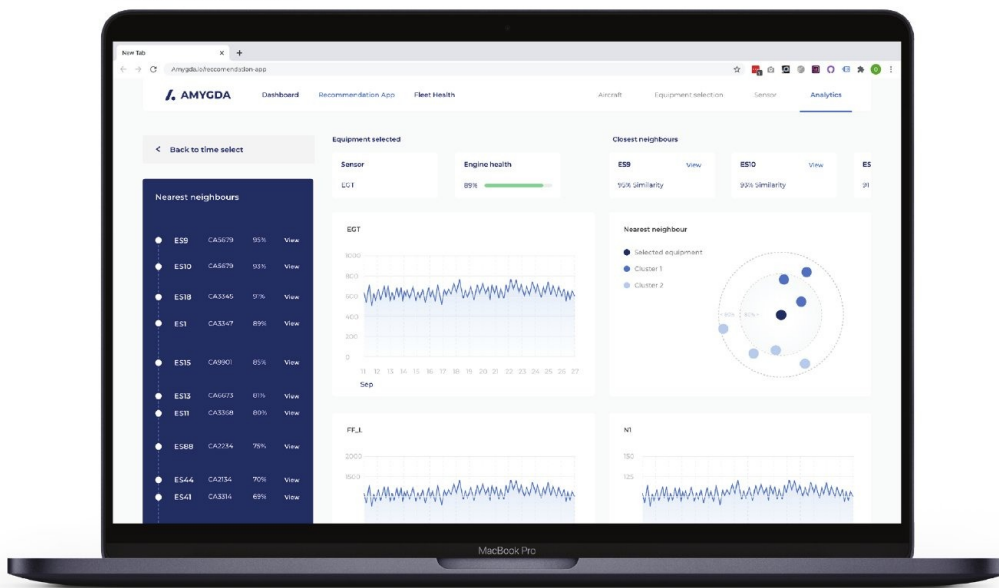
That feature is now installed on every new helicopter leaving the factory, said Paolo Petrosso, Leonardo’s vice president of customer support and training development, digital services and governance.

is digital by design,” recounted Petrosso. “Then, a couple of years ago, we started to provide live applications.”

Leonardo’s HeliConnect portal lets customers access OEM analytics to make better and more informed decisions.

“Now, we are taking all the data from the fleet, produced in the last few years with digital logbooks, and we have a high-performance in-house computer that aggregates

Amygda Image



“In parallel with that, we also started, in the last six to seven years, some related niche services and solutions, such as mission planning, electronic flight bag, [and] weight and balance,” he continued. “Once these activities of exploring digital services became really big in 2019/20, we started seeing machine learning and algorithms.”

The goal was to measure Leonardo’s performance as an OEM through specific key performance indicators, all dutifully recorded in each aircraft’s digital logbook — a cradle-to-grave record introduced for new helicopters in 2020/21.

