

Issue

2

TUESDAY  
19 July 2022

# FLIGHT DAILY NEWS

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## Reddy, steady, show

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BillyPix

# Tempest

ans demonstrator flight within five years



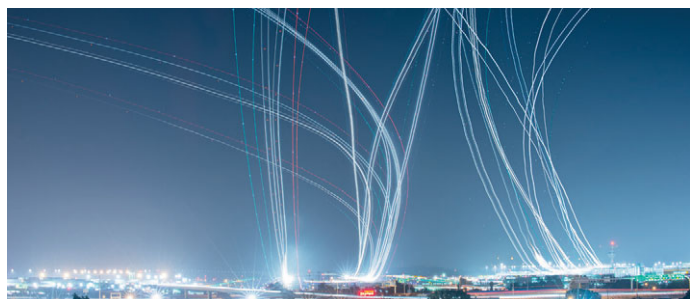
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Launched at Farnborough’s 2018

Continued on page 5



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### Reddy, steady, show

The Red Arrows accompany a specially liveried UK Royal Air Force Eurofighter Typhoon in a flypast to open the show yesterday.

# Time for Tempest

Team behind sixth-generation fighter plans demonstrator flight within five years

**Craig Hoyle**

**G**eneration Tempest took off at the Farnborough air show yesterday, as the UK announced plans to fly a supersonic demonstrator of the sixth-generation fighter within five years, and detailed closer combat aircraft technology links with Italy and Japan.

Herman Claesen, BAE Systems' managing director Future Combat Air System (FCAS),

notes that unlike the last such UK demonstrator – the Eurofighter-precursor EAP first flown in 1986 – digital design and model-based system technology means that company and Royal Air Force pilots have already “flown” the future asset.

“We are already flying this aircraft digitally. We have already conducted 100 flying hours,” Claesen notes.

“The design, development and build of that demonstrator is progressing very well,” he says.

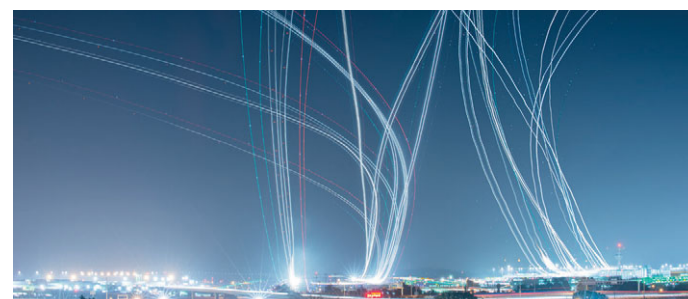


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Continued on page 5



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Continued from page 1  
show, the manned Tempest fighter also has gained a revised look, which now more closely resembles the Lockheed Martin F-22.

Richard Berthon, director future combat air for the UK Ministry of Defence (MoD), says the demonstrator project has been under way "for a couple of years already".

Additionally, he reveals: "We are now conducting joint concept analysis with Japan and Italy on a future combat aircraft. We are looking at our respective military requirements and potential alignment of our industrial bases, to make decisions later on in the year."

"These are serious countries, with serious ambitions," Berthon notes.

Sweden – which has also been linked to the FCAS programme since its launch – "remains a very close partner", but he notes that the nation faces a "radical change in its strategic environment" following Russia's invasion of Ukraine, and that "NATO accession changes the dynamic for them".

Team Tempest partners BAE, Leonardo UK, MBDA UK, Rolls-Royce and the MoD also have launched a 'Generation Tempest' initiative. Berthon says the recruitment drive is intended to attract "the brightest and best" talent to work on the project, which aims to produce a new manned fighter for operational use from 2035.

Meanwhile, Leonardo has identified Mitsubishi Electric as its partner for the Jaguar radar project being advanced by the UK and Japan.

# Leonardo readies Yeovil for AW149

Dominic Perry

Leonardo Helicopters has begun setting up a production line at its Yeovil plant in the UK for the AW149 and could be in a position by year-end to begin building the super-medium-class platform at the site.

The rotorcraft is a candidate for the UK's New Medium Helicopter (NMH) requirement, which is seeking up to 44 helicopters to replace several types in Royal Air Force and British Army service.

Activities to support the establishment of the final assembly line began early in 2022, says head of UK campaigns Mike Morrisroe.

These included the secondment of UK staff to the company's current AW149 line in Vergiate, Italy "working the build of the aircraft" alongside Italian colleagues.

Although the Yeovil site previously assembled the related AW189, additional tooling and jigs specific to the AW149 have been ordered over the last three months, says Morrisroe.

Based on current delivery times of that equipment "by the end of the year we will have sufficient [tooling] to start building an aircraft," he says.

"We are putting the tooling in place so that if we get an order from the UK we could move at pace."

He estimates that delivery of an initial aircraft could



Military credentials of AW149 were highlighted at show

take place within 12-14 months of contract signature, although notes that customer-specific modifications could lengthen that process.

However, Morrisroe says he "cannot confirm at this stage" if the manufacturer would build an AW149 at Yeovil as a trial run ahead of any contract award.

If selected for the NMH requirement, Leonardo would build examples for the UK, plus those for export, in Yeovil.

Parked outside the company's Farnborough chalet, the AW149 at the show was used recently for weapons

integration trials conducted in an undisclosed European country, understood to be Hungary.

Guided and unguided rockets, carried on a brand-new weapons station, were fired from the helicopter, the programme's sixth pre-production aircraft.

Leonardo had previously used what it called the "common platform demonstrator" – a rebadged AW189 – to promote the AW149 in the UK.

But Morrisroe says the switch was made as it offers "a good demonstration of a lot of the [mission] kits that are already on the shelf or

that we are in the process of qualifying."

Gian Piero Cuttillo, managing director of Leonardo Helicopters, says the AW149 has a "great future" in terms of its export potential.

Speaking at later briefing, Leonardo chief executive Alessandro Profumo refused to be drawn on the future of the Yeovil plant if the AW149 does not win the NMH tender.

Stressing his confidence that the helicopter "will win", he adds: "The day we don't win we will take a decision. I don't want to blackmail anyone by saying we will close Yeovil."

## UK team spells out hypersonic ambitions

A UK project to explore the potential of hypersonic propulsion received a major boost at the show, with plans announced for a flight-test activity to take place later this decade.

Announced by Reaction Engines, Rolls-Royce, the Royal Air Force's (RAF's) Rapid Capabilities Office and the UK Defence Science and Technology Laboratory on 18 July, the Hypersonic Air Vehicle Experimental (HVX) activity will employ a reusable platform to demonstrate Mach 5-plus performance.

A 'Concept V' HVX vehicle – to be scaled around the size of a BAE Systems Hawk trainer – will be flown for the first time "well within this decade", says Air Vice-Marshal Linc Taylor, the RAF's chief of staff, air capability.

"One of the things we believe will have value in changing the way we

fight is reusable hypersonics," he says.

The experimentation will provide "the evidence as to whether this plays a part in our future orbat [order of battle]", he adds, while declining to reveal potential operational applications for such a capability.

Reaction Engines chief executive Mark Thomas says HVX will draw on the company's precooler and combined-cycle engine technologies, and knowledge gained from its SABRE project.

"The project has set off at high pace and we expect to maintain that throughout this demonstration phase," he says.

The company is already testing its technology in advance of integrating it with an unidentified donor engine.

"Thermal management is a real game changer," notes Rolls-Royce director of future programmes John Wardell.



Taylor: Prototype will be flown this decade





Nair (left), with Ihsane Mounir, senior vice-president Boeing

## Emirates chief sees no end in 2022 to staffing woes

Emirates Airline president Tim Clark (*below right*) expects the operational issues being seen in some markets to persist into 2023.

Speaking during a panel session at the show yesterday, Clark highlighted a “real supply of labour problem” affecting economies around the world, with businesses throughout the air transport chain struggling to recruit enough staff as a result.

“My view is we’ll get back to equilibrium during the course of 2023 and we’re going to have to tough it out until then, I’m afraid,” he states.

“We have to accept that a lot of people left the industry during the course of 2020 and it is difficult to find [replacements].”

Nevertheless, Clark also believes some businesses failed to plan sufficiently for the post-Covid return of travel demand.

“I was saying ‘it’s coming... it always bounces back,’” he recalls of conversations with airports and other suppliers regarding the likely strong return of customer demand once international flying was possible again. “[But] everybody was more worried about the costs of getting it wrong.”

Speaking on the same panel, IATA director general Willie Walsh (*left*) said he expects to see improvements to the staffing situation in the coming months.

“I think we have the ability to be ready as we go through the rest of this year,” he says, while insisting the problems are not being seen “in all markets or at all airlines”.

Walsh agrees with Clark that a failure to plan is behind some of the issues at airports, stating of Heathrow airport’s challenges, for example: “It should not be as bad as it is.”

Clark also says he became “pretty irate” when he saw Heathrow’s recent announcement regarding capacity caps, prompting the carrier’s strongly worded response.

In that response – communicated in a 14 July press release – Emirates accused Heathrow of having “blatant disregard” for passengers by trying to enforce a daily capacity limit of 100,000 departing passengers through the summer peak months.

“I did light up – I knew I had thousands of people who were going to be left at Heathrow with absolutely no where to go,” Clark says. “This is anathema to what we do as an industry and it has to be better managed than that. ‘It’s not easy but I was pretty irate.’”

The Middle Eastern airline eventually backed away from its refusal to co-operate with newly imposed London Heathrow capacity limits, following a meeting with the airport’s operator.

Nevertheless, Clark describes the situation as “a kind of wake-up call” for the industry.

“We’ve got to have resilience and plans in place to deal with all this,” he states.

Walsh – a long-time Heathrow critic – described the London hub’s actions as “a scandal”.

“It is disappointing that Heathrow has had to take measures that reduce capacity,” Walsh says. “They have no excuses. They should have been ready. They should have been better prepared.”



BillyPax

# Top 10

## Delta Air Lines’ 100-strong order gives needed boost to largest 737 Max variant

Jon Hemmerdinger

Boeing opened the show yesterday by announcing an order from Delta Air Lines for 100 Boeing 737 Max 10s.

The Atlanta-based airline has also taken options to purchase an additional 30 of the jets, with deliveries starting from 2025.

The deal provides much-needed momentum to the 737 Max programme, and more specifically to the Max 10, an aircraft with uncertain prospects due to pending regulatory requirements.

The order is also notable because Boeing had until now not secured Delta, a current 737NG operator, as a 737 Max customer.

Boeing has now sold the Max to all the major US carriers, the others being American Airlines, Southwest Airlines and United Airlines.

The Max 10 has also been a tepid seller when compared with the success of the competing Airbus A321neo.

Delta expects to receive the 100 CFM Leap-1B-powered aircraft between 2025 and 2029, with the options, if exercised, to be delivered between 2029 and 2031.

“This is a terrific moment for us. It is an inflection point in our relationship with Boeing and CFM,” says Delta senior vice-president of fleet and tech ops supply chain Mahendra Nair.

“This is part of the deal we have been working for a long time,” Nair adds. “We are back in the fray. We are pleased to be partnering with Boeing.”

The airline will outfit the aircraft with 182 seats.

Delta operates a narrow-body fleet split between 737NGs and Airbus A220s and A320-family jets. Until

now, Delta had aligned its narrowbody-fleet future with Airbus; it holds outstanding orders for 39 A220s and 152 A321s, according to Cirium fleets data.

Delta will use the incoming 737 Max 10s to replace existing 737NGs. That fleet stands at a mix of about 235 737-800s and 737-900ERs, Cirium shows. Delta chose the 737 Max due largely to pilot commonality with 737NGs, says Nair.

“That’s the biggest factor in the decision-making process,” he adds. “We have aircraft that are retiring.”

The Max 10 faces uncertainty due to a new requirement, set to take effect in December, that will prohibit the US Federal Aviation Administration from certifying aircraft lacking a modern flight-crew alerting system, also known as an engine-indicating and crew-alerting system.

# GE flags aerospace appeal

Jon Hemmerdinger

GE Aviation is to change its name to GE Aerospace in a move executives say reflects the company’s intention to broaden its focus beyond aircraft engines.

The name change will occur when parent General Electric completes a wider restructuring, expected to be finished in early 2024.

“We are going to have a wider strategic aperture,” General Electric chief executive Lawrence Culp said at the show yesterday. In a decade, “we may be in some businesses that we are not in today”.

General Electric is also rebranding its divisions as part of a planned break-up of the long-time industrial giant. The overhaul will see GE divest its healthcare and energy businesses, leaving GE Aerospace as the remaining operation. Its energy unit will be called GE Vernova and the healthcare business GE Healthcare.

As part of the changes,

Culp will become chief of GE Aerospace, with the unit’s current boss John Slattery taking the role of chief commercial officer.

Changing the name will help highlight that GE Aerospace “is more than what we do in commercial propulsion”, says Culp, noting GE also has a strong military aviation business.

GE also announced yesterday that it has completed the world’s first test of a megawatt-class and multi-kilovolt (kV) hybrid-electric propulsion system in altitude conditions that simulate single-aisle commercial flight.

GE says the test of the high-power, high-voltage system – including electric motor/generators, power converters, power transmission and power control systems – successfully demonstrated performance and operation of the components in a replicated flight environment and helps validate the architecture of the hybrid electric propulsion systems it is developing.



Lawrence Culp, General Electric chief executive (left), and John Slattery

## USAF fires F3R for first time



The test round was launched from an F-15E

The US Air Force (USAF) has conducted the first live fire test of the F3R-standard AIM-120D3 AMRAAM (Advanced Medium Range Air-to-Air Missile).

The exercise took place on 30 June, with the missile launched from a USAF Boeing F-15E fighter. Raytheon Missiles & Defense disclosed the successful test at the show yesterday.

The test came under the auspices of the company’s ‘Form, Fit, Function, Refresh’ programme, with updates to the hardware and software of the missile, which

has served as the USAF’s primary air-to-air weapon for decades.

During the test, the weapon was able to engage an aerial target at “long range”.

Without providing exact details, Raytheon contends that updates to the existing AMRAAM can greatly enhance its range.

“The AMRAAM F3R is a comprehensive hardware system redesign impacting 15 circuit card assemblies replacing early 2000s technology components,” says the USAF.

“The core objective of the

test was to execute a long-range shot that physically stressed the new missile hardware and verified missile performance capabilities.”

In April 2021, the USAF achieved the longest known air-to-air missile shot using an AIM-120 fired against a drone, but it did not provide details of the range.

Raytheon says that upgrade work can greatly enhance the range and capability of the venerable AIM-120 missile – a key consideration as the US military contemplates a potential

peer-on-peer conflict with China.

Raytheon also announced that Norway has selected its StormBreaker weapon for its Lockheed Martin F-35A fleet.

StormBreaker is capable of attacking both stationary and moving targets during the day or night, and in a range of conditions.

“StormBreaker delivers a unique combination of power, precision, and operational flexibility to the joint and allied fight,” says Paul Ferraro, president of air power for Raytheon Missiles & Defense.



## Boris makes flying visit

For a man well-known for getting stuck on a zip-wire, the air show surely offers a fascinating learning opportunity regarding the physics of air travel.

And outgoing UK Prime Minister Boris Johnson certainly picked some leading-edge companies to visit during his time at the show yesterday.

Among the stands perused by Johnson, UK firm Vertical Aerospace showed off its VX4 electric vertical take-off and landing aircraft, which it promotes for both civil and military missions.

Vertical promises to “revolutionise urban air mobility” with its product.

As Johnson’s political career powers down, the charge towards the electrification of flight continues apace.



# Sikorsky has the X2 factor

Ryan Finnerty

Sikorsky thinks its vertical lift technology is uniquely suited to meet Europe's future helicopter needs.

Speaking at the Farnborough air show, Sikorsky executives are pitching the Connecticut manufacturer's X2 line of coaxial rotorcraft to European buyers.

"We are ready to promote this technology internationally," says Luigi Piantodosi, director of future vertical lift international for Sikorsky.

The X2 family of aircraft is centred on a coaxial, dual main rotor assembly coupled with a rear-mounted propeller for generating additional forward thrust.

