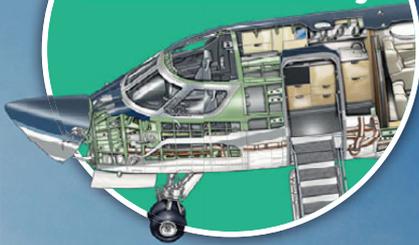


FLIGHT INTERNATIONAL

**INSIDE
Gulfstream
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Sanctioned Aeroflot
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Heart of the matter

Can Swedish developer transform how we fly? **p6**



Warsaw packed
Big-spending
Poland wants
96 Apaches
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Upwardly mobile
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Remember the good old days?

Putin's progress

Ukraine-related sanctions seem to have finally forced Aeroflot into fulfilling the Russian president's desires for a domestically-built fleet



MisledD/Shutterstock

Russian President Vladimir Putin once expressed his dissatisfaction with Aeroflot Group's fleet choices while grilling then-chief Vitaly Saveliev, who was forced to explain why the flag carrier was overwhelmingly using Western rather than domestically-built aircraft.

"I want to understand how many Russian aircraft Aeroflot is going to buy," Putin told him during the face-to-face meeting in 2010.

Saveliev's mentioning that Aeroflot was still using a few Ilyushin Il-96s, while Rossiya was acquiring half-a-dozen Antonov An-148s and domestic consolidation would bring other Russian aircraft into the group fleet, did little to pacify Putin, who was prime minister at the time.

"It's not enough," he told Saveliev. "You want to dominate the domestic market but don't want to buy domestic equipment. That won't do."

Putin's opinion appeared - not surprisingly - to have its intended effect. Aeroflot subsequently signalled that the Irkut MC-21, more Superjet 100s, and other Russian types would make up a substantial proportion of the group's fleet.

But Aeroflot Group's operational restructuring, outlined two years ago, suggested the company had not fully embraced the domestic industry. Under the plan, Russian-built aircraft - including Aeroflot's Superjets - would be shunted to Rossiya, for inter-regional service, while Aeroflot, the more high-profile carrier, would fly Airbus and Boeing models.

With Ukraine-related sanctions imposed on the Russian air transport sector, all assumptions on which the fleet strategy was founded have been overturned, and government-controlled Aeroflot Group is dutifully fulfilling Putin's ambitions for a Russian fleet restoration by committing to almost 340 domestically-built aircraft - but decide among yourselves whether this is genuine affection or posturing in the face of having few alternatives. Tupolev Tu-214s have been available for decades, after all.

There is also reasonable scepticism over the feasibility of producing aircraft in such numbers. Fifty single-aisle deliveries per year might seem a cakewalk given that this amounts to a month's work for either Airbus or Boeing, but it

nevertheless presents a ramp-up challenge for the Russian aircraft industry, especially since the domestically-powered variant of the MC-21 is yet to be certified.

Rostec chief Sergei Chemezov has claimed Airbus and Boeing are unlikely to deliver aircraft to Russia again, although such rhetoric from a close chum of Putin - one invested heavily in the success of the aircraft industry - can probably be taken with a shot of vodka.

Given that some of the largest Russian carriers - such as S7 Airlines and Ural Airlines - exclusively operate Western types, the most interesting scenario is whether Aeroflot's apparent new-found enthusiasm for Russian aircraft becomes contagious if the condition of Western fleets starts deteriorating in the short term.

As for Saveliev, who rose from Soviet hydroelectric engineer to senior banking and government figure, before taking over as the head of Aeroflot, any doubts over his loyalty to the Russian aircraft industry do not seem to have harmed his career. After he left the flag carrier, Putin appointed him minister of transport. ▶

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Bigger and better
Heart Aerospace stretches ambitions with ES-30



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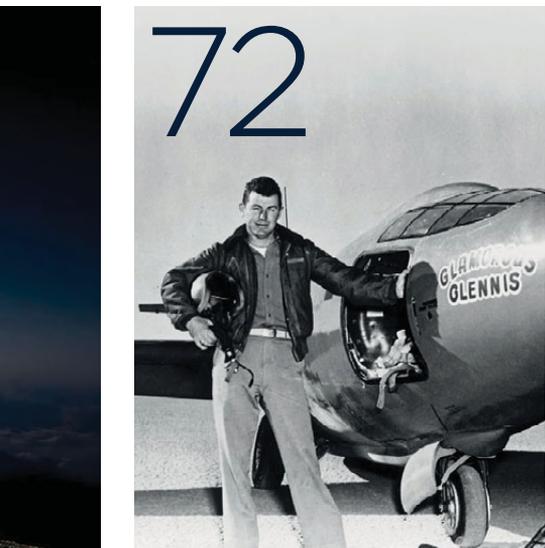
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Batteries will now be stored under the fuselage, while a strut supports the high-aspect-ratio wing



Heart Aerospace scales up to build 30-seat hybrid-electric ES-30

Would-be manufacturer expands ambitions and aircraft size following customer feedback, but service entry slips to 2028

Dominic Perry Gothenburg

Sweden's Heart Aerospace will now build a 30-seat hybrid-electric regional aircraft called the ES-30, dropping previous plans for a 19-seater called the ES-19. However, the switch will see service entry slip to 2028 from an earlier target of 2026.

Heart has also revealed two new shareholders, with Air Canada and Saab each taking a minority stake in the business in exchange for a \$5 million investment.

Revealing the design change at an event at its development centre at Save airport near Gothenburg on 15 September, Heart founder and chief executive Anders Forslund said the ES-30 "is an airplane that the industry can use".

"We have designed a cost-efficient airplane that allows airlines to deliver good service on a wide range of routes," he says.

Although the ES-30 retains the four-motor layout of its ES-19 predecessor, the design now features a wing-fuselage brace and a large battery compartment below the fuselage.

The battery packs would have been stored in the nacelles of the smaller aircraft.

New standard

Range with 30 passengers on board in all-electric mode is a claimed 108nm (200km), or 215nm using reserve power from two turbogenerators. In addition, range of up to 430nm is possible if only 25 passengers are carried, the developer says.

Heart in June said it was changing the certification basis of the ES-19, moving from the European CS-23 to the CS-25 standard for larger aircraft.

No longer constrained by the 8,618kg (19,000lb) weight limit imposed by CS-23, the ES-30 will be more than twice as heavy as its predecessor, with a wingspan that also grows by nearly one-third, according to Heart's preliminary data.

Maximum take-off weight is now in the 20-21t range, of which 5t is batteries, says head of marketing Claudio Camelier. However, he cautions that the aircraft's weight and dimensions could still change as the ES-30 progresses through the design process.

Wingspan has increased to 30.7m (101ft), from 23m on the ES-19, while the ES-30's fuselage

is 22.7m long, a 5.2m rise over the smaller aircraft.

Much of that additional fuselage length is required to accommodate a larger baggage compartment and the two 800kW-class turbo-generators.

Additional room for passengers has been created by an expanded fuselage, growing from 1.46m-wide on the ES-19 to 2.21m on the ES-30, allowing a switch to a 2+1 seat configuration against 1+1 previously. Overhead storage bins are now also incorporated in the cabin.