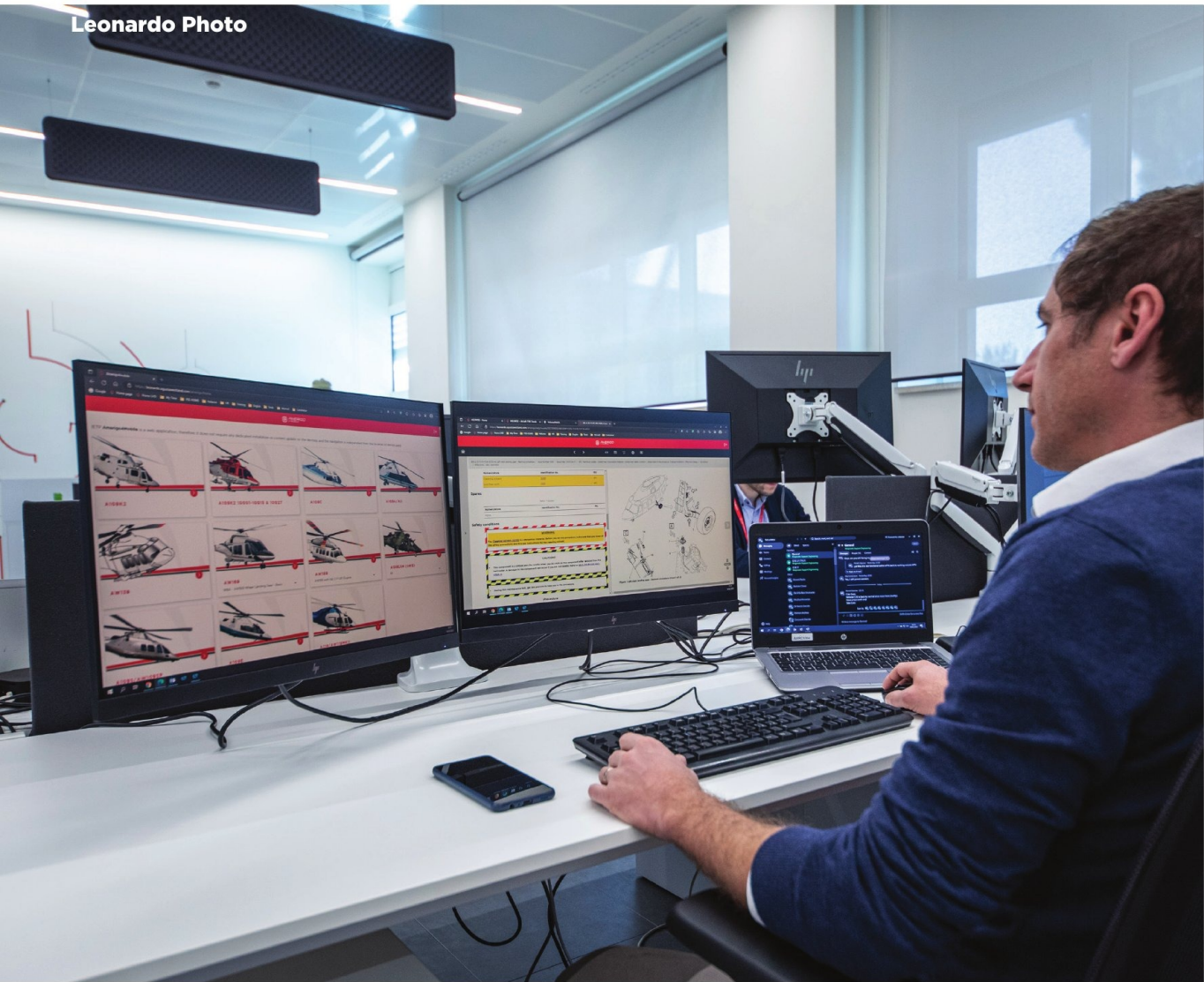
“We said, ‘This is actually a big milestone for us. Let’s build an aircraft configuration that

that data in many different ways. We can review our logistics, our warehouse and how much is in stock, and see how each component is performing on the aircraft.”

Petrosso said Leonardo customers are interested in easy digital services that add value.

“I think that in our business we’re at the beginning of the digital era,” he reflected. “Nowadays, if you Google ‘digital helicopter,’ you get thousands of results. We want to tie data sharing to our value-added services.”

Currently, Leonardo is launching a new system that uses AI to predict the likelihood that a specific component will fail in a pre-determined number of hours.



“We want to reduce aircraft on ground [AOG] events,” said Petrosso. “The customer may want to order the components or make sure we have them available. Ultimately, it’s to make sure the customer flies more and flies better.”

He explained that HUMS is a good example of a predictive data application, but the systems being used today are reliant on human intervention. While they can flag trends, they can’t make the jump to how they relate to specific maintenance codes.

“Customers can look at [HUMS data] themselves, ask us to look if they have questions, or we can provide a service where we

monitor it and notify them,” said Petrosso. “The next level: We won’t need the human being as much. AI will look at recurring trends and there will be a self-diagnosis capability.”