With the latest X2 models reaching cruising speeds above 230kt (425km/h), Sikorsky argues that design is vastly superior in terms of speed and manoeuvrability to the conventional, single main rotor arrangement used by most utility helicopters.

"That is something you quite frankly cannot get from a single, main rotor," says Jay Macklin, Sikorsky's



Sikorsky argues that X2 architecture is vastly superior in terms of speed and manoeuvrability

director of US Army Future Vertical Lift programmes.

Macklin, a former army UH-60 Black Hawk pilot, argues that the ability to fly fast at low altitude will be essential to ensuring survivability in a modern, contested environment, such as Russia's ongoing war in Ukraine.

The comments are aimed

squarely at defence officials in six European countries, which in June announced a multi-national effort dubbed the Next Generation Rotorcraft capability (NGRC) project in which the participants will combine efforts to design and procure a new medium utility helicopter.

The programme envisions delivering the platform to

the militaries of France, Germany, Greece, Italy, the Netherlands and the UK between 2035 and 2040, the estimated period in which those allies' current medium-lift assets will reach the end of their lifecycle.

Sikorsky is pitching two of its X2 platforms, the DefiantX and smaller RaiderX, as candidates for a US Army

initiative to find new utility and scout helicopters, a programme known as Future Vertical Lift.

A decision in the army Future Long Range Assault Aircraft (FLRAA) competition to replace Sikorsky's long-serving Black Hawk, is expected in the coming months.

Piantodosi says that while European customers are largely keeping quiet ahead of the FLRAA decision, which has pitted the Sikorsky-Boeing DefiantX against Bell's V-280 Valor tiltrotor, there is currently "huge interest" in X2 technology from Europe.

When asked if Sikorsky could pitch either the DefiantX or the RaiderX for any future European need, Piantodosi says it is likely the ultimate submission will be a third design "that sits somewhere in between" the two competitive prototypes built for the US Army.

Macklin agrees with that prediction, describing RaiderX and DefiantX as "bookends" to the current X2 line, with potential new airframes, tailored to meet different needs, falling in the middle.

## TAAG bags A220s

Angolan flag-carrier TAAG is to introduce Airbus A220s, through an acquisition from US company Air Lease.

TAAG is to take six of the -300 variant of the twinjets to replace Boeing 737-700s.

The A220 is exclusively powered by Pratt & Whitney PW1500G engines.

Air Lease is to deliver the aircraft over the course of 2023-2024, the company states.

TAAG chief executive Eduardo Fairen says the agreement is "significant" and represents a "new era and a new vision" for the Luanda-based carrier.

"We are alive, back in business, breaching with the past to achieve greater results and becoming a reference for Africa," he adds.

TAAG has seven 737-700s in a fleet which also includes 777-200s, -300s and De Havilland Canada Dash 8-400 turboprops.



Defence minister Daniel Blazkovec, Miloslav Kafka, PBS, and Marie Chatardova, Prague's ambassador to the UK

## Czech this: PBS launches latest UAV engine

Czech manufacturer PBS, which specialises in propulsion systems for unmanned air systems, has formally launched its latest jet engine.

The 202lb (0.89kN)-thrust PJ80-120 was unveiled at the show yesterday at a ceremony attended by Marie Chatardova, Prague's ambassador to the UK, and deputy Czech defence minister Daniel Blazkovec.

The engine joins the 95lb-thrust TJ-40 and the 337lb-thrust TJ150 in the

company's range. PBS is also developing the 500lb-thrust TJ200, which is equipped with a starter-generator, electric metering fuel pump and electronic control system.

The firm, based near Brno, has been producing light propulsion equipment for 50 years and was behind the auxiliary power unit on the original Aero Vodochody L-39.

PBS is still a supplier to the military airframer,

making the environmental control system and starter generator for its successor, the L-39NG.

The company has other customers, but they are "sensitive" so are not disclosed, says Adam Vysocky, product and business development director.

It manufactures its own castings and other components. "We are very vertically integrated," says Vysocky. "Around 90% of our engines are produced in-house."

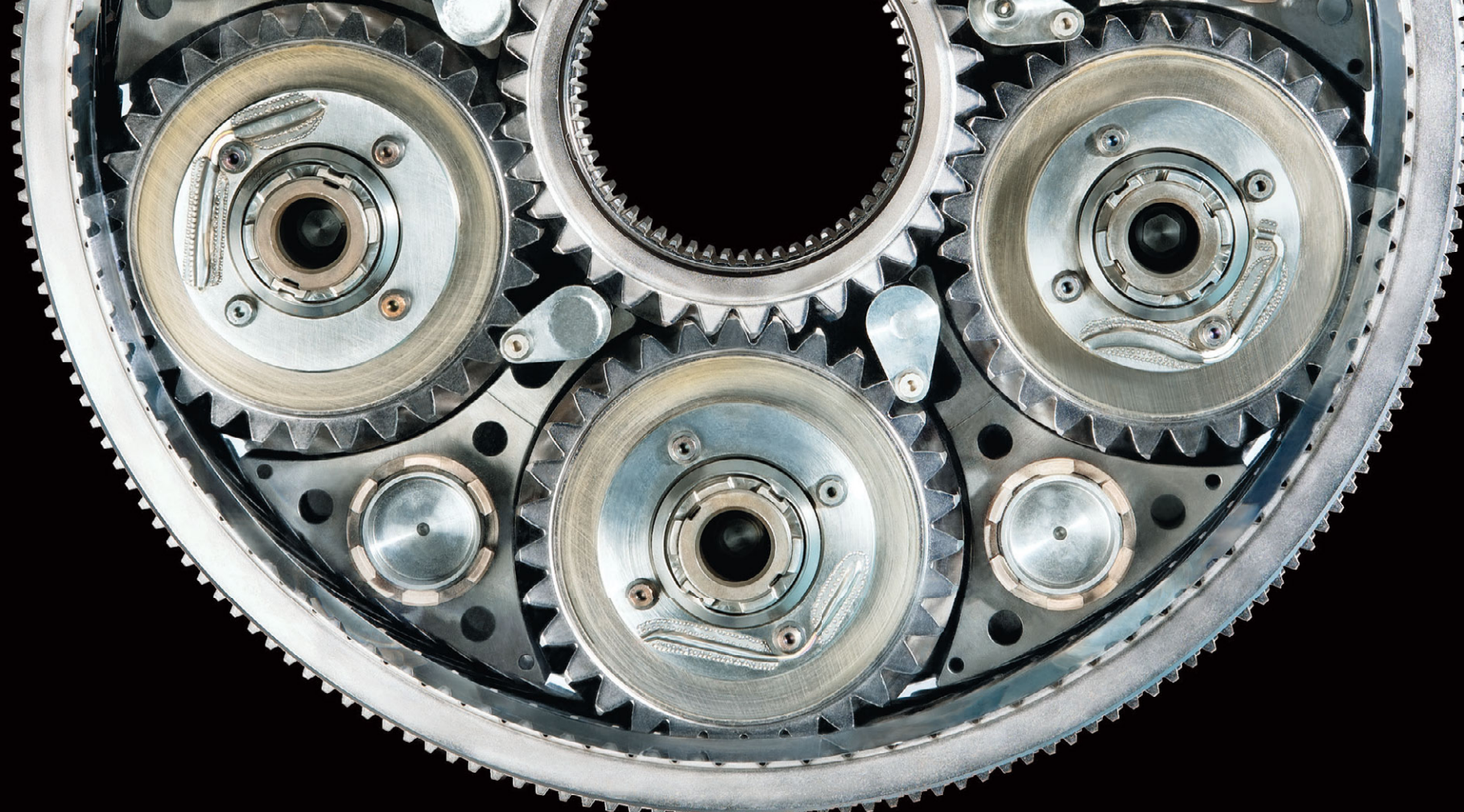
## Feel's deal for ATRs

Start-up Japanese company Feel Air has signed a tentative commitment for 36 ATR turboprops.

Announcing the letter of intent at the show yesterday, ATR says the business intends to use a mixture of 42-600 and 72-600 aircraft - including the short take-off and landing variant, the 42-600S - for domestic operations.

ATR explains that Feel Air is a holding company under which franchisees will "gradually establish a family of regional airlines that will cover different areas within Japan".

Feel Air's chief executive Hideki Ide states: "Our fundamental goal is to improve regional air mobility in Japan by connecting local destinations that currently do not have air service, thereby creating stronger links between regional businesses and people, generating new markets, and enriching local economies."



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GebreMariam receives the Airline Business Award from Tampa International Airport's Chris Minner



Allegiant's John Redmond receives the Low-cost Leadership award from Pratt & Whitney's Mary Prettyman

### The full list of 2022 winners, by category, were:

**Executive Leadership:** Bilal Eksi, Turkish Airlines  
**Sector Leadership:** Jude Bricker, Sun Country Airlines  
**Low-cost Leadership:** Maurice Gallagher and John Redmond, Allegiant Air  
**Air-cargo Leadership:** Walter Cho, Korean Air  
**Innovation & Transformation:** Norwegian  
**Environment, Social & Governance:** United Airlines  
**Diversity & Inclusion:** Air France-KLM  
**The Airline Business Award:** Tewelde GebreMariam



Korean Air's Walter Cho accepts the Air-Cargo Leadership award from SmartKargo's Olivier Hourri

# First class

Sunday night saw the great and the good from the airline industry gather for this year's Airline Strategy Awards at the Honourable Artillery Company's stunning London home.

High-profile industry figures including Korean Air

chief executive Walter Cho and former Ethiopian Airlines chief executive Tewelde GebreMariam were at the event to collect their awards.

The annual gathering – which has been held since 2002 – recognises individuals, airlines and companies supporting

air transport that have demonstrated dynamic leadership and clear vision.

The awards are organised by *Flight Daily News* stablemate *Airline Business* and executive search firm Korn Ferry, backed by a judging panel of global industry veterans.



Norwegian's Geir Karlsen accepts the Innovation & Transformation from Volantio's Azim Barodawala



Photography: Ed Telling



# Boeing focusing on lifecycles

Greg Waldron

Boeing is increasingly focusing on "outcome-based models" for defence customers, with a focus on long-term product lifecycles.

Speaking with journalists in London on the eve of the show, Boeing Global Services

(BGS) chief Stephanie Pope stressed the opportunities offered by data analytics.

"The way we use data, and the way we do predictive modelling is much more massive than it was three years ago," says Pope.

Given that BGS straddles Boeing's commercial and defence product lines, it has visibility in how technical

solutions for civil aviation can be applied for military customers.

"We're being a little bit more innovative on how we use data analytics to make commitments on availability and readiness as a differentiator," she says. "We're going to lean in and really focus on outcome-based models, whereas before it wasn't as

much outcome-based."

Pope partially attributes Germany's recent decision to obtain 60 Boeing CH-47 Chinooks to an emphasis on in-service support.

"Lifecycle sustainment and cost is a competitive differentiator," Pope contrasts this to the previous focus, which was more aimed at delivering specific capabilities, while

"readiness and availability" were not the primary aim.

In terms of the data capabilities offered by specific aircraft types, she contrasts the C-17 strategic transport and T-7A advanced jet trainer. She says the C-17 is "more of a box that you get data from," whereas the new T-7A allows data to be downloaded in real time.



L-r: Pawel Rozkrut, CFO, LOT; Maciej Wilk, COO, LOT; Johann Bordais, Embraer; and Danielle Vardaro, Embraer

## Embraer to support a LOT more E-Jets

Polish flag carrier LOT is to broaden a pool programme with Embraer to help support its expanding fleet of E-Jets. The airline's chief operating officer, Maciej Wilk, signed the agreement with the Brazilian airframer to reinforce supply of spares for the regional aircraft.

Wilk says the airline had 37 E-Jets but recent-

ly agreed to take another seven, sourced from lessor Nordic Aviation Capital in conjunction with a phasing out of turboprops. The carrier has taken the fleet to 41 and will ultimately have 44.

This is "one of the reasons" for the six-year pool deal, says Wilk, extending coverage to 2028.

LOT, which has been a

pool customer since 2012, operates all four E-Jet variants. The revised agreement will cover its 21 E170s and E175s and up to 23 E190s and E195s.

Wilk says the programme has been "paramount" to increasing the airline's fleet availability, "guaranteeing efficiency and competitive results".



## Volatus debuts its UAVs

Canadian firm Volatus Aerospace is making its debut at Farnborough, offering a range of small unmanned air vehicles (UAVs) and related services.

According to Dean Attridge (left), vice-president of solutions engineering, and Steve Emerson (right), vice-president of sales in Europe, Middle East, and Africa, the company offers a range of systems for civilian, parapublic and military uses.

On its stand, the compa-

ny is promoting the Aviadrone 210 – a twin-rotor UAV optimised for lifting work – long-endurance UAVs, and smaller drone systems.

One system the company is highlighting is from UK developer UAVTEK Bug. The micro, four-rotor drone system is roughly the size of a dinner plate. One potential use is for special forces teams clearing a building. Crucially for Western militaries, it has no Chinese components.

## Stacks of opportunity for ZeroAvia

Zero-emission propulsion specialist ZeroAvia is to co-operate with Scandinavian energy firm PowerCell Sweden to develop fuel-cell stacks designed for aviation applications.

Over the course of 2024-2028 the Gothenburg-based company will jointly develop and deliver at least 5,000 proton-exchange membrane

stacks for powertrain installation.

Such cells typically operate at relatively low temperatures.

Protons from hydrogen fuel are separated from electrons – which are used to generate electrical output – and recombined with the electrons, and oxygen, at the cathode.

"Working with ZeroAvia has been a core plank of our entry into the clean aviation market, which is a very large future market for fuel-cell technology," says PowerCell Sweden chief executive Richard Berkling.

PowerCell, which also has German and Chinese offices, will establish a UK operation as part of the provisional

agreement which will be finalised in the third quarter of this year.

"By co-locating this operation we can ensure the full collaboration of both talented teams in tailoring hydrogen fuel-cell stacks for aviation," says ZeroAvia chief Val Miftakhov.

PowerCell has been supplying low-temperature

cells as part of ZeroAvia's HyFlyer II programme, which is centred on developing a zero-emission powertrain for 19-seat commercial aircraft.

ZeroAvia's activities under this programme have included modifying Dornier 228s to test a 600kW powertrain designated the ZA600.

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## Hawk ice

Jon Hemmerdinger

Ice artist Csaba Vass (*pictured*) was behind yesterday's coolest photo opportunity when, amid the stifling heat of Farnborough, he created a sculpture of a UK Royal Air Force Red Arrows BAE Systems Hawk T1 – using a chainsaw powered by Zero Petroleum's synthetic fuel.

The company is working with the RAF on developing the potential of synthetic fuel. In 2021, Zero Petroleum flight tested its fuel using an Ikarus C42 general aviation aircraft – landing the Guinness World Record for the "first aircraft powered by synthetic fuel".

The company manufactures the "drop in" fuel by combining hydrogen extract-

ed from water with carbon dioxide captured from the atmosphere.

"The technology provides a vital answer to the complete de-fossilisation of this industry," says Zero Petroleum co-founder and engineer Paddy Lowe.

As Vass's ice sculpture began to emerge, the only question was: in 34 degree heat, how long would it last?

## Boeing and Alder place a SAF bet

Boeing and Alder Fuels are to collaborate to expand the production and availability of sustainable aviation fuel (SAF) worldwide.

Under the pact, revealed at Farnborough yesterday, Boeing will support testing and qualification of Alder-derived SAF, which is made from forest and agricultural residues, and other regenerative biomass. The programme will include flight testing the new fuels.

The partnership is designed to help scale up the production of SAF. "As we work toward the civil aviation industry's commitment to net-zero carbon emissions by 2050, we know that 700-1,000 times more SAF is needed in order to meet this goal," says Boeing's vice-president of environmental sustainability Sheila Remes.

"We also know that according to the US Department of Energy, US forestry and agricultural residues alone could provide enough biomass energy to generate enough SAF jet fuel to displace 75% of US aviation fuel consumption," she adds.

According to the Air Transport Action Group, an industry coalition focused on sustainability, the single largest opportunity to meet and go beyond the industry's 2050 goal is the rapid and worldwide scaling up of sustainable aviation fuel and new energy sources.