Although billed as a 30-seater, Heart is also offering the ES-30 in a high-density 34-passenger configuration, featuring seating with a pitch of 29in in the forward cabin and 30in at the rear.

Camelier says the distinctive fuselage-wing brace was required because of the length of the “very high-aspect ratio” wing, which as a trade-off for its improved efficiency “imposes challenges on the structural design”.

Power options

Heart has engaged several well-known suppliers such as Aernnova and Garmin on the programme, but has yet to settle on suppliers for crucial components such as the battery pack or 700kW-class electric motors.

Although Heart had been working on its own electric motor, it is unclear if these will be used on the final design; indeed, representatives from Magnix and Evolito were present at the hangar day.

Forslund says the company has been “engaging with the market” for batteries and motors as “this is one way to share our vision with these partners”.

However, he emphasises that no selection has been made, with the company seeking to “make a very informed decision” which will be taken “as soon as possible”.

Fellow Swedish company Saab has also been recruited to the programme, both as a supplier and an investor. Sofia Graflund, Heart’s chief operating officer, says the pair have entered into a “partnership agreement” that will see them working together in several areas. This could see Saab, for example, providing consultancy services, advising Heart on its manufacturing set-up or other aspects of the production or certification process.

The pact will also see the pair

“collaborate on certain subsystems”, says Graflund, without providing details.

For its part, Saab says it “wants to be part of the sustainable future of aviation” and will offer its “expertise” to the programme, while declining to divulge further details.

As a result of the design changes, the list price of the ES-30 is higher than that of the ES-19. “It is obviously more expensive but it is better evolved,” adds Forslund.

He points out that the design of the ES-30 allows for the development of a stretched variant.

“The ES-30 will also form the baseline for a product family and a platform that we can extend,

“The ES-30 will also form the baseline for a product family and a platform that we can extend, [growing] the fuselage to up to 50 passengers”

Anders Forslund
Chief executive, Heart Aerospace

[growing] the fuselage to up to 50 passengers,” he says. However, Forslund offers no timeline for the development of a larger variant; Heart’s efforts are currently focused on the ES-30, he stresses.

Roll out of a “proof-of-concept” aircraft is set for 2024, leading to flight tests from 2026, he adds.

Existing customers Mesa Airlines and United Airlines – which between them have ordered 200 aircraft, plus 100 options – have reconfirmed their interest in the ES-30, Heart says. New shareholder Air Canada has also placed a purchase order for 30 aircraft.

The company also holds letters of intent (LoI) for a further 96 ES-30s from carriers including Braathens Regional Airlines, Icelandair and SAS, plus lessor Rockton, which accounts for 40 units on its own.

Forslund insists operators are firmly behind the revisions to the aircraft’s design. “When we started considering making these changes, the first thing we did was to call up all the airlines,” he says.

Anko van der Werff, chief executive of SAS, which now has a place on the company’s advisory board, says that one element of its feedback “was not to go too small”.

While conceding that even a 30-seater may not fit perfectly with the airline’s current operation, Van der Werff notes that “you have to start somewhere” and sees future stretched variants as offering greater potential. “The trend is really in the right direction,” he says.

However, he is staying tight-lipped on how many aircraft are covered by its revised LoI, particularly given the price differential between the ES-19 and ES-30; SAS will take “at least two”, he says, “but we want to go bigger and do much more”.

Electric first

If network carrier SAS is approaching electrification of its fleet from one direction, then New Zealand’s Sounds Air is coming from entirely the other. Located at the northern tip of South Island, the airline currently operates a fleet of 10 small turboprops – six Pilatus PC-12s and four Cessna Caravans – on inter-island flights.

“Our ambition is to be one of the first in the world to fly an electric airplane,” says director Rhyan Wardman.

Sounds Air’s LoI is for sufficient aircraft to “convert the entire fleet”, he says. Although conceding there is a “bit of a jump” between the size of the aircraft it currently operates and the ES-30, he sees as attractive “all of the other benefits that come out of this design”, such as longer range.

Currently absent from the list of those holding revised LoIs is Finnair, which in 2021 unveiled a tentative agreement for up to 20 ES-19s.

Forslund says talks with the Helsinki-based carrier are ongoing: “We continue to have good discussions with Finnair. We hope to be working with them in the future.”

Simon Newitt, Heart’s chief commercial officer, describes the conversion of the around 250 tentative commitments for the ES-19 to the ES-30 as a “work in progress”. ■

Boeing battles 737 Max hiccups

Supply chain issues still causing problems for US airframer, as relations with China further complicate delivery picture

Jon Hemmerdinger Washington DC

Boeing is still periodically pausing 737 production because of component shortages and other supply chain problems, while also wrestling with the fallout from strained relations between China and the USA.

“If we get a part [that is] defective, if we don’t get a part because they can’t make it, we have to pause our line,” Boeing chief executive David Calhoun said on 15 September.

“That’s a new practice. We never used to do it that way.”

Boeing will continue these stoppages until “we are not getting defects or we are not getting shortages,” Calhoun commented during an aerospace event in Washington DC.

Boeing is not suffering alone, however: companies up and down the supply chain have been struggling to meet increased production rates as the aerospace industry recovers from the pandemic-driven downturn.

Some suppliers are “having a hard time with quality”, Calhoun says. “Our job is to make sure we don’t increase rate until we are stable.”

Wing issues

In August, FlightGlobal reported Boeing had been temporarily halting wing manufacturing because of supply issues, sometimes leaving workers with hours of time to kill. Components in short supply have included wiring harnesses, Boeing has said, but a source has also cited shortages of cabin components.

Suppliers are battling inflation and a shortage of skilled workers. Higher interest rates have driven up borrowing costs, challenging suppliers’ ability to fund badly needed expansion.

Those factors are creating a “squeeze on cash flows”, says Tom Gentile, chief executive of Spirit AeroSystems.

“We have actually seen more bankruptcies in the last six months



Company has to halt production line if parts are substandard or unavailable

than we saw during the whole pandemic,” he adds.

Such issues have limited Boeing’s ability to boost narrowbody production. The company said in July it met a goal of producing 31 737s monthly, but warned about challenges in stabilising output at that rate.

However, Calhoun insists “we are at the 31-rate”.

The company does not disclose monthly production numbers. But data provider Cirium tracks first flights, which it says can be used as a rough – though perhaps delayed – proxy for production.

In August, 20 737s completed their first flights, and as of 15 September, another dozen had performed their maiden sorties that month, Cirium data shows.

Boeing’s deliveries have also been lagging behind targets. It handed over 28 737s in August, and 23 in July, the airframer’s figures show.

While the delivery and production figures might appear at odds, the discrepancy is a result of the fact that 737 Max shipments include aircraft from an inventory of jets that Boeing accumulated during the type’s grounding.

Meanwhile, the airframer is wrangling with a lack of demand from Chinese customers for the Max on the back of rocky Sino-US relations.

As a result, Calhoun says, the airframer is “remarketing a small portion of, and we continue to defer production of, any Chinese airplanes”.

Political hurdles

Calhoun says he underestimated the obstacles to restarting deliveries: “I predicted more progress than I have succeeded in getting.

“The geopolitical situation is rough. It’s tough.”