Currently, Leonardo’s inventory is actively managed by machine learning applications, with AI handling components planning.

“The second step is helping customers to manage their fleet with AI guided HUMS — and that requires the expert eye of an engineer. Third, we want to use HUMS, predictive analysis and inventory analysis to digitize the maintenance process and create a fully connected aircraft.”

Leonardo is also exploring generative AI assistants, natural language processing and maintenance schedule optimization. While Petrosso said concepts are being developed, customers have not seen them yet.

“Models are giving us encouraging results. Imagine if you could navigate through generative AI into an encyclopedia where you could not just search for the word, but ask a question and get a meaningful response. How much time could you save? What if you could wire gen AI into a tech publication? We also know that as human beings, we’re sometimes lazy. We have to make sure that what we deploy is 100 percent reliable. We have to be mindful that there are always human beings on board these helicopters.”

Petrosso said the human role is still important, but in an industry faced with a shortage of maintenance engineers, AI can fill the gap. “It’s going to help the personnel shortage

quite a lot. We see a big generation of highly experienced technicians retiring soon. There is no way, with traditional tools, that we can transfer their experience. If we can get that database ready and accessible, we think you may have qualified people with less experience doing the job.”

Still, there’s going to be a lot of training involved as maintenance moves toward greater automation.

“It’s the beginning of an era,” said Petrosso. “We have to walk people through this change and educate them. Future aircraft will have elements of automated maintenance, similar to autopilot for pilots. You will be able to robotize the system through AI. The human will always be there, but they may be the second line of defense.”

A PRACTICAL AI APPLICATION

Improving operational efficiency is also the mission over at GPMS, which manufactures



Lloyd Horgan Photo

a predictive HUMS solution integrated with flight data monitoring (FDM) and optimizes a helicopter's rotor track and balance system.

"Our goal is to help operators move from unscheduled events to scheduled events, to smooth out how a flight department handles maintenance," said Ronnie Ries, vice president of marketing at GPMS.

The company's Foresight MX is currently deployed on a variety of light to heavy helicopter types, predominantly in the utility sector. Smart sensors located on a series of monitored components record millions of lines of code and translate it into a user interface that makes sense to maintainers.

"If it rotates or vibrates, we can monitor it," said Ries. "The gears, bearing, driveshaft, engines ... all can be monitored. Traditional legacy HUMS used piezoelectric sensors that had a lot of false positives. We use smart sensors, mini micro-processors, and after every flight,

all data is uploaded wirelessly. An automated text message outlines any negative trends. Most HUMS would tell you there is a problem, but they're not necessarily telling you how bad the problem is or when it might need to be addressed. We can tell you up to 100-plus hours ahead of time when that component might need replacement."

Compared to old systems that were heavy and complicated, Ries said Foresight MX is lightweight, fast, and allows access to some of the biggest blind spots in the aircraft. Currently, GPMS has supplemental type certificates (STCs) to install Foresight MX on over 14 models of helicopters, including those from Airbus, Bell, Boeing, MD, Mil and Sikorsky. Its clients fly public safety, utility, executive transport, firefighting and parapublic missions.

"We think Foresight is an exciting example of the practical application of AI for helicopter operators today," said Andrew Swayze, vice



president of strategy and business development at GPMS. “What we’re showing you here is a pretty exciting example of data and analytics and AI, all applied to deliver real benefits to operators on the ground. We see there are huge benefits to safety, availability, maintenance efficiency and savings. If you catch issues early, they are less expensive to fix.”

To enable truly predictive helicopter maintenance, Ries and Swayze explained the cloud

must be populated by good, reliable data.

“The first challenge you have in this world of AI-enabled maintenance for helicopters is getting that data from the aircraft,” said Ries. “Most aircraft are not even connected, let alone smart. While glass cockpits can provide parameter data and telematics, you need HUMS vibration data to understand component health.”