"We can now scale up supply to meet the aviation industry's demand," says Alder Fuels chief executive Bryan Sherbacow. The partnership will advance SAF availability as well as "policies that ensure sustainability and foster environmental justice, and cultivate local economies."

In January 2021, Boeing committed to deliver 100% SAF-capable aircraft by 2030 and is also using SAF in its own operations while working across the globe to scale up the supply of the new fuel.

Boeing began test flights using SAF in 2008, helped gain approval for commercial use in 2011 and enabled delivery flights with SAF starting in 2012.

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# L3Harris harnesses data power to train flightcrew

Murdo Morrison

Two years ago, once busy simulator halls fell silent as airlines grounded aircraft and cancelled training schedules. Would-be aviators were being urged not to invest their savings to learn to fly professionally. Now, as passengers and fleets return to the sky, those centres are bustling again, and a growing pilot shortage means a cockpit career is back to being as attractive as ever.

For one of the leading players in the sector, L3Harris, the rebound in activity has been welcome. The company manufactures and operates full-flight simulators, as well as running ab initio programmes and marketing a range of avionics products, as part of its Commercial Aviation Services business unit, whose

president, Alan Crawford, is delighted normal service is being resumed.

"The recovery had been in fits and starts, but we have seen a real sustained change in quarters one and two of this year," he says. "Airlines are spending capital on simulation and upgrading avionics, and we are certainly seeing a demand spike for pilots. The message is getting through to cadets that there has never been a better time to start your career," he says.

Along with its sister business units, L3Harris Commercial Aviation Services is at Farnborough talking to airlines about how to address crew shortages, but also another key capability Crawford says is becoming more important in the industry – the ability to analyse data from simulators to develop targeted training and address safety risks in an airline's operating culture.

L3Harris's purchase in 2019 of a small, private company called Flight Data Services makes this possible. Its experts extract readings from the flight-data recorder, process them, and draw conclusions. Crawford's team already use the technology in their training academies. Now they are trialing it with potential customers.

While the idea of employers indirectly monitoring their simulator training flights makes some pilots wary, Crawford insists data is aggregated and anonymized. The objective is not to single out crew for criticism but pinpoint areas



L3Harris says now is the perfect time to learn to fly

of concern and provide flight departments with remedial solutions. "Ultimately, our aim is to make a better pilot rather than just ticking a regulatory box," he says.

Another area Crawford is keen to develop is training a new breed of urban air mobility (UAM) pilots. With estimates of tens of thousands of electric vertical take-off and landing craft in operation by the 2030s – all requiring pilots until authorities deem them safe to fly autonomously, something that could be decades away – the opportunity for training organisations is clear.

Crawford

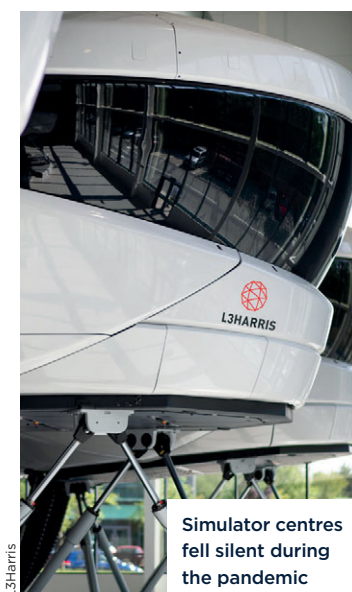
says the UAM market is "hugely exciting and plays well into us in Commercial Aviation, but also across much of L3Harris", given the firm's experience

Crawford: Sustained recovery this year



in supporting the US Federal Aviation Administration's air traffic management infrastructure. L3Harris already has a deal with German start-up Lilium to provide its xLDR lightweight flight-data recorder for its in-development eVTOL jet.

When it comes to the training requirement, UAM pilots are unlikely to need the same level of qualifications as airline or helicopter crew, but they will need to get to a "basic level of flight proficiency" and the scale of that challenge is sometimes under-estimated, believes Crawford. The sector provides the potential for some radical thinking in how training can be applied, he says.



Simulator centres fell silent during the pandemic



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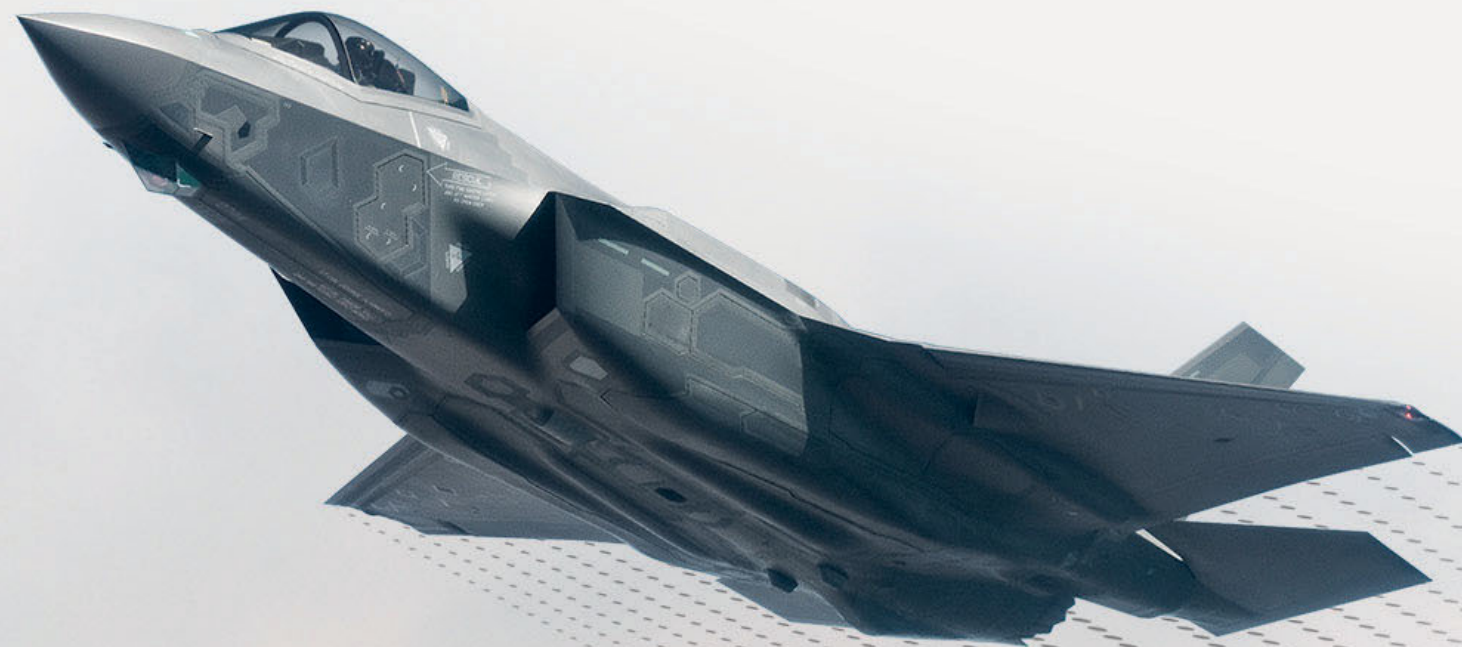


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## Military might

Back after a pandemic-enforced three-year gap, the Royal International Air Tattoo, held over the weekend on the eve of the Farnborough show, drew star attractions from around the globe – and 200,000 visitors – to RAF Fairford. Highlights included marking the US Air Force's 75th anniversary, multiple international aerobatic display teams and iconic military aircraft – both new and vintage.

Photography: Ewan Hoyle

2Excel's striking 727 was accompanied by The Blades



Royal Air Force P-8A Poseidon MRA1, with the Red Arrows



'Doomsday' booked: one of the US Air Force's E-4B airborne strategic command posts made an impressive arrival



The Swedish air force historic flight brought a trio of veteran Saab fighters, with the stunningly colourful Viggen (pictured), Draken and Lanser



Bahrain became the 57th RIAT attendee nation, with a C-130J





# Opening the door

Ancra and Curtiss-Wright snap up key contracts on Airbus freighter

The A350F is scheduled for service entry in 2025

Airbus

David Kaminski-Morrow

Airbus's A350 freighter development is advancing with Ancra International set to deliver the initial cargo-loading system in 2024, while Curtiss-Wright will provide actuation for the type's main-deck cargo door.

The twinjet will be configurable for general cargo – with 30 pallets on the main deck and 12 on the lower – or express freight, with 30 main-deck and 40 lower-deck containers.

Airbus has designed the jet for rear loading with a large cargo door, measuring 3.7m by 3.1m, capable of transporting items including large commercial engines such as the Rolls-Royce Trent XWB or General Electric GE9X.

"There's been quite a bit of demand for that in the market," Airbus head of freighter marketing Crawford Hamilton tells Flight-Global, adding that it is intended to handle engines yet to be introduced. "You have to look to the future because this aircraft will be in service in 40 years' time."

California-based Ancra's A350F system will feature a door-sill protector to interface with K-loaders, and a castor design which includes DC power-drive units to facilitate movement of pallets

into the aircraft.

"One of things our technology does that's different is that you don't lose engagement with the pallets," says aircraft systems vice-president for sales and marketing Ed Dugic.

He says some aircraft use AC-based power-drive units which disengage when loading personnel want to stop or change direction. Dugic says the Ancra system maintains engagement with the pallet underside, which results in a "much safer operation".

While the guide rails, vertical and fore-and-aft restraints, and other components will be standard, Ancra will migrate a unique lock system for certain pallets from the A330 to the A350F.

Dugic adds that Airbus has requested the ability to transition and restrain some pallet sizes which are "not typical", stating: "There's going to be a capability in the A350F which hasn't been seen in other available freighters."

He says Ancra will start delivering equipment to Toulouse in 2024. "We'll be providing them with a mock-up system for testing, as well as the first system deliverable," says Dugic.

Hamilton says: "We'll be testing a mock-up, [Ancra] will be testing a mock-up, and we'll also have it on the aircraft and it'll be tested

there as well. The big thing here is reliability and ensuring that it's mature at entry-into-service."

Custom technology for the A350F's main-deck door will be supplied by Curtiss-Wright, featuring rotary and linear actuators as well as power and control electronics for opening, closing, latching and locking.

The company's chief executive, Lynn Bamford, says the agreement is its first with Airbus for electro-mechanical actuation.

"This programme closely aligns with our strategy of helping our customers improve the functionality and reliability of their aircraft, including enhanced fuel efficiency," she adds.

Curtiss-Wright's system will include high-voltage DC architecture to minimise weight as well as health-monitoring functions, which will provide "greater reliability over legacy systems", it says.

Airbus is scheduling A350F service entry for 2025. The aircraft, powered by Trent XWB-97 engines, will have a maximum take-off weight of 319t and a payload capability of 109t, with a range of 4,700nm. Along with its cargo accommodation, the twinjet will feature a courier area – separated from the main deck by a rigid barrier – with 10 premium-economy seats and a cabin attendant position.

## P&W taking Advantage on certification route

Pratt & Whitney has started work related to certification of the GTF Advantage – a more efficient variant of the company's PW100G geared turbofan.

It has already completed more than 2,000h of GTF Advantage development and certification trials. Later this year, the company intends to fly the powerplant on the wing of a flying testbed operating out of Mirabel, Canada.

The company rolled out the GTF Advantage development programme in late 2021 and has said it expects to begin delivering the enhanced PW100G, for Airbus A320neo-family jets, in 2024.

"The engine will also start aircraft-level validation testing on the Airbus A320neo development aircraft in Toulouse, France," P&W says.

P&W says the GTF Advantage is more powerful than the current version of the powerplant, and is 1% more efficient.

Meanwhile, Pratt & Whitney is forging ahead with research in order to make the GTF future-proof, with plans to increase use of sustainable aviation fuels, hybrid-electric technologies and hydrogen.

"We think we've got game-changing products in the market today, and we see a path to the future where we can deliver net

zero sustainable solutions by 2050," said Pratt & Whitney technical fellow Sean Bradshaw at the show yesterday.

"Today, not tomorrow we are ensuring that the GTF engine family will be fully compatible with future fuels as required by our customers," he adds.

The GTF engine currently increases fuel efficiency by 16% and all engines are capable of operating with blended SAF. Bradshaw says that the company earlier this year ran tests with unblended fuel.

The company is also working on hybrid-electric as well as hydrogen propulsion systems.

"We think that a hybrid electric powertrain and game-changing GTF technology, when paired in a smart way can wield a greater optimised propulsion system for the single-aisle market," Bradshaw says.



GTF is 1% more efficient than current product

Pratt & Whitney

## GKN to RISE to opportunity

GKN Aerospace is to collaborate on the RISE open rotor demonstrator engine being developed by GE Aviation and Safran joint venture CFM International.

Enabled by an agreement with GE announced at Farnborough this morning, the UK-headquartered firm will supply its latest technologies to the programme, as well as component design services. It will also develop a validation plan for the engine.

GKN Aerospace is now working with GE to establish detailed schedules for its participation.

RISE was launched by CFM in 2021 and is aimed at maturing the technologies required for a new engine to enter service in the mid-2030s. Flight tests of the engine are scheduled for the middle of the decade.

GKN Aerospace sees itself as occupying a unique space in the engine world. Thanks to its 2012 acquisition of Volvo Aero, the company has whole-engine design capabilities.

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# The write stuff

contributor Kerry Reals took the Best Sustainable Aviation submission prize for a feature on efforts to stamp out airborne wildlife trafficking.

And long-time *Flight International* editor and publisher Allan Winn was honoured with a Lifetime Achievement Award. Winn was also chief executive of the Brooklands aviation and automotive museum near London.

Several other FlightGlobal journalists were shortlisted: Alfred Chua for Best Young Journalist, Jon Hemmerdinger for Best Propulsion submission, and Lewis Harper for In-depth Aviation feature. Pilling and Wolfsteller were also nominated in other categories.

## FLIGHT DAILYNEWS

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FlightGlobal journalists triumphed at the 2022 Aerospace Media Awards with

Americas air transport editor Pilar Wolfsteller (pictured left) named Aerospace Reporter of the Year, and

consulting editor Mark Pilling scooping the Best Propulsion submission category. Meanwhile, freelance

## Vertical and Babcock connect on eVTOLs

Vertical Aerospace and helicopter emergency medical services (EMS) specialist Babcock International are to explore the potential for new applications for the developer's VX4 electric vertical take-off and landing (eVTOL) aircraft, including both civil and military missions.

The partners will work together to explore how to use the VX4 in new applications such as EMS and cargo transportation, or even casualty evacuation for the armed forces.

Vertical says the 85nm (160km)-range VX4 has the potential to "transform these types of operations and reduce their carbon impact

at a lower overall cost."

Babcock will review how it could use the VX4 to perform roles including first-responder operations and emergency transport between hospitals.

Beyond civil applications, Babcock will also explore the potential to use the VX4 for military missions such as medium-range logistics

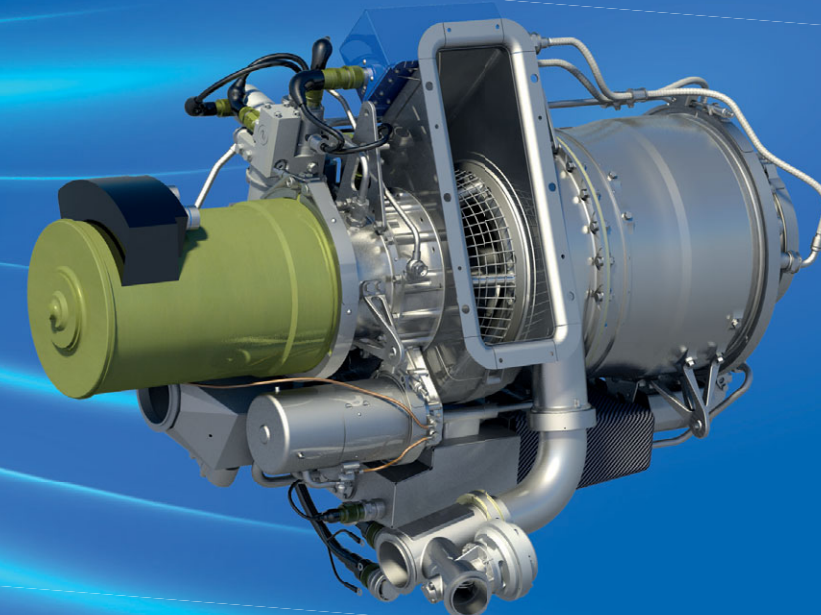
delivery and casualty evacuation.