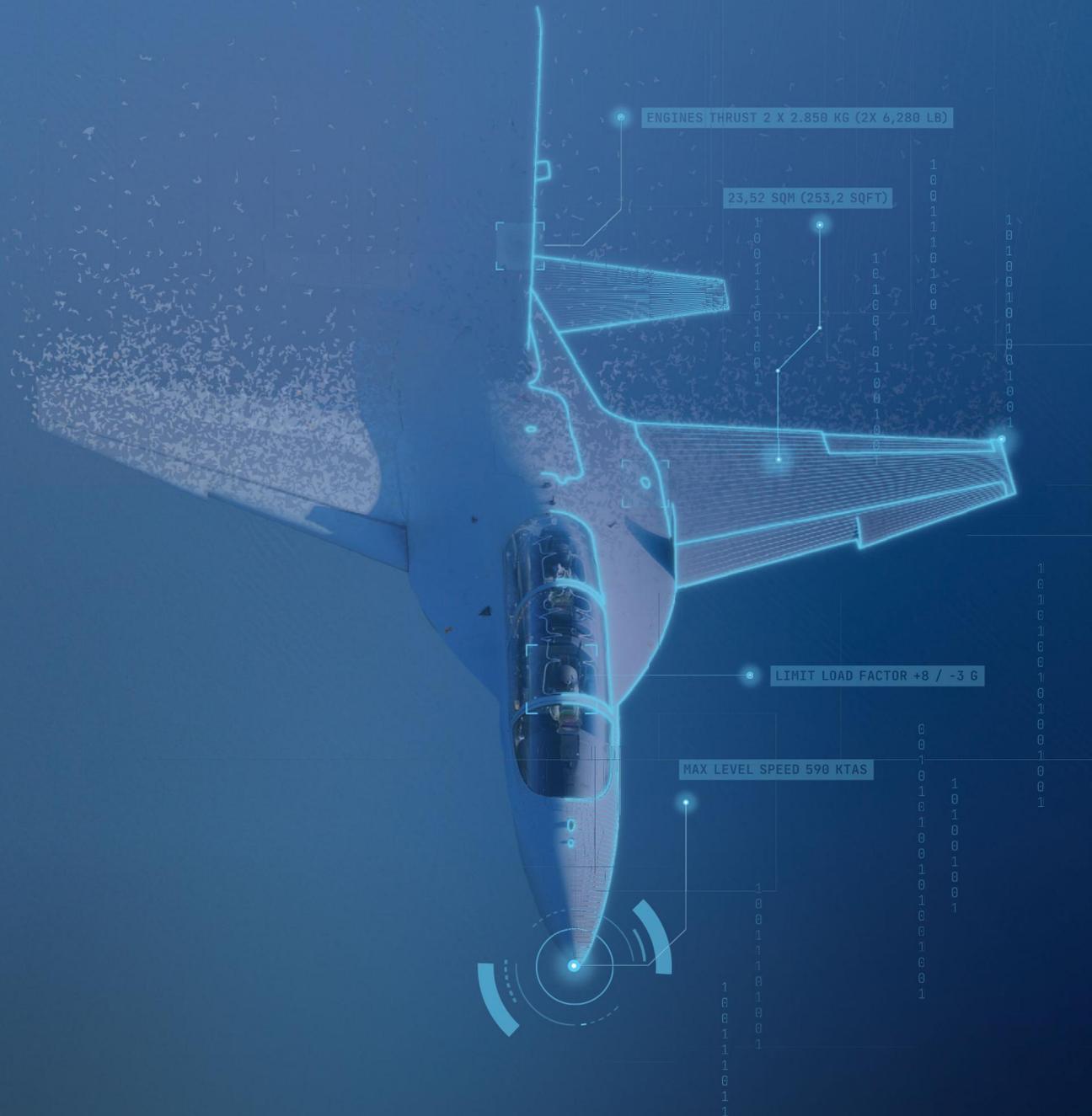
Boeing on 14 September met with the country’s regulator, the Civil Aviation Authority of China (CAAC), to discuss the 737 Max.

Although the CAAC recertificated the twinjet in December 2021, Chinese carriers have yet to resume Max operations.

The meeting, which included officials from several regulatory bodies, reviewed the revised training regimen for the 737 series and also raised additional questions with Boeing. ▀

Additional reporting by Greg Waldron in Singapore

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Bern finalises \$6bn F-35 deal

Switzerland to receive 36 stealth fighters from 2027, after confirming terms with US government and Lockheed

Jon Hemmerdinger Tampa

The government of Switzerland has signed a contract formalising its planned acquisition of 36 Lockheed Martin F-35As, with the deal worth Swfr6.0 billion (\$6.2 billion).

Confirming a selection decision announced in June 2021, the award covers aircraft deliveries to take place between 2027 and 2030.

Bern's Armasuisse procurement body on 19 September announced that its F-35A programme manager Darko Savic and national armament director Martin Sonderegger had finalised the process to acquire the type via the USA's Foreign Military Sales process.

"With this, the procurement of 36 F-35As is contractually agreed," it says. "The prices and contractual conditions are defined bindingly in this contract and are also enforced by means of strict supervision.

"In addition, Switzerland and the USA have negotiated a specific clause and signed a separate declaration which establishes the fixed-price nature of the agreement," says Armasuisse, while adding: "The US authorities have already signed the procurement contract."

The deal includes "mission-

specific equipment, weapons and ammunition, a logistics [and support] package, mission-planning systems, training systems and initial training, [plus] the cost for the integration into the Swiss command and control system", it says.

Savic and the head of Switzerland's Air2030 programme, Peter Winter, also signed an offset agreement with Lockheed valued at about Swfr2.9 billion.

"This forms the basis for the US manufacturer to conduct offset businesses with the Swiss industry," Armasuisse says.

"Switzerland will benefit from Lockheed Martin's dedication to autonomy and sovereignty in integrating indigenous solutions," the US manufacturer says.

"We look forward to growing the partnership with the Swiss air force

and industry to deliver and sustain the aircraft for decades."

Bern's decision to acquire the F-35A dealt a blow to the European defence industry, with its evaluation process favouring the type over the Dassault Rafale and Eurofighter Typhoon – as well as Boeing's F/A-18E/F Super Hornet.

In its selection announcement, Switzerland said purchasing either of the European products would cost Swfr2 billion more than acquiring the US type. However, its estimate at the time was for the F-35A procurement to total just over Swfr5 billion.

The fifth-generation assets are being acquired to replace the Swiss air force's current F/A-18C/Ds and Northrop F-5s: a combined inventory of 53 aircraft. ▶

See p30



Acquisition of fifth-generation type includes offset business worth almost 50% of deal's value

Jamie Hunter/Lockheed Martin

USAF sets December date for B-21 Raider reveal

Ryan Finnerty Washington DC

The US Air Force (USAF) has detailed plans to reveal its new Northrop Grumman B-21 Raider bomber during the first week of December. The formal unveiling event will be held at the airframer's production facility in Palmdale, California.

Andrew Hunter, the service's assistant secretary, with responsibility for overseeing acquisitions, disclosed the news

on 20 September at the Air & Space Forces Association (AFA) conference near Washington DC.

Northrop, which was awarded a \$21.4 billion engineering and design-phase contract for the B-21 in 2015, says it has six examples in testing and final assembly.