GPMS’s Foresight MX processes raw vibration data on board the helicopter to separate signals from “noise,” looking for departures from normal. Then, a secondary level of processing occurs off board, where machine learning and physics-informed AI applications generate reliable component health data to predict hours of useful life.

When it comes to the human element, Ries said Foresight MX is a recruitment and retention feature for younger maintenance workers.

“You have an MRI machine for your aircraft. You can drill down to find a particular component and what is happening. You can avoid exploratory surgery.”

This last fact is something that has proven particularly valuable in the field, with data transfer via wireless connectivity back to maintainers at company headquarters. In some cases, issues can be analyzed and solved without dispatching an engineer with a toolbox. At the very least, technicians can be dispatched with all required parts in hand.

Both Ries and Swayze stressed that human verification and processing is mandatory with Foresight MX.

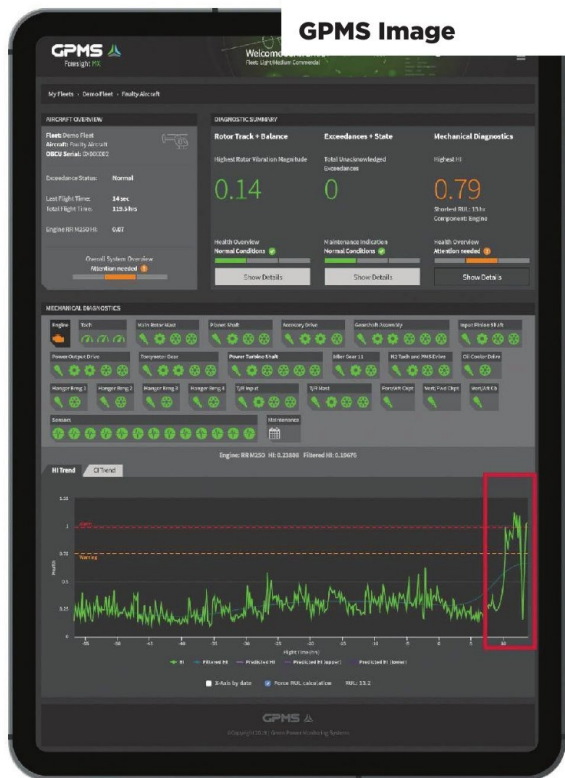
“Our system will not tell you when to fly and when not to fly,” said Ries. “You have data; you have to make decisions on what that data is telling you in terms of risks.”

The next step could be combining HUMS data, the voice of the aircraft, with maintenance tracking data, the voice of the OEM.

“That seems like a very powerful next level



Troy Dominy Photo



improvement,” concluded Swayze. “Every OEM is looking to figure out how they can connect the fleet and really use that data to improve not only their aircraft, but also the service experience.”

A MAN-MACHINE PARTNERSHIP

As AI continues to make inroads in aviation maintenance, the emphasis is on human and machine working together.

Bart Vredereg, CEO and co-founder of Aiir Innovations in Amsterdam, Netherlands, said that in simple terms, his company is creating a “spell check” to point out where human maintenance technicians may have made a mistake.

“AI is trained to search for things that are similar to what has been reported before,” he explained. “The human is doing their inspection as they normally would. AI is about making sure that man and machine are working together effectively.”

Aiir Innovations — founded by a group of engineering students — honed in on borescope inspections in 2016, after KLM Royal Dutch Airlines invited them to evaluate AI

applications in the hangar.

“A borescope is a snake-like camera that goes inside the engine to see the turbine engine blades. You want to spot cracks, dents, missing material, missing coatings or deterioration,” said Vredereg.

“It’s a lot of work to inspect so many blades. It took one expert three eight-hour shifts to do a full inspection on one commercial jet engine with 1,200 blades. As students, we had four weeks to build something and present it to the management. They were interested.”

Initially, Vredereg admitted their goal was to engineer humans out of borescope inspections within so many years. However, that quickly changed.