Phil Craig, managing director of UK aviation at Babcock, says: "Exploring the V4X's technological capabilities allows us to understand how it can be used to deliver critical care and logistical support in challenging environments with zero emissions."

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Joby was among four prominent UAM start-ups that raised equity in 2021

# Future air mobility funding slowing: report

Murdo Morrison

Future air mobility is the all-encompassing term for the disruptive technologies expected to change aviation dramatically during the next decade, from electric vertical take-off and landing (eVTOL) platforms and supersonic jets to unmanned air vehicles – or drones – used for freight deliveries.

However, after attracting a flurry of investment in the years before and during the pandemic – including \$6.9 billion in 2021 – funding

flows into the sector have slowed, according to McKinsey, which adds that the “long-term outlook remains positive”.

In a study released today, the management consultancy identifies a number of reasons for the slowdown in the first half of 2022, when just \$2.2 billion was invested, compared with \$4.3 billion in the same period last year.

Firstly, says McKinsey, is the decline in the SPAC trend. So-called special purpose acquisition companies were behind much of the activity in 2021, when four eVTOL companies – Archer,

Joby, Lilium and Vertical Aerospace – raised a combined \$2.8 billion from these funds. In the first half of this year, by contrast, two start-ups, Eve and Surf Air Mobility, have generated \$800 million from SPACs. McKinsey speculates that some of this may have had to do with the poor performance of the first four developers, who lost an average of half their value in the first six months of 2022.

Another reason is that some of the momentum is shifting to what McKinsey calls the sustainable aviation segment – largely companies

that are adapting existing propulsion systems or airframes to be more environmentally sustainable rather than designing clean-sheet airframes, a process that is much more capital intensive for eVTOL developers.

Many of the leading players may also be “pausing before another big funding influx is needed”, suggest the authors.

Additionally, some funding for these potential disruptors may not be reported as it is channeled through internal research budgets controlled by large airframers or suppliers, automotive

manufacturers or organisations owned by high-net-worth individuals. “In that way, current funding levels may appear artificially low,” says McKinsey.

Finally, the downturn in the global economy may be impacting equity markets, it argues.

“The slowdown in funding this far in 2022 is stark, and is driven by factors both inside the future air mobility industry and across global markets,” say the authors. “The question is whether the current trend indicates a short-term disruption or a longer-term inflection point.”

## Ontic poised for expansion

UK aftermarket parts firm Ontic is keen to boost its factory capacity as it looks to add to its lines of legacy components.

The Cheltenham-headquartered company, which buys or licenses the rights to make and supply formerly branded aerospace parts their original manufacturers no longer want to produce, was sold three years ago by BBA Aviation to private equity company CVC.

Chief executive Gareth Hall says that, despite the challenges of the pandemic, the new ownership has “allowed us to capitalise better on opportunities”, including the acquisition last October of Triumph’s hydraulic equipment plant, also in Cheltenham.

Ontic, which has revenues of around \$450 million, has

also expanded its Creedmoor, North Carolina facility.

“The key for us is always to have that space for original equipment manufacturer partners when they want to dispose of or license product lines,” says Hall. “We want to make sure there are no constraints around capacity.”

The former Triumph plant, which supplies parts for the Saab Gripen and the Boeing Saab T-7 trainer, is Ontic’s first foray into the hydraulics market, which had been a gap in its portfolio, according to Hall.

Most of the product lines Ontic takes on have an ongoing service life of at least 20 years, and original manufacturers include Collins Aerospace, GE Aviation and Honeywell. Around 70% of its business comes from the

military sector.

“We invest in acquiring established IP [intellectual property] lines, and continue supplying them until there is no longer a market,” says Hall.

Hall insists the company’s expansion ambitions are not hampered by the fact that its owner will want to exit the business eventually. “We know that there will be a disposal at some point, but [our shareholders] are not short sighted and want us to make good investment decisions that will serve the business well beyond this ownership cycle,” he says.

He adds that Ontic did not shed any jobs or take any government support during the Covid-19 crisis, and that one of his aims at the show this week is to “give our customers and partners

confidence that we will be around to support them. Even through the horrific economic conditions we went through, we stood firm and continued to deliver.”

Hall: Our owners want us to make long-term investments



Ontic

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The new leader of Boeing's military and space division spells out his priorities for the business, one of the biggest contractors in the industry but, like its commercial counterpart, one that has also faced challenges



Fixed price contracts on programmes such as the KC-46 have been a challenge

## Greg Waldron

**T**ed Colbert, the new head of Boeing Defense, Space & Security, stands poised to lead his organisation in a decade where the emphasis is decidedly shifting from specific platforms to networked assets and the new frontier of autonomy. Colbert passed his first weeks in the role listening and gathering feedback. He cites Boeing's 'Seek, Speak & Listen' initiative as a guiding principle.

"I've been spending most of my time with our customers, understanding what their priorities are, getting a better understanding of the challenges that we have, and trying to ground myself in the realities of the many current situations going on around the world, and trying to match that with near-term and future priorities for the defence business," he says. Colbert has also spent time with colleagues internally coming to grips with things, especially as the world emerges from the coronavirus pandemic. "I've done several roundtables and touched hundreds – if not thousands – of our teammates, just listening and understanding what's going on." Even before this, Colbert already

had a clear-eyed view of Boeing's opportunities and challenges. Prior to becoming president and chief executive of the defence business, he headed Boeing Global Services, which deals with both commercial and government customers globally. Colbert has also served as the company's chief information

officer. An engineer by training, his resume has a distinct information technology focus, with senior IT roles at Citigroup and the Ford Motor Company. Colbert feels that working in IT gave him a broad view, both at the strategic and platform levels.

With eight divisions, Defense,

Space & Security is one of Boeing's three pillars – the others being Global Services and Commercial Airplanes. The unit produces a range of systems, from fixed-wing fighters such as the F-15EX and F/A-18E/F Super Hornet, to helicopters such as the AH-64 Apache and CH-47 Chinook. It is also responsible for Boeing's space business, including the Starliner spacecraft that recently flew an automated mission to the International Space Station.

In 2021 the unit generated revenues of \$26.5 billion, just under half of Boeing's total revenue of \$62.3 billion.

Asked about the defence unit's opportunities and challenges in the coming decade, Colbert suggests they are much the same thing.

"We have a portfolio of very strong, proven platforms in the defence business," he says. "The next 10 years, I believe, will amplify the importance of things like autonomy."

As examples, he cites the developmental MQ-25 Stingray, an unmanned air vehicle (UAV) that will serve as a refueller for US Navy carrier air wings, the ScanEagle UAVs produced by unit Insitu, and Orca, an unmanned submarine programme for the US Navy. Colbert also offers Boeing Australia's Airpower Teaming System as a



Colbert: Spent first weeks in job listening to colleagues and customers

Boeing Defense, Space & Security



prime example of autonomy that will grow and mature over the next decade.

Still, Colbert sees an important role for manned aircraft, as customers will need a mix of assets, both autonomous and manned, working together.

"I don't think the manned aircraft is going to go away in the next 10 years," he says. "I think it will be integrated with other unmanned and autonomous capabilities."

Colbert adds that software plays a fundamental role in linking up autonomous and manned systems to provide capabilities. Still, integrating software and autonomy, and aligning this to customer missions, can be challenging, from both a procurement and integration perspective.

Says Colbert: "It's a little different from the traditional 'here's a platform, here's a set of requirements, go build that thing'."

The emphasis, from a customer perspective, will be increasingly on getting disparate assets speaking with each other.

Colbert also sees opportunities in the "model-based enterprise", where a digital model serves as the key resource for a given platform – he cites the "digital twin" of the T-7A advanced jet trainer as a prime example of "model-based engineering".

"How do you take advantage of that foundational model, and pull the thread of opportunity across the entire value chain?" he asks. "The T-7 is model-based, which allows for a digital twin, it allows for the opportunity to interact with the supply chain in a different way."

Further to this, data from a model-based design can have an impact in areas such as mission planning and training, with artificial intelligence and analytics providing feedback in areas such as how an aircraft is being flown, and what a pilot is – and is not – doing well. Such data will also support sustainment and inform future engineering efforts.

More immediately, Colbert says

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Manages Boeing's aircraft modernisation and modification portfolio, and the KC-46, P-8 and VC-25B programmes.

### Phantom Works

An advanced research and development organisation that leads the company's modelling and simulation efforts.

### Space and Launch

Provides government and commercial space customers with advanced technological systems including the International Space Station, the Starliner commercial space transportation system, NASA's Space Launch System, the launch vehicles of United Launch Alliance, and government and commercial satellites.

### Vertical Lift

The world's largest provider of military rotorcraft including the H-47 Chinook, AH-64 Apache, AH-6 Little Bird, V-22 Osprey, MH-139 and next-generation rotorcraft including the Defiant X.

Boeing is focused on sorting out supply chain issues – something that is also a problem for the broader aerospace sector. In the first quarter of 2022, cost overruns, largely driven by changes to government contracts and supply chain challenges, led to a 24% year-on-year decline in the defence unit's revenue to \$5.5 billion. Supply chain issues were partially responsible for first quarter charges Boeing took

against the VC-25B Air Force One replacement and the T-7A.

"Supply chain is an everyday challenge," says Colbert. "It's not just Boeing. The industry is having challenges across the supply chain, many of which were triggered and amplified by Covid-19. We are spending a lot of time defining challenges that we have, working with the suppliers, getting on site with the suppliers, and being more

strategic with how we mitigate issues."

Another challenge Boeing has faced in recent years is with fixed-price contracts for programmes such as the KC-46 tanker, T-7A, and VC-25B. These limit the government's exposure to cost overruns, but have seen the company incur development costs. Although cleared for 97% of refuelling missions, for example, the KC-46 has suffered several issues, generating cost overages of over \$5 billion. The VC-25B has also experienced cost issues, with Boeing taking a \$660 million charge against it in the first quarter.

During a recent earnings call, Colbert's boss, Boeing chief executive David Calhoun even questioned the wisdom of accepting the VC-25B contract under fixed-price terms.

Colbert, for his part, suggests the experience with fixed-price contracts is a learning experience for both Boeing and the US government.

"The goal will be taking all the lessons learned around these fixed-price programmes, and making the right decisions going forward," he says.

"I'm an engineer by trade, and I'm all about continuous learning. This is about what did we learn from this? And what's the best way going forward to fulfil the mission for the customer, to do it in a way that meets their timelines, and do it in a way that delivers quality and safety to the customer?"

Colbert adds that it is also important to fulfil contracts in a manner that inspires people on the programme. He relates the pride that the VC-25B team takes in its work to produce a new presidential aircraft.

"VC-25B is a great example of a workforce that is proud of the work they do, and they just want to deliver a great product, period," he says. "It's our job to figure out what we learned from the past and how we move forward." ▶

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Northern Ireland's largest manufacturing business – once Short Brothers – is bouncing back after the pandemic under new ownership, and with big ambitions for growth

Recruitment has re-started following job cuts due to the pandemic

# Belfast Spirit

Dominic Perry

In the four years since the last Farnborough air show, much has changed for the Belfast-based aerostructures business that started life as Short Brothers. Back in 2018, it was still part of Bombardier and was led by Michael Ryan, a Belfast native who had been involved with the company since the early 1980s.

But in early 2019, cash-strapped Bombardier announced that it had slapped a for sale sign on the aerostructures operation – which in addition to Belfast also includes sites in Dallas, Texas, and Casablanca, Morocco. A buyer quickly emerged, with USA-based Spirit AeroSystems in October that year striking an agreement to acquire the three sites for a total consideration of \$1.1 billion. The deal eventually closed around a year later, for a reduced figure of \$865 million.

Last year, Ryan – whose lengthy full title is now vice-president, European space & defence, and government affairs; chairman, Spirit AeroSystems UK – also saw a change on a personal level, gaining a knighthood for his services to the economy.

The \$235 million reduction in the asking price was, however,

symptomatic of the wider issues hitting the industry at that point: mere months after Spirit announced its intention to acquire the Bombardier business, Covid-19 arrived, putting air travel on ice and triggering an unprecedented downturn.

As demand for new aircraft dried up and deliveries and revenues dropped, the aerospace industry scrambled to stay upright. For many,



Michael Ryan was knighted last year for his services to the economy

## Output reduction

Boeing's initial reduction to 737 Max output was eventually followed by a halt to production as the airframer grappled with the ramifications of the type's grounding on the back of two fatal crashes. Spirit, as a supplier of complete fuselages to the narrowbody programme, was deeply affected by that move. However, the heavy exposure to Boeing was also pushing the company to seek alternative revenue streams: on that basis, the Belfast business – and its wing production for the Airbus A220 – was a logical target.

that meant job cuts and Bombardier in Belfast was not immune, shedding around 600 positions from its 3,500-strong workforce.

With that as a backdrop many observers wondered if Spirit would still press ahead with the deal. But Sir Michael was not one of them: somewhat counter-intuitively he saw a separate crisis being dealt with by the Kansas aerostructures giant as offering a clear reason for proceeding.

"The other pressing issue for Spirit at the time was the challenge of the 737 Max setbacks which had started before they had agreed to buy us," he says.

"When they decided that this [purchase] was still so strategically important to them that they would continue with it even in the face of the 737 Max crisis then I was less concerned with the pandemic's interference in the acquisition," he says.

"Spirit were very transparent about this, that the 737 circumstances reinforced their need for diversification and that's why they went into it at the time." The assumption was that the industry would emerge from the pandemic at some stage, Ryan says, and "Spirit still believed that the diversification strategy was the right way to go".

Of course, concluding the purchase and then integrating the new acquisition at the height of the pandemic was not made easier given the travel restrictions in place. "Spirit actually completed the biggest acquisition that they have done without being able to visit us," Ryan says.

Despite this, the integration has proceeded smoothly; as an example Ryan highlights the migration of the unit's IT systems from Bombardier to Spirit, a process that was concluded around six months early and, crucially, was "invisible to the customer".

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Composite wings for Airbus A220 are key business line

But almost two years since the acquisition closed, what has actually changed? From an outside perspective the answer appears to be very little: the Belfast plant is still churning out composite wings for the A220 – one of the things that made the plant so attractive to Spirit in the first place – along with composite horizontal stabilisers for Bombardier's Global 7500 business jet, plus nacelles and other structures for a variety of platforms. Support of the company's products, particularly nacelles, on the in-service fleet also continues.

#### Engineering expertise

However, Ryan says it is only once you peer under the surface that the changes become apparent. Although a core part of the business is its manufacturing capability and composite competence, Belfast also has a substantial engineering organisation, employing around 300 people. Since "becoming part of the Spirit family", as he puts it, the site has taken on engineering responsibility for the company's contribution to the A350 widebody, for which it makes the section 15 central fuselage panels.

That work has transferred from Spirit's Wichita headquarters and is also ramping up, thanks to the launch last November of the A350 Freighter.

"Not only were we supporting the A350 from a sustaining engineering point of view but we are actually hugely involved [in the] product development of the A350 Freighter, which includes a significant redesign of our part of the fuselage, and then supporting it into service as well," he says.

The acquisition by Spirit has also given Belfast the freedom – a mandate, even – to seek work outside of Bombardier, particularly in the business and regional aircraft segments. "Now we are not part of Bombardier then the opportunities

to work with other business aircraft OEMs is more possible than it had been within Bombardier," Ryan says.

"Spirit are prepared and willing to look at engagements with other business aircraft OEMs, other regional aircraft OEMs, as well as the big two [Airbus and Boeing]."

But to date, the only contract win for the Belfast plant is with Airbus for the development of the 16m (52ft)-wide single-piece composite wing for its CityAirbus NextGen electric vertical take-off and landing (eVTOL) aircraft.