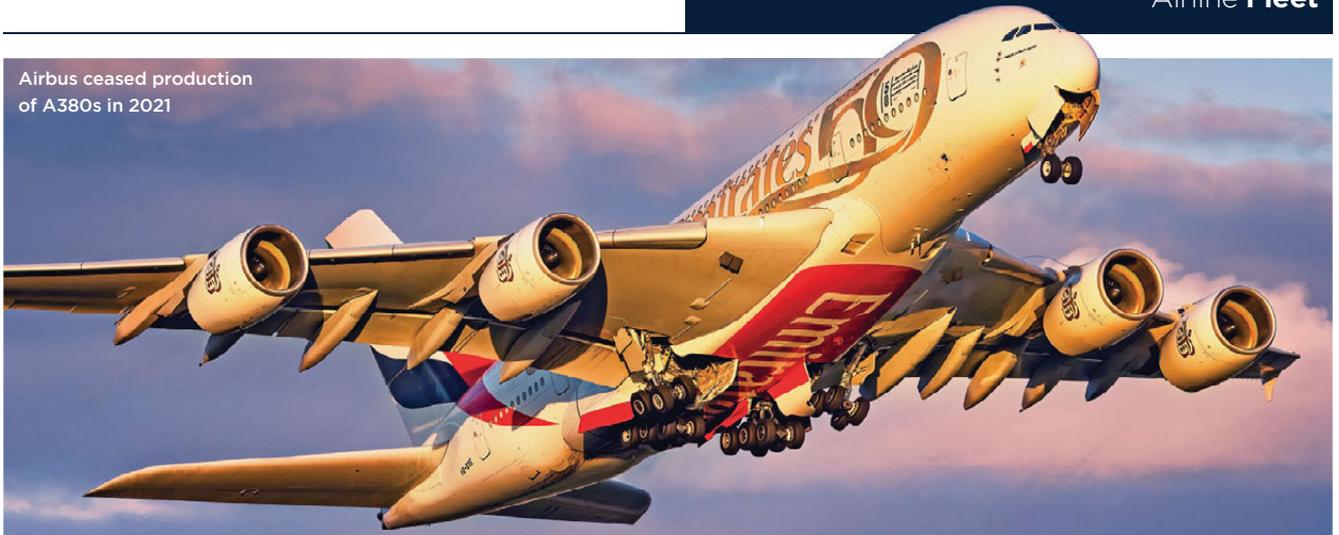
Also speaking at the AFA event, Northrop vice-president Thomas Jones noted that while the B-21 may appear outwardly similar to the company's B-2 that it will replace, the new platform represents a substantial upgrade.

The Raider's real "leap forward" comes from the aircraft's "brain": a computer system which uses a modular open architecture design. This will allow for faster and easier modernisation upgrades.

Jones declines to address details regarding the stealthy aircraft's survivability features. However, he says the B-21 was designed to be a "daily flyer" that can be easily maintained.

"We took lessons learned from the B-2... in maintaining stealth platforms," he says.

Airbus ceased production of A380s in 2021



Clark renews call for updated A380

Emirates president says industry will need ultra-high-capacity aircraft to cope with rising demand and airport slot constraints

AirTeamimages

Jon Hemmerdinger Washington DC

Emirates Airline president Tim Clark fears the industry's shift away from ultra-high-capacity aircraft could leave carriers short on seats in the coming decades, potentially leading to "enormously high fares".

"You will not be able to accommodate [future] demand" with existing aircraft, Clark told Flight-Global on 14 September.

"How are you going to manage?" he adds, noting that a glut of narrowbody jets will not fill the gap.

"You will be back to enormously high fares."

Clark, speaking during an event near Washington DC, also reiterated his pitch for Airbus to develop an updated A380.

"You are talking about an aircraft in 2040," he adds. "But at least it brings back the seat capacity."

Emirates specialises in carrying large numbers of people between the world's major cities - for example, flying eight A380s daily between London airports and Dubai.

The airline has 145 Boeing 777s and 121 A380s, and orders for 50 A350s, 30 787s and 117 777-8s/9s, according to Cirium data.

But Emirates aside, airlines have been shifting away from high-capacity four-engined widebodies for years. The trend started even before the pandemic, with Airbus halting production of the A340 in

2012 and the A380 in 2021. Meanwhile, Boeing expects to deliver its final three 747-8s - all freighters - before year-end.

"We used to have such wonderful [aircraft]," Clark says.

Covid-19 accelerated the trend, prompting airlines to ground widebodies and stifling demand for new twin-aisle airliners. Instead, carriers have been eagerly acquiring new Airbus and Boeing narrowbodies.

Though the industry is well along the recovery path compared with the depths of the pandemic,

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A380s currently operated by Emirates

international air travel remains significantly below 2019 levels, and some analysts predict the long-haul segment will need until 2026 to fully rebound.

Nonetheless, air travel will still grow: a June 2022 report from trade group IATA predicted the number of passengers will increase by 3.3% annually through 2040.

But Clark thinks the sector is poised for faster growth - "four, five, six percent" annually in the coming years, he says.

If that happens, the industry will need aircraft that can carry more people than the largest variants of the A350 and 777, Clark says.

Boeing puts the two-class capacity of its 777-9 at 426 seats, while Airbus says the A350-1000 can accommodate 410 passengers in a three-class layout, or up to a maximum of 480.

The unavailability of airport slots will exacerbate the problem, Clark adds.

That is why Clark thinks the industry needs a larger new jet, like an updated A380 - an idea he has previously floated.

Such an aircraft could deliver efficiencies through aerodynamic improvements and greater use of composite materials, while a new engine - for example, the Rolls-Royce UltraFan - could provide further efficiencies.

Airbus in 2017 proposed its A380plus concept, which, through the addition of large winglets and other aerodynamic tweaks, would have delivered a fuel-burn saving of about 4%. However, amid the programme's wider issues, development never progressed.

But Clark sees other ways to improve efficiency, through, for example, the application of technology instead of traditional design: "I don't want windows... I can create individual windows with a camera," he says.

"The weight that is built into an aircraft structure because of the windows all goes," he says.

If the industry does not act, Clark sees trouble. "All the benefits of mass travel by air that came with the 747 widebody will go," he says. ▀

Back to the USSR?

Aeroflot's order for almost 340 Russian-built jets appears to be borne out of political and economic necessity rather than clear-headed fleet planning

Dominic Perry London

Faced with effective isolation on the world stage, Russia – and by extension Russian industry – has had little choice but to turn inwards.

Therefore the news that flag carrier Aeroflot intends to order up to 339 Russian-built jets to replace its domestic fleet of Western types comes as little surprise.

Deliveries of the initial aircraft from the deal are due to begin next year, with the first “firm contracts” covering shipments in the 2023-2025 period due to be signed off in the final quarter.

Aeroflot chief Sergei Aleksandrovsky says that the pact is the largest purchase order in the company's history.

“Signing of this agreement clearly demonstrates to the whole world that Russia is a great aviation power with great potential and rich experience in the field of aircraft construction, capable of producing reliable and modern aircraft,” he adds.

The intended distribution among Aeroflot Group carriers, which include Aeroflot itself as well as Rossiya and budget airline Pobeda, has not been disclosed.