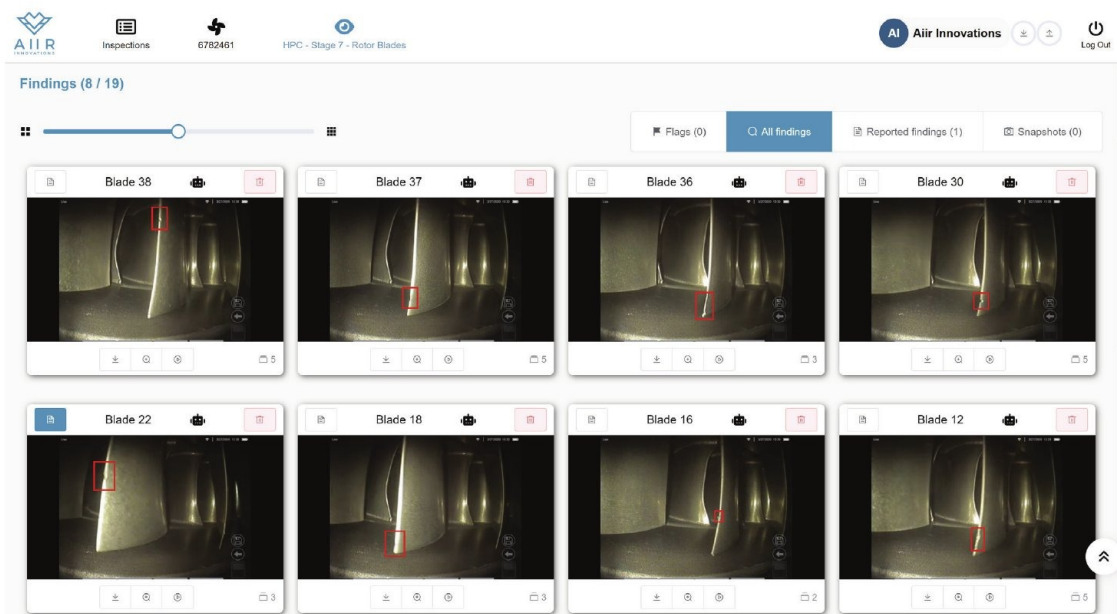
“We realized quite soon that it’s not about replacing humans,” he told *Vertical*. “It’s about getting the best experience for the inspector and using the skills of the human in the most optimal way. We use AI to narrow it down, focus their attention in the right places.”

Now, the company’s Aiir Inspection software



Aiir Photo

Aiir Image



is branded as a maintenance co-pilot, designed to “shout out” when it sees a potentially dangerous situation.

Aiir Innovations has tested its AI-based borescope inspection tool on helicopter engines, finding that the applications are similar to commercial aviation.

“We also work with business jets with smaller gas turbines,” said Vredbregt. “There are similarities in how the defects look. You are catching defects that otherwise go on to cause bigger problems down the line.”

For newer borescope inspectors, the application acts as a safety net — a second set of “eyes” that references acquired experience to achieve the highest level of quality.

“The man-machine combination is key. We designed our system to make sure it’s always a human making the final call. As with the spell check example, the human can always overrule it.”

Aiir Innovations aims to set the standard for borescope inspections. Its product is compatible with any borescope, as long as it has a video output.

“We believe this is one of those places where there is a lot to be gained,” said Vredbregt. “We are now working with 10 customers and we are rapidly growing in the

commercial aviation space. We are looking at helicopter and business jets, too. The more people who use the solution, the smarter it will get.”

No matter the application, AI and related technologies are steadily changing the way aviation maintenance is performed. As time goes on and more data is acquired to inform experience, we can expect machines to evolve from educated apprentice to seasoned expert.

Still, Aiir Innovation’s Vredbregt cautioned that humans should never become complacent and expect too much of AI.

“We need to make sure people don’t overestimate what AI can do and will do,” he said. “In the end, it’s easy to hear these things and think AI is magic, but the reality is more nuanced. AI will change the world forever, and there’s a lot of things it can do — but still the human component is there.” ✦



✦ **LISA GORDON**

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