Involvement in the fledgling eVTOL market makes sense for Spirit and Belfast, says Ryan, because they are "going to require the capabilities and skills all of [the aerostructures suppliers] have developed over the years, designing something, testing it and bringing it to market".

#### Mass production

Spirit Belfast believes its experience with composite technology and links with the regulators "can be

exploited in that marketplace", he says, although the challenge will be to ensure that the structures can be built at rates much higher than those seen in aerospace today: "There's things that we will have to learn in terms of mass production going forward."

One obvious area of change though is the Belfast site's relationship with its former owner Bombardier. Although there was always an arm's-length relationship between the different parts of the business, "we were also really ingrained in the process", Ryan says. "We would have seen what they were developing months, maybe years ahead of a third-party supplier."

Obviously that has now changed, and Belfast is adjusting to its new role. "I don't think it would surprise anybody that it has been a challenge for us to move from being part of the family with Bombardier to being a supplier," he says.

Ryan asserts, however, that this has "forced us" to "up our

game", helping the company to overcome the loss of "familiarity and understanding" – he doesn't use the word complacency, but it is close – that comes from being an in-house supplier.

Competition on cost to get onto any aircraft programme is fierce, he notes, and "therefore when Bombardier comes up with another product launch we are going to be competing as other aerostructures providers will do, so we need to be on top of our game".

As Northern Ireland's largest manufacturing business, Spirit Belfast's continued health is vital to the country's economy. And as the market for civil aircraft ramps up again, the plant is once more taking on staff.

#### Apprentice scheme

Around 300 people across all disciplines have so far been recruited over the past six months, an apprentice scheme is up and running once more, and graduate recruitment has also recommenced. Pre-Covid levels of employment should be attained within "a couple of years", assuming customer demand remains strong, says Ryan.

Despite the size of the UK's aerospace sector, prior to the Belfast acquisition Spirit's only presence in the nation was its plant in Prestwick, Scotland, which makes wing leading and trailing edges and spoilers for Airbus programmes.

Ryan sees the strong links between the government and industry in the UK through bodies like the Aerospace Growth Partnership and Aerospace Technology Institute as offering a key advantage to Spirit, helping to fund the development of the capabilities required for future programmes.

"And now we are bringing from Belfast opportunities as well, over and above what they [previously] saw and hoped for," he says.

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Shane Eddy became president of Pratt & Whitney in March after six years with the propulsion specialist and a career that included stints at GE Aviation, Sikorsky and Bell. He outlines his vision for the business

# Engines of change

**Q** Congratulations on your appointment. How has the job gone so far?

**A** Inspiring, humbling and exciting. I recently celebrated my hundredth day in this role with a global employee forum, sharing our priorities and initiatives with our 37,000 people around the world. Our people remain a constant source of inspiration. Our organisation is committed to delivering dependable engines to our customers as we shape the future of sustainable propulsion.

**Q** We are emerging from one of the deepest crises in aviation history. How is the recovery going in the commercial market and how is P&W adjusting to the challenges of ramp-up, rather than adjusting for much reduced demand?

**A** It's clear there is pent-up passenger demand, and we are seeing strong recovery in narrowbody and regional aviation in every region. Throughout the pandemic, Pratt & Whitney worked with our customers to ensure they were ready for the return to the air. The GTF-powered fleets were the last to pause and the first to return, proving the value of the world's most efficient engine in the single aisle segment. Demand for new aircraft is sharply rising, and Pratt & Whitney is re-ramping production. We are certainly not immune to the supply chain issues the industry is experiencing, but we expect those pressures to begin to ease in the second half of this year.

**Q** As well as the impact on engine deliveries, the pandemic greatly reduced flying hours and thus MRO revenue for all engine manufacturers. How did P&W cope when it comes to this side of the business and how quickly is this market recovering?

**A** We took advantage of the downtime early in the pandemic to run our GTF engines through the shop for upgrades to the latest standard, positioning our customers for a ready fleet. We see growing demand on the aftermarket side as utilisation increases and customers resume engine maintenance deferred during the pandemic. We're expanding global capacity and inserting technology across our facilities to enhance operational efficiency.

**Q** On the military side, what are P&W's key programmes and what will the focus be on at Farnborough?

**A** The F135 engine for the Lockheed Martin F-35 Lightning II is the backbone of allied air power in Europe today and will be for decades to come. As the only fifth generation fighter engine in production today with a growing list of customers, the F135 continues to be our marquee programme. With more than 500,000 flight hours logged, it's been proven in the field as the safest, most capable, reliable, and powerful fighter engine in the history of military aviation. We're already looking to the future with our Enhanced Engine Package (EEP), the first block upgrade for the F135, and one that can meet the needs of Block 4 and beyond.

**Q** The industry is on a remarkable sustainability journey. How is P&W contributing to the efforts to reach carbon neutrality by mid-century?

**A** Pratt & Whitney invested 20 years and \$10 billion in developing the GTF, which increased fuel efficiency 16-20% over prior generation engines. When it entered service in 2016, it was the biggest step-change in efficiency and reduced emissions for a new engine since the dawn of the jet age.

We introduced the GTF Advantage engine for the A320neo family in December 2021, delivering another 1% in fuel efficiency with higher thrust for greater payload and range. The GTF Advantage will be our production standard by the mid-2020s.

In addition to growing the competitive gap for narrowbody aircraft engines, we are investing in hybrid-electric and hydrogen technologies for airframes of the future, as well as participating in the validation journey for 100% SAF (sustainable aviation fuel) drop-in solutions. We believe greater production and use of SAFs will significantly reduce carbon emissions as we build the propulsion of the future.

**Q** What other technologies can we expect to see P&W advancing this decade?

**A** Bearing in mind that today's flying fleet will be flying for decades to come, there's a

long runway for growth in our GTF family of engines. The GTF enables us to grow bypass ratio by enabling the fan to spin at optimal speeds, unlocking propulsive efficiency, resulting in world-class fuel efficiency, 50% reduced NOX emissions and a 75% smaller noise footprint. We are also developing technologies to increase thermal efficiency for the GTF engine family to further improve its performance, which will require advanced materials like CMCs to run the engines at higher temperatures. We are exploring hybrid-electric technologies and hydrogen-fueled propulsion systems as well and making great progress on both. Right now, we see more opportunity in the lower-range passenger aircraft for hybrid-electric, while hydrogen propulsion might be more suitably adapted for the larger commercial aircraft – but it's early days.

**Q** Finally, P&W is now part of Raytheon Technologies. What synergies, scale benefits and shared technologies derive from being part of an exclusively aerospace and defence-focused entity?

**A** We are proud to be Raytheon Technologies' propulsion business, and to share best practices within Raytheon Technologies on our implementation of Industry 4.0 principles, notably at our new Asheville, North Carolina facility. In addition, being part of Raytheon Technologies means Pratt & Whitney will grow our competitive positioning for the next generation single aisle and the sixth gen fighter, through the synergies in technology and innovation with our sister companies. Developing high-temperature materials, advancing additive manufacturing and making our business more streamlined through our CORE operating model will position Pratt & Whitney for strength as we near our 100th year as a company. The future is bright. ▶



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Collins Aerospace may be the sum of its many parts but its president – who has steered the business through the Covid-19 crisis and its absorption into Raytheon Technologies – believes its diverse elements combined create the perfect aerospace systems supplier

# Making connections

Murdo Morrison

The pandemic did not dampen Stephen Timm's enthusiasm about running an organisation that combines "all the parts of the ideal aerospace systems business you'd create with a blank sheet of paper". The "long-time aviation enthusiast" was "excited" to be offered the chance to lead Collins Aerospace in February 2020. "Then Covid happened and it meant we had other things to deal with," he says. "But the energy hasn't gone away."

As president of the Raytheon Technologies subsidiary, Timm heads an entity that combines some 17 enterprises that ended up under one roof following a flurry of consolidation the previous decade. Rockwell Collins had acquired the likes of communications specialist ARINC and interiors supplier B/E Aerospace before merging in 2018 with United Technologies Aerospace Systems, itself an amalgam of famous former aerospace brands including Goodrich, Hamilton Sundstrand and Ratier-Figeac.

## Merger mania

That merger mania continued in April 2020 when Collins Aerospace was absorbed – along with UTC sibling Pratt & Whitney – into the new Raytheon Technologies creating the industry's biggest first-tier supplier. In fact, based on 2020 revenues of \$64.6 billion, Raytheon Technologies is second only to Lockheed Martin in the latest FlightGlobal Top 100 ranking by aerospace sales, ahead of both Boeing and Airbus (although the commercial sector recovery could



Timm: Most competitors in the market are pure-plays

– Timm has a background in information technology. "There is a new generation of systems coming that connect the aircraft and all the nodes," he says. By combining Raytheon's experience in airspace management with the technology Collins provides on the aircraft "you will start to see solutions that are common to Raytheon Technologies".

Collins' latest acquisition, FlightAware – announced last August – adds a business that provides tools for global flight tracking, data collection and analytics. That, together with its existing ARINC unit, helps Collins create a "connected ecosystem", according to Timm. "We acquired FlightAware because of their data science capability and ability to combine AI (artificial intelligence) and machine learning to help customers operate their aircraft more efficiently," he says.

## Opportunity

Another opportunity is Collins' ability to innovate and bring products to market quickly. While about 30% of Collins' activities have traditionally been in the defence sector, it is a largely commercial and business aviation focused business. The legacy Raytheon organisations, by contrast, are almost entirely positioned at the military user. In that segment, says Timm, contractors typically wait for demand signals from the end customer.

"Most players in [the military] market are pure plays," he says. "What we do is invest in commercial technology and make that extensible into defence. We spend \$3.5 billion a year on research and development and of our 150 leading products half have a defence derivative product." He cites as an example Collins' avionics technology for business jets. "Today that same architecture is in tankers, military helicopters and other aircraft. We can extend those benefits to defence markets," he says.

Timm is looking forward to Collins' first big air show outing as part of Raytheon Technologies, to show potential customers how technology can be an "enabler" to more profitable operations. "We are a systems leader that is driven by efficiency and sustainability," he says. "And we have the best talent in the world – 68,000 people, a third of which are engineers." ■

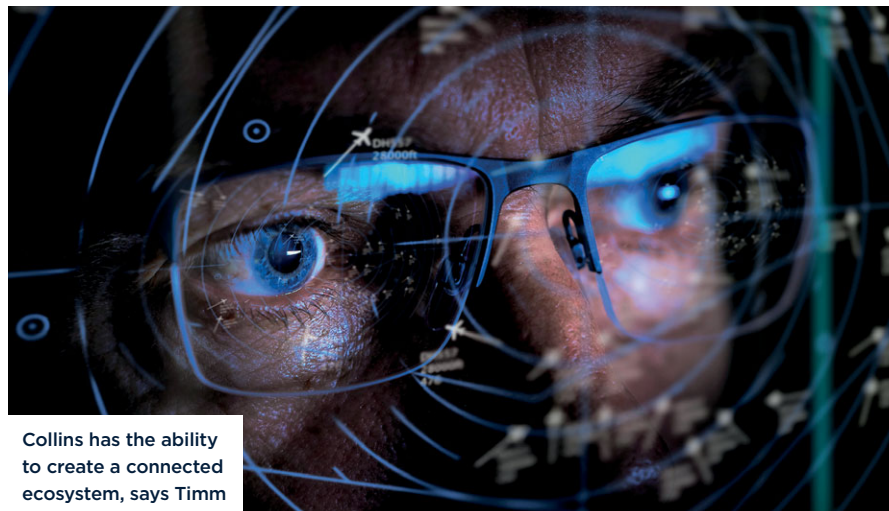
alter that this time round).

Collins is the biggest of four units within Raytheon Technologies, based on 2021 revenues of \$18.4 billion. With Pratt & Whitney, it sits alongside two divisions that

formerly made up Raytheon Systems: Intelligence & Space, and Missiles & Defense. Timm took on the role of president after previously heading the avionics unit. He has spent almost 27 years in the industry, mostly with Collins and its predecessor companies.

The creation of Collins Aerospace opened the way for synergies, scale economies, and sharing technologies across a diverse portfolio ranging from first-class airline seats to military ejection seats, and from avionics to auxiliary power units. However, the coming together with the former Raytheon Systems businesses takes that potential even further, into areas such as advanced materials and the connected battlefield, according to Timm: "The excitement really just elevated."

Two opportunities in particular interest him. One is the potential of so-called digitization and big data, enabled by analytics software



Collins has the ability to create a connected ecosystem, says Timm

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For a previously high-flying sector still recovering from the pandemic, gaining the investment needed to fund a zero-emission future will be key

# Spend to save



FlyZero project outlined three hydrogen-powered aircraft concepts

**Dominic Perry**

The requirement to decarbonise aviation could arguably not have arrived at a worse time for the global aerospace industry: just at the point at which the sector is attempting to ease its way back to financial stability following the ravages of Covid-19, there comes the need to spend unprecedented sums on research and development projects.

While many of the technologies required – particularly those that will increase an aircraft's efficiency – do not represent a complete pivot away from previous research efforts, the new emphasis on zero-emission propulsion technologies, notably hydrogen, is a significant shift.

That switch, of course, comes with both risk and opportunity: whoever masters these new technologies stands to reap the financial rewards; on the flip side, however, the companies or countries that specialise in disciplines which stand

to be fundamentally changed are in danger of losing their leadership position.

For UK aerospace, the risk is real. In the executive summary of its year-long study into the feasibility of zero-emission flight, released in March, the Aerospace Technology Institute (ATI)-led FlyZero project concluded that the country's specialisms – airframes, wings, fuel

systems, thermal management, and turbine engines – are among those likely to be most affected by a potential switch to liquid hydrogen as a fuel.

"All these elements would need to be redesigned for a hydrogen aircraft, presenting the UK with both a threat and an opportunity," it says. "If the UK acts ahead or alongside other nations, it can lead the

development of new technologies where it is currently strong and secure a greater share of activity."

And as ATI chief executive Gary Elliott and FlyZero project director Chris Gear note in their foreword to the executive summary: "The UK is ideally positioned to build on decades of expertise in aerospace innovation to develop, test and certify the advanced technologies which will propel a new generation of liquid hydrogen-powered aircraft into our skies."

But that will require rapid action to secure future work: in order to win a place on any programme entering service in the 2030s, "UK companies must be ready to demonstrate new systems by 2025", FlyZero says. In essence, those developments must be brought to technology readiness level 6 by that point, it says.