But as ever the devil is in the detail, not least the composition of the order: 210 Irkut MC-21s, 89 Irkut SSJ-New aircraft and 40 Tupolev Tu-214s.

All three aircraft – the pride of Russia's aerospace industry – will be powered by domestically developed engines and otherwise free of sanction-afflicted Western content.

The two design bureaux sit within holding company United Aircraft (UAC), which in turn is controlled by Rostec, the state-owned industrial giant that has progressively hoovered up Russia's entire aerospace supply chain, including powerplant specialist United Engine.

In essence, the Aeroflot deal sees the Russian government tell two state-controlled companies that they must do business together – a throwback to the heady days of the Soviet Union. Back then, Aeroflot had a fleet full of smoke-belching Ilyushin, Tupolev and Yakovlev aircraft, before the end of the Cold War enabled access to modern – read efficient and comfortable – Western-built types.

“What's happening in Russia is that the state is going to be responsible for the entire economy. We have seen this movie before and it doesn't end well,” notes Richard Aboulafia, managing director of consultancy AeroDynamic advisory. He likens the order to the Potemkin villages of the 18th century – sham settlements that were built to fool Russia's aristocracy about the country's progress.

Narrowbody flagship

Although the developmental MC-21 has some of the credentials to make it the carrier's narrowbody flagship, on the other hand, the selection of the SSJ-New – an updated version of the Superjet 100 – and the Tu-214 appears to have been driven by political and economic necessity.

That the SSJ 100 has not set the world alight is well documented. Since service entry in 2011, a total of 200 examples of the regional jet have been delivered, according to Cirium fleets data, of which 54 are

currently in storage. On average, the manufacturer has handed over 16 aircraft per year, rising to a maximum of 28 units in 2018.

Even before the imposition of sanctions on the Russian aerospace industry, UAC had been working to create a ‘Russified’ version of the Superjet, replacing its around two-thirds of Western content with domestically-sourced parts.

Western suppliers included Honeywell, Thales, and France's Safran, which developed the SSJ 100's SaM146 engines alongside Russian firm NPO Saturn through their PowerJet joint venture.

But the sanctions that were brought to bear in March following Russia's invasion of Ukraine have created a more urgent need for



Schusterbauer/Shutterstock

“What's happening in Russia is that the state is going to be responsible for the entire economy. We have seen this movie before and it doesn't end well”

Richard Aboulafia Managing director, AeroDynamic advisory



Acquisition strategy appears to hark back to Soviet-style central planning

the Russified jet: deliveries for the year to date have slumped to just three aircraft, down from full-year totals of 18 in 2020 and 26 in 2021, Cirium data shows.

Ignoring for a moment an acute shortage of semi-conductors, which could derail the whole Russian aerospace project before it even starts, the success of the SSJ-New and the MC-21 hinges on the performance of their respective Russian powerplants – the Aviadvigatel PD-8 and PD-14 (the latter replacing the Pratt & Whitney PW1400G).

Fuel-burn savings

Aviadvigatel claims the PD-14 family will deliver a 10-15% fuel-burn saving over “other contemporary engines of similar thrust range and application”, however what that performance is being benchmarked against is unclear.

The fuel consumption of an engine is driven by many factors, but those with a higher bypass ratio – how much air moves around the core rather than through it – are regarded as more efficient. For the PW1400G that figure is around 12:1, while for the PD-14, it is more like 8.5:1, according to their manufacturers’ data. Of course, there is a drag

and weight penalty from a larger fan – 206cm (81in) on the PW1400G versus 190cm on the PD-14 – but that is more than offset by the gain from the higher bypass ratio.

Little data is available on the 17,000lb (78kN)-thrust PD-8, but even the comparable PW1700G for the Embraer 175-E2 has a 142cm fan with a 9:1 bypass ratio, P&W figures show; for reference, the SaM146 boasts figures of 122cm and 4.4:1.

4

Number of Tu-214 jets currently configured for passenger operations; Aeroflot intends to order 40 units

Aboulafia, though, doubts that Russia’s propulsion industry can deliver products that match the performance of those from Western rivals.

“They simply have not had the kind of technological investment you need to maintain competitiveness. It’s all about design teams and experience – and there’s a reason why there are only three countries

in the world that can design world-class jet engines,” he says.

Although the Soviet Union was able to maintain some engine design and production know-how “in the last 30 years that capability has badly deteriorated”, he says.

The result, he argues, will be an engine “that burns a lot more fuel and requires a lot more maintenance”.

Phil Seymour, president of aviation data and advisory company IBA Group, concurs. “Maybe I’m doing the Russian industry a disservice, but I don’t think they have the resources and technology to develop something that competes against the Pratt engine,” he says.

Reliability issues

Reliability – of the engines and the aircraft – will be a key metric to watch, Seymour says. “I think they may need to have several aircraft as spares because I don’t think they are going to get the reliability – we have already seen that with the Superjet, which had awful issues around that.

“It’s going to be like the Aeroflot of old – operating Russian equipment that require a much larger spares inventory.”

But if the acquisition of the MC-21 and SSJ-New can be justified if you try hard enough, an order for the Tu-214 is indicative of an airline that has run out of other options. After all, why else would a supposedly 21st century carrier like Aeroflot consider acquiring the Tu-214 single-aisle? It is an aircraft that has never sold in any noticeable quantity, and is powered, in the form of twin Aviadvigatel PS-90As, by engines that are very much of the previous generation, if not the one before that.

Cirium fleets data lists just 23 examples in service and a further six in storage; of that 29-unit total, just four jets – all stored – are passenger aircraft. Indeed, even Tupolev parent UAC does not list the Tu-214 as a passenger jet, instead categorising it as a “strategic and special purpose aircraft”.

Ultimately, though, as Aeroflot will largely operate in a vacuum with precious little competition, the performance or comfort offered by its new fleet may not matter at all.

“Maybe in a closed market like in the old Soviet days that will be enough, in an awful sort of way,” says Aboulafia. “But the whole thing gives the word Potemkin a bad name.” ■

Adapted twinjet would meet US needs at dispersed bases



'Agile Tanker' emerges

Partners Embraer and L3Harris pitch boom-equipped derivative of KC-390

Embraer/L3Harris

Jon Hemmerdinger Tampa

Embraer and L3Harris are to offer a "tactical tanker" version of the Brazilian airframer's KC-390, which they believe could support the US Air Force's (USAF's) so-called Agile Combat Employment (ACE) concept.

Announcing the step on 19 September, the companies said their proposed "Agile Tanker" will develop the KC-390 - already in service with the Brazilian air force - via "the addition of advanced boom operations and mission systems to support agile basing and sustainment for operations in contested areas". "Aircraft enhancements will

complement the tanker's capabilities, which already include the ability to refuel aircraft with a variable-speed drogue, receive fuel, and to take off and land from short and improvised runways," they say.

The twinjet would be able to "address the USAF's operational imperatives and joint-force refuelling requirements, especially for contested logistics environments", they add.

L3Harris says the partners are developing a prototype "which is expected to [be] complete in late 2025, with opportunities to accelerate with government funding". They also are considering completing the aircraft's final assembly in the USA, with L3Harris to perform "aircraft modernisation and missionisation" work in Waco, Texas.

Intended to counter the threat posed to USAF equipment and personnel located at major air bases by long-range missiles, the ACE concept calls for its combat aircraft and other assets to be relocated as required "to predetermined, dispersed locations".



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Pegasus declared ready for combat

As its active fleet passes 60 examples of the 767-based type, US Air Force clears troubled tanker for global operations

Ryan Finnerty Washington DC

The US Air Force (USAF) has cleared Boeing's KC-46A Pegasus tanker for worldwide operations, including combat duty, following a recent successful evaluation.

"We are ready to use this aircraft globally in any fight, without hesitation," General Mike Minihan, commander of the USAF's Air Mobility Command (AMC), said on 19 September.

Confirming the step, the AMC says the 767-based type has been approved "for worldwide deployments to meet combatant command taskings", effective from 14 September.

"The KC-46 now officially joins the rest of the air force's refuelling fleet in meeting requirements around the world," says Brigadier General Ryan Samuelson, the command's team lead for the programme. He describes the type as "a game changer in its ability to transmit and exchange data between networks, arming warfighters with real-time battlefield awareness".

In June, the AMC said it had approved the KC-46A to perform missions for the US Transportation Command, which oversees logistics support for the nation's military.

Minihan says he cleared the Pegasus for combat duty based on its performance during an "employment concept exercise" evaluation in the Middle East, combined with previous activities conducted in Europe and the Indo-Pacific region.

But he told a conference held by the Air & Space Forces Association in Washington DC that USAF crews have had to be creative in working around numerous technical issues.

"There are still things that need to be addressed," he adds.

System limitations

As an example, he notes that the KC-46A's remote vision system (RVS) still does not function adequately in some weather conditions and when the sun is at certain angles. An issue with the aircraft's operating software also creates stability issues when loading cargo, he adds.

However, those and other problems have been addressed by the AMC to allow for safe operations, he says, while adding: "If I can put an incredibly capable tanker in the fight now, why wouldn't I?"

Speaking at the same event, Secretary of the Air Force Frank Kendall was more blunt in his assessment of the KC-46A.

"It has been a very painful experience," he says. "Boeing has

struggled. They have not performed where they should have."

The USAF and Boeing have devised a plan to deliver an improved RVS2.0 system at no cost to the service by 2024, although the US Government Accountability Office has previously been critical of that proposal. "[The USAF's] choices mirror those made during the development of the KC-46 that led to the delivery of an aircraft that did not fully meet its requirements, and the air force stands poised to potentially repeat its past mistake," it cautions.

In a further boost for the programme, Boeing was on 31 August awarded a Lot 8 KC-46A production contract by the USAF. Valued at more than \$2.2 billion, the deal covers the delivery of its next batch of 15 aircraft, for completion by 30 November 2025.

Cirium fleets data indicates that the USAF has 61 KC-46As in active use, with another example in storage. The service has a programme of record requirement to eventually operate 179 of the type.

Boeing also was awarded a Foreign Military Sales contract worth \$927 million to supply the Israeli air force with four of the in-flight refuelling platforms.

Work under Israel's first order for the type will conclude by 31 December 2026. ▶



Fuselage would generate 20-30% of the aircraft's total lift



A perfect blend?

Canadian airframer Bombardier begins testing larger unmanned demonstrator featuring configuration that could inform future fuel-efficient business jet designs

Jon Hemmerdinger Montreal

Bombardier has started flight testing a second, larger unmanned demonstrator of a conceptual blended-wing-body aircraft, expanding an effort the company says could inform the design of a radically different large-cabin business jet in future.

Earlier this year, the Montreal-based manufacturer revealed the “EcoJet demonstrator” programme, and said it was flight testing the design using a model aircraft.

Bombardier says initial findings from the flight trials have prompted it to continue the programme using a larger unmanned demonstrator.

“We’ve flown a much-larger model, in the 20ft-span size,” Bombardier director of research and technology Benoit Breault told FlightGlobal at the International Aerospace Innovation Forum in Montreal on 6 September.

The latest model is about 20% the size of a large-cabin business jet, he adds. The earlier demonstrator is around 1.2-1.5m (4-5ft)-long.

Bombardier believes the radical new shape could enable a significant reduction in emissions and fuel burn. “With only changing the shape of the aircraft today, we believe we can reduce [emissions] by 17-20%,” says chief executive Eric Martel.

Bombardier stresses the EcoJet project is not a development programme but an effort to understand the configuration.

Breault says the cabin of a blended-wing-body aircraft would be too low for a smaller jet like a midsize Challenger but perfect for the large-cabin sector, in which

Bombardier competes with its Global series.

While conventional aircraft have wings mounted above or below a cylindrical fuselage, Bombardier’s EcoJet is designed with a wide non-cylindrical fuselage that curves smoothly to wings that blend into the fuselage itself.

Instead of a T-tail, the EcoJet has a U-tail with two horizontal and two vertical stabilisers. It has twin engines mounted on the top of the aft fuselage.

The shape sees the fuselage generate 20-30% of total lift – versus 5-10% for a traditional aircraft, says Breault. That means the wings can be smaller, reducing weight and drag, and therefore requiring less thrust and fuel, he adds. That is how Bombardier arrives at an estimated 20% fuel saving. It says the design could use traditional turbofan engines or novel propulsion systems.

Certification challenges

Many hurdles remain, but the airframer says it has solutions to technical and certification challenges. “We’ve found nothing that kills the concept,” says Breault.

The EcoJet project comes as aircraft manufacturers face immense pressure to cut carbon emissions, a tall challenge considering the energy requirements of large business jets.

Breault says Bombardier has achieved its original flight-test goals for the smaller model but will continue using that aircraft to evaluate technologies before moving them to the larger demonstrator. However, the company declines to say where it is conducting test flights, nor to provide funding or timeline details, saying progression

depends on test results. It has partnered on the programme with unnamed Canadian universities.

The blended-wing-body concept was developed decades ago and was the subject of numerous studies. It gained attention in recent years after Airbus said it was looking at the concept.

Breault says technical challenges have kept the design from mainstream adoption. He cites flight-control complexity noting that the U-tail and wing location require “completely different control laws”.

“The common knowledge of such an aerodynamic shape, in the world of flight sciences, has not been greatly explored,” Breault says. “The stall [speed] of this vehicle is going to be unknown territory for Bombardier.”

Additionally, non-cylindrical fuselages are more difficult to pressurise, tending to require more structural reinforcement, adding weight.

There are manufacturing hurdles. Unlike cylindrical fuselages, which can be lengthened or shortened by removing sections, blended-wing-body designs are harder to stretch or shrink due to their non-linear fuselages, Breault says.

That creates challenges because aircraft manufacturers invariably create aircraft families around baseline variants, enabling them to squeeze maximum value from massive investment.

But Breault says Bombardier has found a “solution” to that issue, without elaborating.