#### Market share

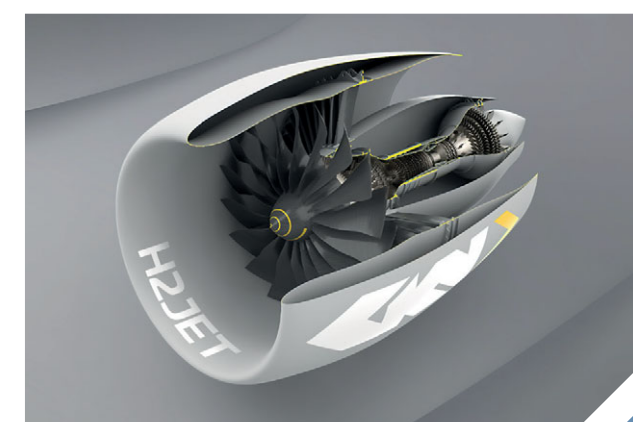
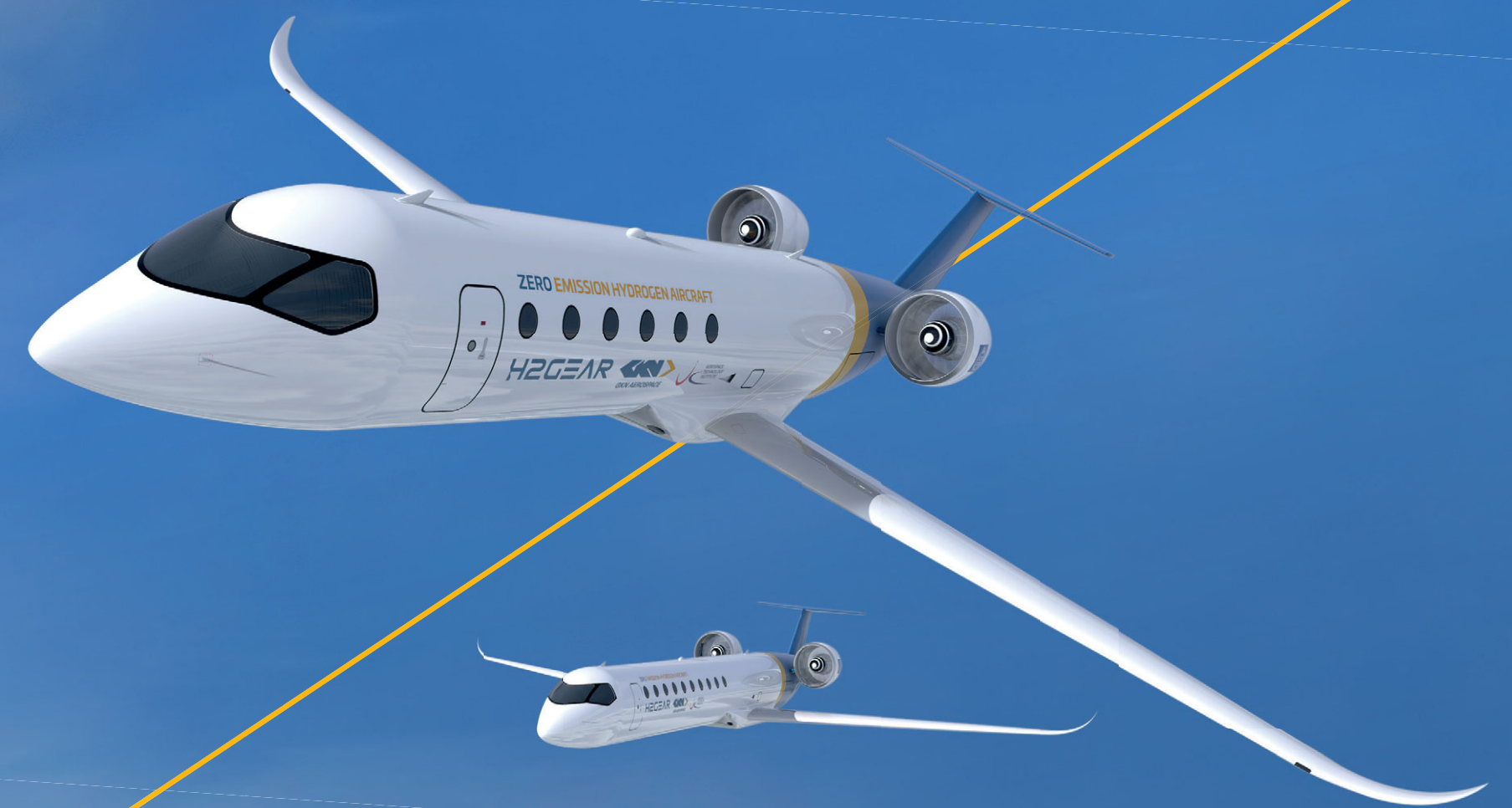
The reward? The UK could potentially see its share of large commercial aircraft global market turnover rise from 13%, or £11 billion (\$13.8 billion) in 2019 to 19%, or £36

**"As aviation addresses the challenge of zero carbon and complex new mobility markets, the industry must develop a swathe of new technologies in short order and no single country can accomplish this alone"**

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# Making light work

TISICS says UK taxpayer support has helped it bring its innovative composite material to market

An exhibitor that is bringing to market a component made from lightweight matrix material it has spent 17 years developing says it could not have succeeded without a UK government scheme to boost technology start-ups.

Farnborough-based TISICS is displaying at the show a titanium composite side stay it has designed for the Safran-produced Airbus A330neo landing gear, claiming it is 50% lighter than the steel part it replaces. It hopes to qualify the part for production after completing a crucial destructive test on the 1.6m-long component in recent weeks.

"This has a real impact on emissions because if it were applied to the whole landing gear, it would save thousands of tonnes of CO<sub>2</sub>," says TISICS founder and managing director Stephen Kyle-Henney.

The company, which is part of the Farnborough Aerospace Consortium exhibit, has been supported with a £2.5 million (\$3 million) grant from the Innovate UK agency, set up in June 2020 to help companies impacted by the pandemic to develop green technologies.

Kyle-Henney, who hopes to transition from research and development start-up to manufacturing firm by establishing a factory in the second half of the decade, maintains the aid was key to the business being able to finance the project through the Covid-19 crisis.

Through Innovate UK, TISICS was able to join a consortium led by Airbus and Safran to conduct research into lightweight critical aircraft structures.

"There is no way we could have done this on our own," says Kyle-Henney. "People might call it a cash hand-out, but it has allowed us to work with the likes of these companies, and move up the food chain."

TISICS' technology, which involves bonding ceramic fibres to metals to create a matrix structure, originates in research carried out in the UK by oil company BP in the 1970s. When BP looked to offload the business, the UK government bought the intellectual property and it ended up within what was then the Defence Evaluation & Research Agency (DERA).

After DERA was spun off and floated as Qinetiq in 2001, the technology was not deemed core, so Kyle-Henney, whose team had worked on the project, led a management buy-out and established TISICS in 2005.

Since then, the company, which employs about 18 people and turns over a modest £1 million a year, has done small-scale prototyping

and manufacturing for customers including Surrey Satellites and ThalesAleniaSpace. Small research grants have also provided a lifeline.

TISICS' proprietary material is made up of 35% ceramic fibre and 65% metal, and Kyle-Henney says it retains the strength and stiffness of steel.

With the product close to certification, the company plans a funding round this year to raise up to £8 million. This will help it open a factory, probably in the English Midlands or South Wales where commercial property is cheaper and labour costs lower than in Farnborough, says Kyle-Henney.

After that, the entrepreneur will consider

offers for the business, as he says it would take "tens of millions" more of investment for TISICS to establish itself as a volume manufacturer.

"Once we've convinced someone to use our product on their plane, we become a very attractive candidate for acquisition," he says.

Kyle-Henney, who has invested "a lot of my own money and time" in the start-up, returning "every penny of profit into technical development", has taken the unusual step of not seeking a patent for his technology. Perhaps paradoxically, it is because he does not want to make public the technique. "Our IP is nailed and we have enough black art to protect us," he says.



A TISICS member of staff with the composite side stay

billions, in 2050. Conversely, if the nation does nothing, then market share could fall to 9%, the number of aerospace jobs could drop to 74,000 from 116,000 at present, and "crown jewel technologies" could be relocated overseas.

FlyZero's research has already had an impact, shaping the ATI's latest technology strategy, Destination Zero, which was released in late April.

The government-backed body identifies three core areas of focus: zero-carbon emission aircraft technologies; ultra-efficient aircraft technologies; and cross-cutting enabling technologies and infrastructure.

Pursuit of all three technology streams is an "imperative" for the UK as they are "interdependent and mutually supportive", says the ATI.

But this grand ambition is largely

moot if the funding – whether public or private – to support the research required is not in place. Here, there has also been progress: following a difficult 2021 when the ATI had to suspend applications for new grants due to a pandemic-driven cash crunch, the government has now said it will provide an

industry-matched £685 million to the body over the next three years; an increase over the £235 million of the previous period. Additionally, the ATI will also now be supported until 2031.

Sophie Lane, the ATI's chief relationships officer, welcomes the investment uplift but recognises

there will be "a lot of competition for the funding available" given the scale of the challenge and the industry's broader financial state.

"We will need to make some clear choices about where we invest that money," she says.

Overall, she is "encouraged by the amount of support that the government is willing to give at this time", adding: "I think this will allow us to focus clearly on what needs to be done and to make clear choices."

However, there will need to be a "sustained commitment" from both government and industry until the end of the ATI's current term, she says. "That really allows you to not only invest in the technology development, but also ensures that you get the environment in which that technology can be adopted. "In many ways, those are the

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# Collins Aerospace's FlightHub: increasing sustainability and improving the pilot experience



For the past decade, the aviation industry has embraced Electronic Flight Bags (EFBs) to help move the manuals and information required for flying away from paper and onto a tablet. This helps airlines make updates easier and automated for pilots – eliminating time-consuming manual processes. The EFB is also a fraction of the weight and size, putting much less strain on the backs and necks of commercial pilots, and wasting far less paper – which is a win for the environment.

Recently Collins Aerospace, a Raytheon Technologies company, introduced FlightHub, its new Electronic Flight Folder, accessible on a pilot's EFB. A digital aviation solution that makes flights more efficient and sustainable, FlightHub centralizes data sources and workflows for pilots and airlines.

Collating information into a single stream, FlightHub gives customers fast and easy access to all their flight information, from pre-flight documents, like flight plans and weather information,

to post-flight summaries with actual timing and fuel burn reports.

"We've created FlightHub to reduce workload and streamline the experience for pilots by cutting out unnecessary time sorting through multiple data sources," said Jen Schopfer, president of Connected Aviation Solutions for Collins Aerospace. "The application is also a quick and easy installation for airlines, which is key when implementing new technologies."

In addition to aggregating all necessary documents and flight data into a single pane of glass, FlightHub customers will also receive the ability to streamline flights and increase fuel efficiency. That's because FlightHub users also get access to Collins' new Flight Profile Optimization solution, which delivers real-time route recommendations to improve efficiency throughout a flight to help reduce CO2 emissions by saving fuel and time.

Set for release later this year, FPO provides flight path information taken from multiple aircraft and ground sources for more up-to-date information than what is generally obtained from the operational flight plan and the flight management system, which can be several hours old. In aggregate, airlines using FPO could see up to 1 percent annual savings on fuel per year.

"Flight Profile Optimization is the first of many features we will be introducing into FlightHub as we build and implement the right solutions to help our customers operate more efficiently and more sustainably."

FlightHub supports the integration of airline and third-party applications and can operate as a stand-alone system or connect to the aircraft's IP network to receive real-time updates. It's one of many Collins applications designed with unique data and analytics capabilities to provide value and efficiency to customers across the aviation industry.



Developing more efficient gas turbines like UltraFan remains vital

areas that worry me more than the technology," adds Lane, noting the "chicken and egg" nature of the investment.

## Infrastructure issues

To an extent, the wider infrastructural and operational considerations will be addressed by the UK's newly created Zero Emission Flight Delivery Group, a body that sits under the existing cross-industry JetZero Council. The collaborative approach taken by the ATI is also crucial, argues Lane. "When we made our [funding] application and in our discussions with government, the fact that the industry was willing to invest was incredibly important."

"I also think industry is really ambitious about what can be done. And there is a huge opportunity coming with the zero-carbon market because globally there is a lack of [technology] maturity."

However, she is acutely aware that there are plenty of countries dangling financial carrots at the aerospace industry in the hope of securing inward investment. "So really all we are trying to do is show why the UK is a good place to invest and a good place to do that technology development."

On the face of it, Brexit would appear to be a factor in the UK's thinking, pushing London to re-enforce its position outside of the EU through higher spending. While acknowledging a likely impact from the UK's withdrawal from the bloc, Lane thinks it is "the technology advances in the last two

years [which] have fundamentally changed the conversation about what the art of the possible is". It is this, rather than politics, which is driving the need to invest, she believes.

There are already signs that the funding committed to the ATI is having an impact. Announcing the establishment of a Zero Emission Development Centre (ZEDC) focused on hydrogen technology research at its Filton site near Bristol in late May, Airbus cited the financial uplift as a factor behind its decision.

"Establishing the ZEDC in the UK expands Airbus's in-house industrial capabilities to design, develop, test and manufacture cryogenic hydrogen storage tanks and related

systems for the ZEROe project," says Sabine Klauke, Airbus chief technical officer.

"This, coupled with our partnership with the ATI, will allow us to leverage our respective expertise to realise the potential of hydrogen technology to support the decarbonisation of the aviation industry."

Airbus had previously said it would set up ZEDCs at its facilities in France, Germany and Spain.

Continuity also appears to have played a role. "We can continue to invest in one of our largest [research and technology] programmes, the 'Wing of Tomorrow', based in Bristol and Broughton, and launch new [research] development around fuel and landing systems," adds Airbus

chief executive Guillaume Faury.

The progress on Wing of Tomorrow – another ATI-backed project – is illustrative of a broader point raised in the Destination Zero strategy: although not directly related to zero-emission flight, the development of ultra-efficient aircraft forms a vital component in the overall drive to lowering aviation's carbon footprint.

As such, Lane estimates that at least 50% of the projects that the ATI funds in future will be a continuation of previous work. While some projects – for example Rolls-Royce's ACCEL electrification programme – have a logical end point, there are others, like Wing of Tomorrow and the engine maker's UltraFan programme, which could naturally carry on.

But the financing of UltraFan also highlights another important point: the global nature of aerospace means that it is high-on impossible for the UK to act in complete isolation. Many of the technology bricks used in the UltraFan demonstrator – its Advanced Low Pressure System, for instance – have been developed thanks to funding from a variety of sources, including the ATI, its German equivalent LuFo, and the EU's Clean Sky initiative.

Alan Newby, director of aerospace technology and future programmes at R-R, believes it will be vital that those multinational efforts continue in order to "maximise synergies between European and national programmes" to ensure "there is no discontinuity" between the research activities in different countries.



The Airbus 'Wing of Tomorrow' is being developed in Bristol and Broughton

Airbus





Plus, the sheer level of investment required will drive companies and nations down the collaborative route, he adds: "We need to look at all possible funding sources to bring things together." Or, as the ATI puts it: "As aviation addresses the challenge of zero carbon and complex new mobility markets, the industry must develop a vast swathe of new technologies in short order and no single country can accomplish this alone."

#### EU funding

Despite Brexit there appears a strong likelihood that UK firms will still be able to benefit from the Clean Aviation programme, the EU's successor to Clean Sky. However, how deeply they will be involved is as yet unclear: although UK companies will be allowed to participate, their eligibility for EU funding hinges on London signing up to the Horizon Europe programme as an associate country.

If that does not take place, UK entities can form part of a bidding consortium but will not receive EU funds, instead potentially seeking additional financial backing at national level.

Lane says the UK has "an incredible amount that we can offer in this sector" and thinks it would be "disappointing" if companies are unable to take part. "We will continue to work as hard as we can to support their applications," she adds.

Newby says the advice R-R is receiving from the government is to apply for funding through Clean Aviation as the UK is keen



"There's a lot happening that could fundamentally change the way we fly in the future. But we are going to have to make some investments that might not pay off and we're also going to have to learn lessons quickly"

Sophie Lane Chief relationships officer, Aerospace Technology Institute

to be an associate country to the effort. "Clearly we have a footprint outside the UK which we could use, but our prime role is in line with the guidance from the UK and we are planning an association to the programme."

But what if UK entities can take part in but not obtain funding from Clean Aviation? "There needs to be an alternative if they can't participate," says Lane.

At its heart, an investment in research and technology is a bet: it is a wager that whatever is developed or validated can eventually be commercialised. In normal times the aerospace industry tends towards a safe bet, but the capacity to tolerate higher levels of risk at institutional level may now have to rise. Indeed, the ATI argues that firms will have to "accept more risk within their technology portfolios to make the advances that will be needed".

However, as many observers have noted, aviation appears to be on the cusp of a revolution as significant as the dawn of the jet age, with substantial rewards available for those that back the right horse.

"There's a lot happening now that could fundamentally change the way we fly in the future," says Lane. "But to do that we are going to have to make some investments that might not pay off and we're also going to have to learn lessons quickly and apply those into development. And that's going to mean for some people that they have to take a number of risks that maybe corporately they wouldn't ordinarily." ▮

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Start-up military jet developer Aeralis is approaching a key design milestone as interest soars in its innovative modular family of products



Development draws on off-the-shelf technology from multiple UK partners

Craig Hoyle

Aeralis is one of the many companies hoping to help propel the UK aerospace industry out of the pandemic-driven downturn, as it attracts new industrial partners and fresh financial backing for its modular family of military jets.

The firm will conduct a preliminary design review (PDR) for a demonstrator aircraft "in the autumn", and is aiming for a first test flight within three years.

Interest in Aeralis has spiked since the aerospace sector began emerging from the Covid-19 crisis late last year. The start-up

company's stand at last September's DSEI exhibition in London was inundated with visitors, and it also grabbed attention by unveiling two full-scale mock-ups at March's DIMDEX event in Qatar.

"The aim is to get the first article of the modular vehicle flying by

2025, so we can prove that the company is capable of getting approval to fly a modular jet training aircraft," says chief executive Tristan Crawford.

Aeralis's concept makes use of a core common fuselage, to which a variety of propulsion systems, wings

and payloads can be integrated. Roles could range from basic and advanced jet training to light attack duties, along with operational/aggressor training and aerobatic display team use.

Originally piloted assets could later in life be converted for unmanned roles such as intelligence, surveillance and reconnaissance, "loyal wingman" or even autonomous in-flight refuelling, it believes.

Aeralis has been at the Royal International Air Tattoo (RIAT) at Fairford in Gloucestershire this weekend before moving along the M4 to Farnborough.

Crawford says the company's focus has been more on the

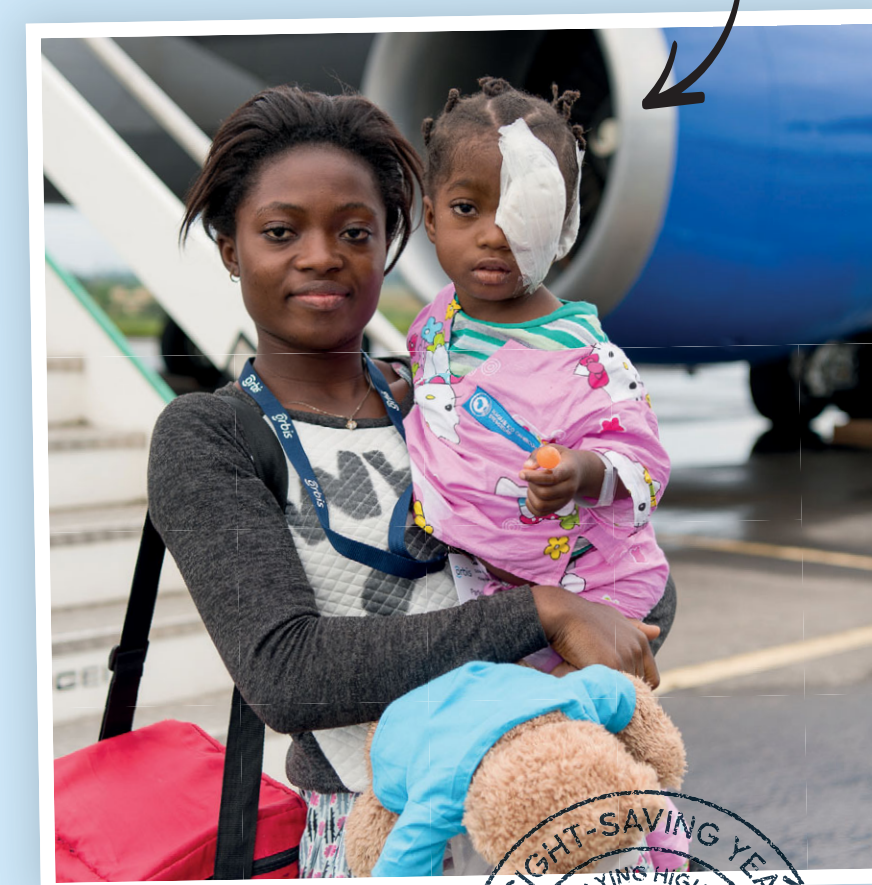
"We don't want to hook ourselves to investors that will limit our ability to change the aeroplane later on"

Tristan Crawford Chief executive, Aeralis

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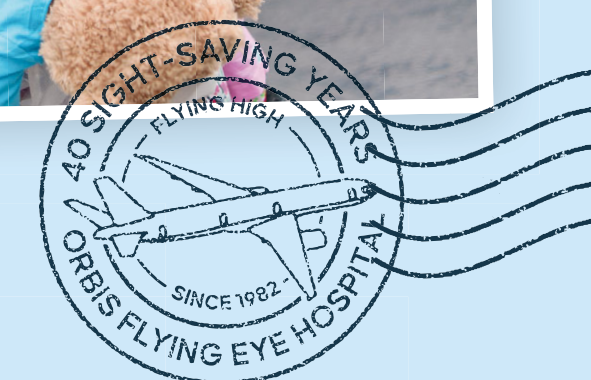
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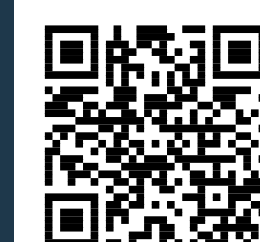
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normally annual military spectacular, staged for the first time since 2019, where it hosted a number of delegations, including potential customers with RFIs [requests for information] and RFPs [requests for proposals]. However, Aeralis was also keen to appear at this week's air show.

#### Emission statement

At Farnborough, Aeralis is taking space on the West of England Aerospace Forum stand: in May it opened a new office and "enterprise hub" in Bristol.

"We will be looking for the aerospace supply chain to come and talk to us about the technology options that we can bake into our technology roadmap to achieve net zero [emissions] in the timeframe that we are looking for," Crawford says. "That's everything from biodegradable aerostructures, sustainable aviation fuel [SAF], more electric aircraft systems and digital manufacturing and assembly."

Crawford believes Aeralis presents a real opportunity for UK industry to shine on the global stage. "We are looking to independently develop this aircraft system as a UK solution, and we are going to hold true to the model that we are using – best in breed, best in sector, best in UK – to do it. We are not looking to create an aircraft company on our own," he adds.

Its core design organisation is now working with nine UK aerospace SMEs to design its demonstrator vehicle. "Including the large industrial partners, there are 16 companies involved in the programme, and 136 individuals working on the design," Crawford says.

There are pacts with the Aircraft Research Association (design), Atkins (structural and systems design), Aernnova-owned Hamble Aerostructures (core fuselage design), Martin-Baker (crew escape system), Rolls-Royce (propulsion systems), Siemens UK (digital enterprise and digital mock-up), Swift Aircraft (design), and Thales UK (synthetic training).

Asked whether Aeralis could explore establishing a manufacturing arrangement with a prime contractor such as the nation's largest defence company, Crawford notes: "We are open to working with the best companies in the UK. And if that included BAE Systems, we would be delighted – just as we were with everyone else."

Investment secured last year – including from Barzan Holdings, the sovereign wealth investment arm of Qatar's defence ministry – has enabled Aeralis to hone the design for its pre-production aircraft. "Their interest is, first and foremost, purely a financial one," Crawford says of the stake from Doha.

Earlier this year, the UK Royal Air Force's (RAF's) Rapid Capabilities Office (RCO) also strengthened its collaboration with the company, and could in the future agree additional work packages.

"We are now extending that to start to design and



Aeralis is aiming for a first flight within three years

test the [RCO's] Pyramid avionics system that we are going to be baking into the preliminary design of the vehicle," Crawford says.

"When we go past PDR, that's the point at which the commercial model is set and agreed for investing deeply into the detailed design," Crawford says.

"That's the current drive: the next tranche of investment to get us to first flight." He says the company is in discussion with a potential "key sponsor", whose support "will unlock the other equity investors".

#### Staying flexible

However, he notes: "What we don't want to do is constrain the design by hooking ourselves to investors that will limit our ability to change the aeroplane later on. So we are narrowing that pool down to the three or four that actually will allow us to maintain the

flexibility in the aircraft design."

Comparing its offering to urban air mobility products as an investment prospect, he notes: "It's nearer term, it's more real. There's much less R&D risk in what we are doing."

"We will be starting with an off-the-shelf engine, but making sure that it's going to be SAF-compliant. We are also having the debate now over whether some of the systems that we are putting into the design even for the first vehicle could be fully electric."

For an operator, equipping an Aeralis jet to serve as a companion

trainer for a frontline type such as the Lockheed Martin F-35 – including emulating elements of the stealth fighter's cockpit – would carry "five or 10% of the operating cost", Crawford claims.

This could enable air forces to avoid a situation where perhaps 70% – or potentially even 90% for some platforms – of their training will be performed using simulators.

"We see the aeroplane providing this cross-cutting mix of synthetic and live flying experience which is a lot richer than you have today, which is basically 'make everything synthetic, and you might get to fly every now and then if you are lucky'," Crawford says.

So, when does Aeralis expect to attract its first customers?

"Once the industry can see that it's happening and it has been invested into actually flying, that is when the first discussions on payments and deposits will start," Crawford believes.

An aspirational target for the company is to see its product become a candidate to re-equip the RAF's Red Arrows aerobatic display team, which is expected to stop flying its BAE Hawk T1s after 2030.

"I would be lying if I said that wasn't something that we would be really excited about," Crawford says.

"We like to think that when they are ready to make that decision, we are a very good candidate. We are designing a jet that would be perfect in that role. It would display the best of British."

good candidate. We are designing a jet that would be perfect in that role. It would display the best of British."



A graphic showing the modular construction of the aircraft

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Mohamed Ali is engineering vice-president and general manager at GE Aviation. He explains how the engine company is contributing to the industry's push for net-zero carbon flying

**Q** What is GE Aviation's vision on how the company can contribute to the airline industry's quest for net-zero?

**A** Sustainability is how we build back better. And the world works better when it flies. We all have an innate desire to travel, see the world, see family and friends, and engage in trade. We will have the technologies ready to meet the industry's net-zero ambition. A hallmark of GE Aviation in our more than 100-year history has been helping to invent the future of flight. To that end, since June 2021, we've announced three bold, disruptive technology programmes:

First is the CFM RISE, or Revolutionary Innovation for Sustainable Engines, programme (CFM is a 50-50 joint company between GE and Safran). Through RISE, we're maturing multiple technologies to achieve at least 20% better fuel efficiency compared to our most efficient engines today. This includes the development of new advanced engine architectures, such as the open fan, and compact engine core designs.

As part of the Electrified Powertrain Flight Demonstration (EPFD) project, we're collaborating with NASA and Boeing to develop a megawatt-class hybrid electric powertrain for single-aisle aircraft.

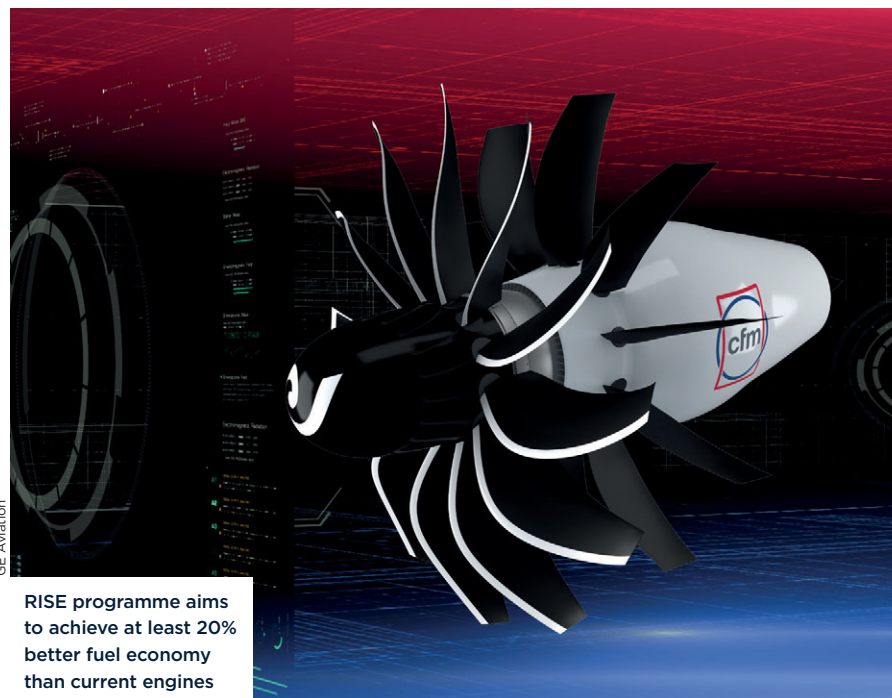
We've also announced plans to develop a hydrogen combustion engine and flight test it with Airbus. This will lead to the development of new cryogenic fuel storage and delivery systems and a combustor capable of burning hydrogen. We'll see open fan, hybrid electric and hydrogen technologies go through ground and flight tests this decade. What we learn could lead to the development of new engine products for entry-into-service in the mid-2030s.

Growing adoption and availability of Sustainable Aviation Fuel (SAF) is also significant to reaching net-zero. All GE and CFM International engines can operate on approved SAF today.

**Q** In particular, can you bring us up to date on GE Aviation's various initiatives on disruptive technology? What is your view on the prospects for electric, hybrid-electric and hydrogen propulsion?

**A** Aviation is a long-term industry and technology advancements can take decades to mature. GE Aviation isn't waiting. We've continued to invest in R&D to the tune of \$1.6 billion in 2021 despite the industry's current challenges, so we can deliver jet engines that meet consumer and operator demands. GE Aviation recently completed what we believe is the world's first test of a megawatt (MW)-class and multi-kilovolt (kV) hybrid electric

# Inventing the future



RISE programme aims to achieve at least 20% better fuel economy than current engines

propulsion system in altitude conditions that simulate single-aisle commercial flight.

The test of the high power, high voltage system – including electric motor/generators, power converters, power transmission and power control systems – successfully demonstrated performance and operation of the components in a replicated flight environment. The altitude integration test of the system began in June 2021 and was completed earlier this year at NASA's Electric Aircraft Testbed facility in Sandusky, Ohio.

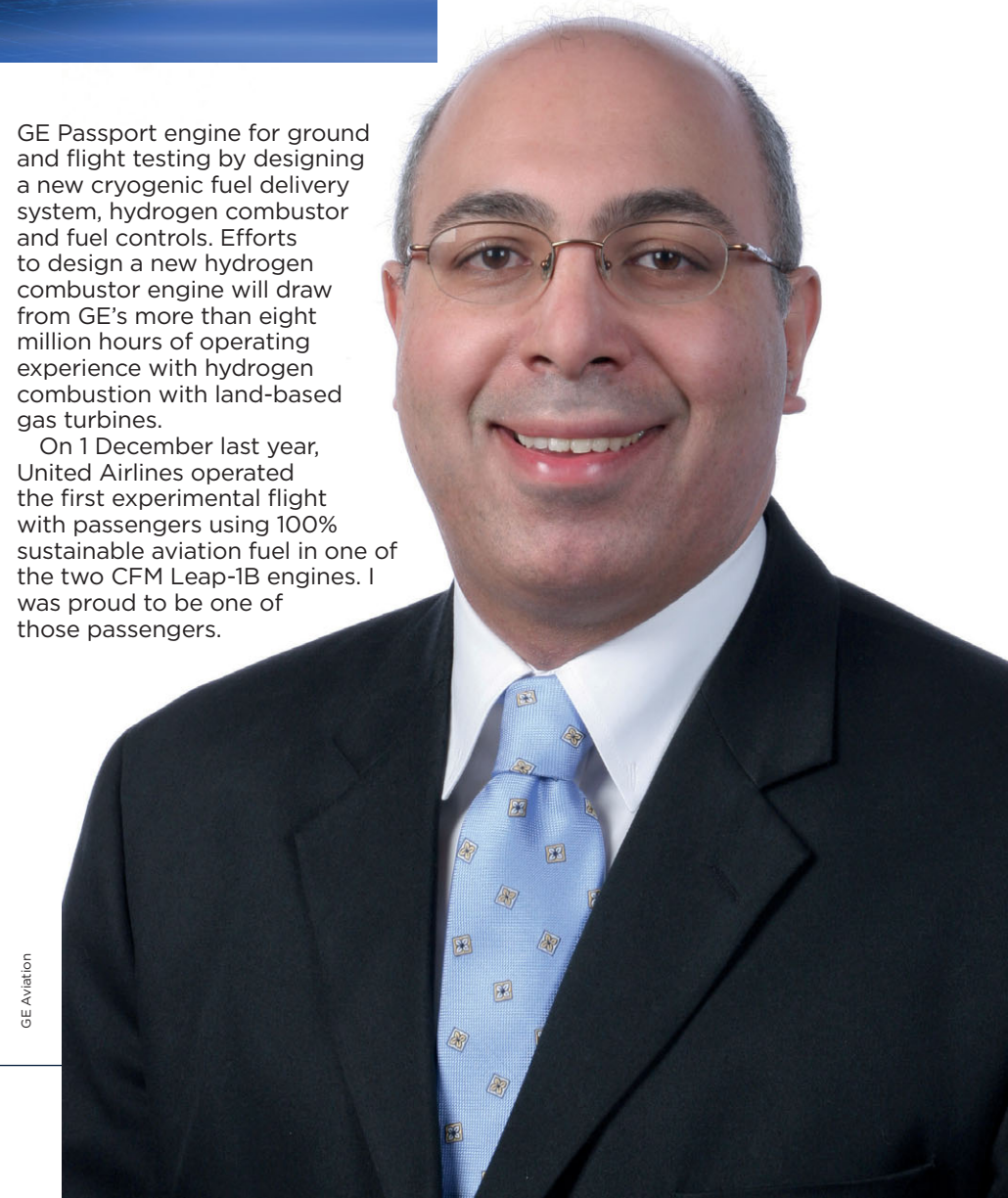
Through CFM RISE, GE Aviation is researching advanced engine cores for single-aisle aircraft. As part of NASA's Hybrid Thermally Efficient Core (HyTEC) project, GE will test and mature compact jet engine core designs, including compressor, combustor and high-pressure turbine technologies to improve thermal efficiency. Continued development of Ceramic Matrix Composites, an advanced heat-resistant material, is also a key part of the effort to improve fuel efficiency. Additionally, GE will demonstrate hybrid electric power extraction technologies on a turbofan engine.