“We think we’ve got some fancy ways to make the economics work,” he says. “I allow myself to believe... I’m going to put one in service before I retire.” ▶

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Frontier chief says rival's acquisition will give Colorado carrier significant cost advantage

Thiago B. Trevisan/Shutterstock

Frontier unbowed as Spirit slips away

US ultra-low-cost carrier confident that acquisition of previous takeover target by JetBlue will ultimately leave it in a stronger competitive position

Jon Hemmerdinger Washington DC

Frontier Airlines believes it has emerged from a failed merger bid in a stronger position, thanks to the tie-up of takeover target Spirit Airlines with JetBlue Airways.

Chief executive Barry Biffle insists that deal will give his company a cost advantage greater than any a US carrier has enjoyed for decades.

"We are in a situation where... 95% of the capacity in the USA is going to have [a cost that is] one-third or higher than ours," Biffle told Flight-Global on 15 September.

"I don't think it has been that good since Southwest [Airlines] in the late 1980s," he adds.

Biffle's comments came one month after ultra-low-cost Spirit walked away from takeover talks with Colorado-based Frontier.

Instead, Spirit agreed to pursue a competing acquisition offer from New York's JetBlue, an airline with significantly higher operating expenses.

JetBlue reported a cost per available seat mile - excluding fuel expenses - of about 10 cents in the second quarter, nearly 40% higher than Spirit's 7.2 cents.

Higher prices

Frontier had intended to use Spirit to create a huge ultra-low-cost carrier (ULCC), while JetBlue will use the merger to expand its existing business model.

"That's going to hurt consumers," Biffle says. "It's bad for consumers if they have to pay higher prices."

Biffle thinks Frontier will end up on top, even though it lost out on this particular deal. That is because, he says, JetBlue's plan will eliminate Spirit as a ULCC competitor,

leaving Frontier with a huge share of the ultra-discount segment.

The US airline market essentially has three ULCCs - Allegiant Air, Frontier and Spirit, which collectively account for about 10% of domestic available seat miles, according to Diio data. Of that, Allegiant holds 15%, Frontier has 36% and Spirit the remainder.

With Spirit out, however, Allegiant and Frontier would have the segment to themselves - effectively giving Frontier a 70% share of US domestic ULCC capacity. In that scenario, Biffle is correct: 95% of US domestic airline capacity would be controlled by airlines with costs significantly higher than Frontier's.

JetBlue's acquisition of Spirit remains far from certain: the carriers must secure regulatory approval from an administration that has taken a strong stance against business deals it views as anti-competitive.

The Department of Justice is already battling in federal court to force JetBlue and American Airlines to abandon their partnership in New York and Boston.

JetBlue anticipates it will clear those hurdles and close its Spirit acquisition by the first half of 2024, paying \$3.6-3.7 billion in cash, depending on the close date.

Frontier had offered to buy Spirit with a mix of cash and stock valued at about \$2.8 billion. But, Frontier insisted its offer stood a greater chance of securing regulatory approval. ■

Eve of change for United

US carrier could acquire up to 400 examples of four-seat type to develop its presence in advanced air mobility space

Jon Hemmerdinger Tampa

United Airlines has conditionally agreed to purchase an initial 200 electric vertical take-off and landing (eVTOL) aircraft from Embraer spin-off Eve Air Mobility, and announced a \$15 million investment in the air taxi developer.

The carrier says its conditional purchase agreement also includes options for a further 200 examples of the four-seat aircraft, which should enter use with a range of 54nm (100km). Deliveries could begin as soon as 2026, it indicates.

“This marks another significant investment from United in flying taxis,” it said on 8 September, adding that it will join Eve in studying the “development, use and applications” for such aircraft, which it believes have “potential to revolutionise the commuter experience in cities around the world”.

Michael Leskinen, president of United Airlines Ventures, the company’s in-house technology investment arm, frames the Eve deal as reflecting a commitment to achieve net-zero carbon emissions by 2050. United last year also agreed to

purchase 200 Maker eVTOL aircraft from Archer Aviation.

However, both agreements remain subject to uncertainty, due to factors including the need for the eVTOL developers to secure regulatory certifications for their innovative designs.

Growth opportunities

“United’s investment in Eve was driven in part by confidence in the potential growth opportunities in the [advanced air mobility] market, and Eve’s unique relationship with Embraer, a trusted aircraft manufacturer,” the airline says.

Eve also stresses the importance of its relationship with Embraer, saying the Brazilian airframer’s

engineering and certification support will provide valuable assistance through the regulatory approval process.

The carrier’s deal with Eve also includes “access to Embraer’s service centres, parts warehouses and field service technicians”.

“Upon entry into service, United could have its entire eVTOL fleet serviced by Eve’s agnostic service and support operations,” the airline notes.

Eve co-chief executive Andre Stein says that the airline’s backing “reinforces the trust in our products and services and strengthens our position in the North American market”.

See p66



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Project Heart swells as fresh funding enables expansion of effort

Consortium grows membership and scope as it works towards real-world testing of technologies designed to revitalise sub-regional aviation

Dominic Perry London

A UK government-backed consortium seeking to develop technologies that could revolutionise sub-regional aviation could begin tests of a highly automated, retrofitable flight-control system as early as next July.

Led by specialist autonomous system integrator Blue Bear Systems Research, Project Heart - or Hydrogen Electric and Automated Regional Transportation - was in July awarded a £10 million (\$11.5 million) grant under phase 3 of the UK's Future Flight Challenge (FFC) initiative.

This newly-allocated funding will allow the 14-company consortium, which also includes Britten-Norman, Highlands & Islands Airports (HIAL), Loganair, and ZeroAvia - to build on work carried out under the FFC's phase 2, which officially ended on 31 August.

Core pillars

Heart is attempting to address three core pillars - aircraft automation, innovative powertrains and fuel, and the accessibility of transport - to bring down the cost and environmental impact of sub-regional aviation, while also increasing the frequency and availability of services, says programme manager James Owen.

Solving these issues has the potential to boost connectivity for otherwise isolated communities such as the Scottish Highlands and Islands, he says.

During phase 2, those pillars have been addressed individually, and the goal of the phase 3 project is

to bring all the elements together, culminating in "a multi-platform, multi-leg demonstration" of a "hydrogen-electric, automated sub-regional transport aircraft" in the north of Scotland, says Owen.

In addition to the hardware, the trials will also evaluate all the supporting infrastructure - such as fuelling and green hydrogen

"There are still a huge number of conventionally powered island-hopping aircraft out there and [autonomy] can still make a huge difference to how they are operated"

James Owen

Programme manager, Project Heart

generation, or booking and operational changes - required for such flights.

"We will be trying to take each of these pillars further in phase 3 and integrate them with one another," says Owen. He points to the "huge sweep of extra items" included within the latest phase, in order to "make it as comprehensive



Linear/Shutterstock

a demonstration of how we would run a network as humanly possible".

Although ZeroAvia is maturing its hydrogen fuel cell powertrain under the Aerospace Technology Institute's HyFlyer II programme, a separate UK-funded initiative, the Dornier 228 it is retrofitting with the new propulsion system will feature prominently in Project Heart.

Here, the consortium will equip it with an autonomous control system developed by Blue Bear, which will actively fly the aircraft, allowing a "governing pilot" to "supervise" the mission. This should sufficiently increase flight safety and reliability to permit single-pilot operations with more than nine passengers aboard, says Owen.

Should regulators sanction such a rule change, the per-flight cost for sub-regional operators would decline, potentially lowering fares. Equally, airlines could look to increase the frequency of flights without the need for additional pilots.