CFM International will modify a

The flight was also important for efforts to increase SAF above the current blending limit of 50%. Two different SAF types were blended for this flight to get to a drop-in 100% SAF that is fleet-wide and infrastructure compatible today. GE's fuels expert chairs an international task force to develop standardized industry specifications supporting adoption of 100% drop-in SAF, which does not require blending with conventional jet fuel. GE plans more test flights with 100% SAF in 2022 and beyond.

**Q** Your boss John Slattery described sustainable aviation fuel as a stepping-stone to sustainability, but said a carrot and stick approach was needed to increase its availability and use. What role can GE Aviation play in boosting the take-up of SAF?

**A** We are engaged in nearly all aspects of the SAF space, from research and development, to policy, standardisation, customer collaborations, and more. One of the major roles we play is in evaluating and qualifying SAF production process pathways to help make sure that a candidate SAF pathway results in a fuel that is equivalent to Jet A or Jet A-1 and that there will be no adverse impact on engine operation and performance with the use of it. ▶



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After coming back strongly from a dismal 2020, ATR is at Farnborough to talk about prospects for the regional market and its ambitions to be a leader in sustainable aviation

# Top of the props



ATR delivered 31 aircraft last year, more than three times its 2020 total

The Covid-19 crisis hit ATR badly, with deliveries almost dipping into single figures in 2020. However, the Toulouse-based turboprop manufacturer is enjoying a strong recovery and is at Farnborough to talk about a flurry of new products and innovations, as well as what it calls the “strong future for regional aviation”. It is also presenting later today its first global market forecast since 2018.

The Airbus/Leonardo joint venture said in February that shipments this year will be in the “mid-to-high 30s”, after handing over 10 aircraft in 2020 and 31 in 2021. It is targeting 50 deliveries by 2024. That is still short of 2019’s total of 68, but, given many of ATR’s core market of small regional airlines remain capital-constrained after a tough pandemic, it represents a major bounce-back.

ATR’s engineers have also been busy during the downturn with a number of significant launches or developments. This year, the company will introduce the 3% more efficient Pratt & Whitney Canada PW127XT engine as standard on the 42-600 and 72-600. ATR launched the new engine model at last year’s Dubai air show with a five-unit commitment from long-term customer Air Corsica.

Meanwhile, the company is continuing development of the

ATR 42-600S, the short take-off and landing (STOL) version of the smaller of ATR’s two aircraft types. The 42-600 – designed to operate from the reduced-length runways that pepper many of the territories in Southeast Asia, Africa and South America where ATR has a strong customer base – made its maiden flight in May.

A larger rudder will be installed before the variant enters its final certification phase in 2023. So far, ATR has commitments for 20 examples of the STOL aircraft, which it says will improve regional connectivity by opening access to around 500 airports worldwide that have landing strips of 800-1,000m.

It was developed before the pandemic, but ATR has also brought to market its first purpose-built freighter, the ATR 72-600F, launched in 2017. The aircraft, which is fitted with a large cargo door in the forward fuselage and can carry 9t of freight, is flying with launch customer FedEx, which placed an order for 30, plus 20 options.

However, it is on the environmental front that ATR has really been making the running in recent months. In June, Swedish carrier Braathens Regional Airlines completed the first flight of a commercial aircraft powered entirely by sustainable aviation fuel (SAF),

a 1h 20min sortie from Malmo to Stockholm on an ATR 72-600.

The European Union Aviation Safety Agency, like most regulators, currently only permits flights using a maximum 50% SAF blend, but Braathens – which collaborated with ATR and fuel supplier Neste on the initiative – obtained a special exemption for the flight, which was not carrying passengers. The aim is to have an ATR aircraft certificated to operate on 100% SAF by 2025.

The three companies claim that using Neste SAF in its neat form would reduce an aircraft’s greenhouse gas emissions by up to 80% over its lifecycle, compared with conventional fuel. ATR chief executive Stefano Bortoli described the flight as “historic” and “a true milestone...in the transition to low-emission aviation”.

SAF might be the most immediate way of reducing aviation’s carbon contribution, but ATR is also looking at more disruptive propulsion solutions. The company this year unveiled its Evo, a concept hybrid-electric variant featuring an eight-blade propeller and other new features, which ATR is promising to have on the market before the end of the decade.

ATR has issued a request for information to the major engine suppliers seeking proposals for a

new turboprop powerplant that would partly use batteries and an electric motor to supplement a conventional engine during the take-off and climb phases of flight. The engine would also have to be capable of running on 100% SAF.

Meanwhile, US start-up Connect Airlines is pairing with a company called Universal Hydrogen to commission 75 used ATR 72-600s converted to run on hydrogen. While ATR itself is not directly involved in the effort, the companies believe the aircraft could be ready to operate on domestic routes by 2025.

All this comes as ATR faces competition in a sector where for decades the only turboprop rival has been the De Havilland Canada Dash 8-400 (previously the Bombardier Q400). Embraer has long been mulling launching a 70- to 90-seat turboprop, and is promising to release more details about its plans by the first quarter of next year.

Perhaps ATR will welcome the development as an endorsement of its long-held claim that turboprops offer a much more fuel-efficient alternative to regional jets, particularly in emerging markets where there is a need for lower-cost connections to under-served or unserved communities. Whether there is room in the turboprop sector for three players remains to be seen. ▶

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Greg Ulmer is executive vice-president of Lockheed Martin's Aeronautics business, responsible for a \$25 billion enterprise behind types such as the F-35, F-16 and C-130, as well as programmes by its Skunk Works advanced development house. He spells out his vision for the 2020s and beyond

# Defending the skies

**Q** Looking out over the 2020s, what are the major opportunities for Lockheed Martin Aeronautics?

**A** Lockheed Martin is an air power solutions leader, delivering 21st century security capabilities across the entire spectrum of training and combat aircraft through development, production and sustainment.

We see major opportunities in four areas for Lockheed Martin Aeronautics: combat air systems including future fighter capabilities and next generation air dominance priorities as well as new customers for existing fighters; air mobility and tanking platforms, like our C-130J Super Hercules and LMXT strategic tanker; intelligence, surveillance and reconnaissance, and integrated battle management command and control systems; and, finally, upgrade and sustainment programmes, which we provide across platforms.

Our team is committed to shaping the future of aviation by connecting systems across the battlespace, embracing digital tools to drive innovation into our processes and technologies, and developing systems that allow for speed and maneuverability when it matters most.

**Q** And what about the major challenges?

**A** Across our industry, we're facing competition for talent with the commercial sector and managing stresses in our supply chains that will remain after the effects of Covid-19 subside.

There are also challenges in smoothly and cost-effectively transitioning to evolving digital design and manufacturing tools and processes, such as determinate assembly and additive manufacturing. In recent years, we've made significant advances in digital engineering and open architectures that are accelerating development, production, upgrades, and mission readiness, positioning us well to meet these challenges.

**Q** The F-35 has had some impressive wins recently, most notably Finland and Switzerland. What is the outlook for additional international F-35 sales?

**A** With 15 customers, nine of which are currently operating their jets, the interest in the F-35 continues. The F-35 is essential to deter threats and disrupt adversaries' plans and behaviours. By its very presence, the F-35 secures regional stability and ensures security and sovereignty of allied air space.

Since Finland's and Switzerland's announcements, Canada also announced the F-35 is the preferred bidder moving into the finalisation phase of its competition, and Germany stated its intent to acquire F-35 jets.

We continue to have conversations in Greece and other

interested European countries, underlining that the F-35 is the European aircraft of choice for replacing heritage fleets and offers unmatched interoperability with NATO and other allied assets.

We also see existing customers seeking follow-on buys, such as Israel and the Netherlands.

**Q** Can you discuss the outlook for further F-16 Block 70 sales? How is the new Greenville, South Carolina line ramping up?

**A** Today there are more than 3,000 F-16s operating in 25 countries, including about 700 operating every day in Europe. We have a backlog of 128 new F-16 Block 70/72 jets to be produced in Greenville. We see potential for up to an additional 300 or so new production aircraft to be produced based on interest particularly in Europe, Africa and Asia.

We plan to deliver the first jet from our Greenville production line during the first half of 2023, with production rates increasing significantly throughout 2023 and deliveries for additional customers continuing into the mid-to-late-2020s.

**Q** Korea Aerospace Industries (KAI) and Lockheed Martin recently beefed up the marketing relationship for the T-50 trainer. Can you give a sense of Lockheed Martin's projections for the trainer/light attack market?

**A** Lockheed Martin and KAI recently signed a teaming agreement for future T-50 opportunities. We are proud to continue to partner with KAI on the T-50 to leverage our collective experiences to train the

next generation of pilots.

The T-50 is a proven aircraft programme that reduces the learning curve for new pilots and allows pilots to fly operational sorties faster. Feedback from many of the 2,500 pilots who have trained in the T-50 is that it's easy to fly and offers controls similar to other Lockheed Martin aircraft, which allows student pilots to focus airmanship skills.

**Q** Can you share some details on what Lockheed Martin is working on in crewed uncrewed teaming (CU-T)?

**A** As a part CU-T efforts, we are exploring distributed teaming concepts where fighters and bombers are complemented with a mix of autonomous vehicles consisting of low-cost expendable systems, optionally attritable mid-tier systems and high-end survivable uncrewed systems. This mix efficiently and significantly enhances the power of the combined team to successfully achieve any mission at hand.

These distributed teaming concepts are a key focus area for us, and we are excited about the future, which includes flight test demonstrations that show the advantages of survivable combat air teams in the near future.

**Q** Lockheed Martin recently delivered its 500th C-130J. What is the outlook for this type in 2020s?

**A** As someone who was part of this programme in its early days, I'm incredibly proud of this milestone. The demand is strong for the Super Hercules around the globe and within the US military. We also continue to partner with the US military in modernising legacy C-130 fleets to move toward a common, all-C-130J fleet.

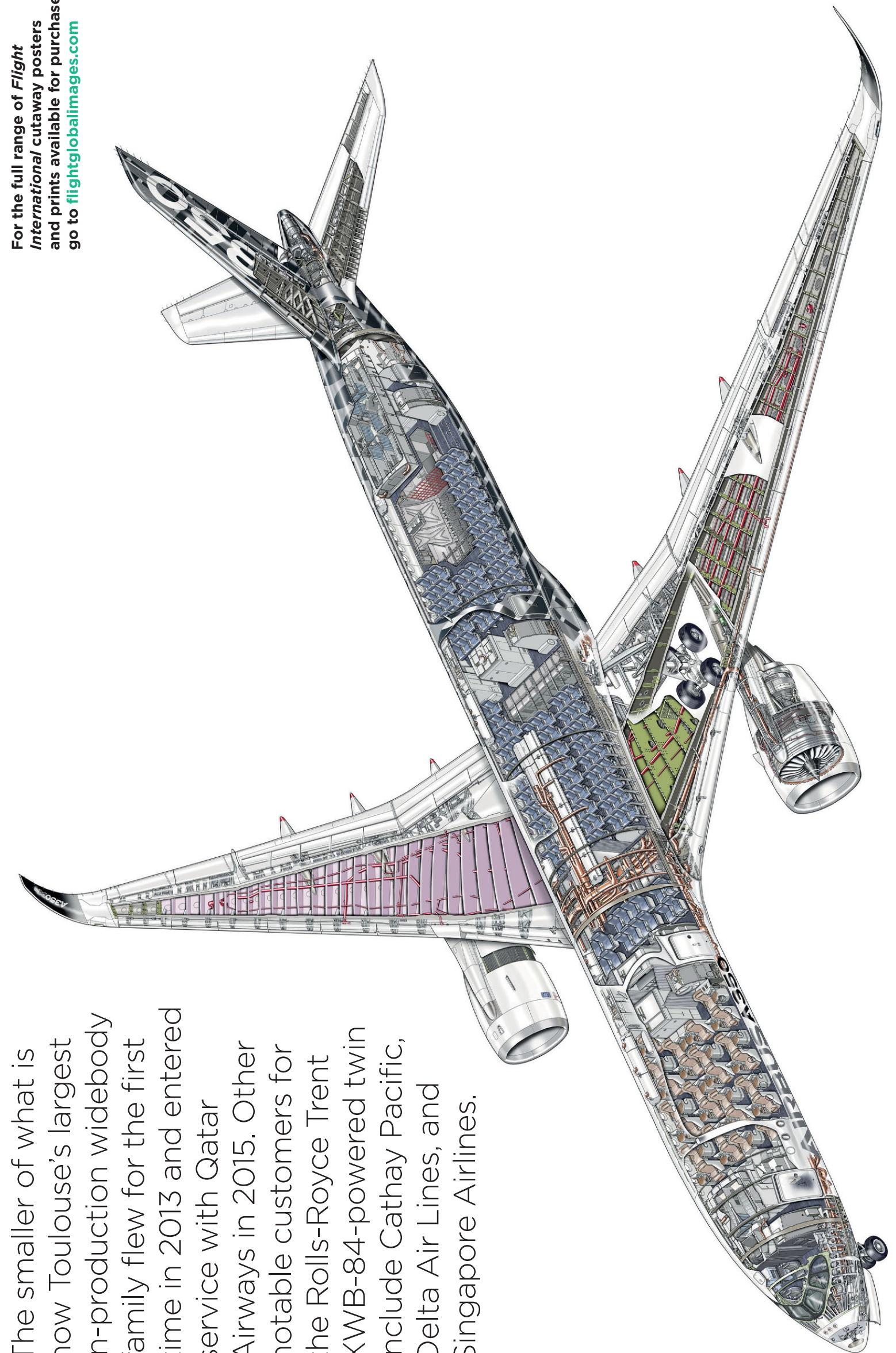
The C-130J's commonality with legacy Herc fleets, proven performance, large global presence and unmatched versatility make it a truly unmatched asset that is well-positioned to support current and future mission requirements.

Our operators say it best: the only replacement for a Herc is a Super Herc. With 26 operators in 22 countries, we see growth as a natural path forward for the C-130J programme. ▀

## Airbus A350-900

The smaller of what is now Toulouse's largest in-production widebody family flew for the first time in 2013 and entered service with Qatar Airways in 2015. Other notable customers for the Rolls-Royce Trent XWB-84-powered twin include Cathay Pacific, Delta Air Lines, and Singapore Airlines.

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