Early work to integrate the system on ZeroAvia's Do 228 - which has yet to fly - could commence shortly, says Owen; talks with the propulsion system developer are



Loganair and Highlands & Islands Airports bringing operational experience to the project

continuing in order to establish a schedule, he adds.

Phase 2 saw the integration of a suite of avionics onto a Britten-Norman BN2 Islander that “listens to the aircraft and reports back to the pilot”, via a bespoke digital cockpit display, reflecting the operation of the autonomy system and the monitoring of the aircraft’s performance.

Sophisticated sensors

This phase 2 work brings the high levels of automation and sophisticated sensors found on a modern commercial airliner to much smaller aircraft types. Flight tests of the system from Britten-Norman’s Leigh-on-Solent facility on the south coast of England concluded in mid-August.

Those trials, designed to ensure the equipment is “listening to the aircraft and correctly characterising its flight condition”, went “very well”, says Owen, yielding “lots of data” from the “great flights over the Isle of Wight and a bit beyond”.

Phase 3 work will build on this stage to deliver more sophisticated automation that reads across to much larger transport and cargo aircraft. But the move to active control under phase 3 is not the only change: Owen stresses that the system being developed will offer “configurable autonomy” - essentially “an automation system that in future can equip any aircraft”.

Although flight trials of the system will only be conducted using two aircraft types, Project Heart

will also run simulator tests using other sub-regional transport aircraft, he says.

Britten-Norman is not providing a hydrogen-powered aircraft for the project - that role is fulfilled by ZeroAvia - but Owen insists the potential performance gains for such a type from the autonomous control system alone are still significant.

“There are still a huge number of conventionally powered island-hopping aircraft out there and [autonomy] can still make a huge difference to how they are operated.”

Phase 3 of Project Heart is a two-year programme and Owen is hopeful that early flight testing of the autonomous system can commence from July 2023, leading to “more fundamental flights” in the following quarters.

Rapid progress

“Once we get our avionics suite into an aircraft and everything works we can move ahead quite quickly,” Owen says.

He sees the potential for 2025 service entry of the configurable autonomy system - whether entirely platform agnostic or tailored to a particular aircraft type. However, the steps required to bring it to certification will mature as the project progresses, he notes.

As well as an increase in scope, the move from phase 2 to 3 has seen the size of the Project Heart consortium swell. It now numbers 14 partner companies, up from 10 previously, having added encryption specialist Arqit, software firm Geneo, infrastructure consultancy Mott MacDonald, Saab Technology UK, and control systems firm RDM Group. Original partner Inmarsat has dropped out, but remains allied to the project, supplying its Satcom connectivity.

Project Heart recently held its first public engagement event at Inverness airport to outline the achievements under phase 2, and highlight the plans for the subsequent phase. ▶

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Connect Airlines

Joined-up thinking

New entrant intends to shake up North American regional airline market with bold plans for turboprop operations

Pilar Wolfsteller Las Vegas

Connect Airlines may not be a household name in North America, but that could change if Australian airline veteran John Thomas has his way.

The carrier, a new entrant in the North American market, plans to shake up regional travel in the eastern third of the continent this November by offering a unique perk in turboprop flying: premium cabins.

Over time, Connect aims to grow through partnerships with major US airlines and, longer term, to operate hydrogen-powered ATRs, becoming what chief executive Thomas calls “the continent’s first zero-emission airline”.

“We are going to recalibrate US travellers’ perception of the turboprop,” Thomas told FlightGlobal on 7 September. “It’s a hell of a lot nicer travelling on a turboprop than on a regional jet.”

He thinks equipping De Havilland Canada Dash 8-400s with more comfortable cabins will entice North American travellers to choose turboprops over older, less-economical jets like the Bombardier CRJ200 and Embraer ERJ-145.

The Bedford, Massachusetts-based start-up will be the first North American carrier to offer Dash 8s with premium cabins, he says. Connect removed a row of seats and increased space in the front six rows, providing more leg-room.

Configured in a 74- rather than typical 78-seat layout, the aircraft will have 26 seats in the forward cabin, and 48 in regular economy.

Only a handful of North America carriers – Horizon Air, Porter Airlines, Ravn Alaska Airlines and WestJet Encore – still operate Dash 8s, and all in single-class configurations. Propeller aircraft lost out to jets in the USA in recent decades because, regional airlines say, passengers typically shun the types, viewing them as outdated and noisy.

400nm

Longest route carrier plans to operate – the Dash 8-400’s ‘sweet spot’

The US Department of Transportation (DOT) in July issued Connect Airlines a certificate of convenience and necessity for domestic air transportation, and granted the carrier a certificate for foreign transport on 6 September. Connect still needs Transport Canada’s approval to begin trans-border flights. The airline began proving runs in July and is “about half-way through”, he says.

Connect plans to launch in November with passenger flights between Billy Bishop Toronto City airport and two US destinations: Chicago O’Hare International and Philadelphia International.

Connect has two Dash 8s at the ready, and a third scheduled to join the fleet in October. Following that, it expects to take delivery of another example each month through February. The airline’s operating certificate permits it to fly seven aircraft, but Connect aims to expand to “about 100 aircraft in the next few years”, Thomas says.

Connect sits under an existing Massachusetts company called Waltzing Matilda Aviation, which specialises in charter air travel and aircraft management, and operates Cessna Citation Excels, Bombardier Challenger 604s and ERJ-135s.

Thomas, also Waltzing’s co-founder, was chief executive of Virgin Australia Airlines in 2016-2017. He also has experience as an airline consultant in the USA, having worked on projects including the Delta Air Lines-Northwest Airlines merger, Delta’s joint business with Virgin Atlantic and Alaska Airlines’ purchase of Virgin America.

Connect is clearly targeting business travellers. Thomas hopes flights to Toronto’s downtown Billy Bishop airport will be more attractive than those to the much-larger Pearson International airport, on the northern periphery of the city.

“Toronto is the fourth largest airline market in North America. Our strategy for the first 20-25 aircraft is to build out of Toronto,” he says.

In time, the airline’s network could include destinations like Baltimore, Charlotte and Cincinnati, he adds.



Start-up is targeting business travellers flying into Toronto

Connect's plan is to operate routes of less than 400nm (741km) – the Dash 8-400's "sweet spot", Thomas says.

"At 400 nautical miles, the block-time differential between a [regional jet] and a Q400 is *de minimis*. From a customer-value proposition, they don't lose any utility by flying on a turboprop because it's just one minute slower."

And, with several airlines upgrading their fleets to jets, used Dash 8-400s are cheap and plentiful.

"Because there's so many Q400s in the marketplace at the moment, we're picking them up on lease rates that are basically one-third of what we would have been paying three or four years ago," Thomas says.

The airline has no plan to join network alliances but seeks interline and codeshare deals with major US carriers.

One major US airline has already taken the bait, though Connect has not publicly said which one. "We will be the first start-up to have an interline agreement with a major carrier," Thomas says.

Connect recently turned heads by offering to pay newly-hired "direct-entry", or experienced captains up to \$250,000 annually – far more than other US regional airlines. Thomas says this is aimed at older pilots who, through no fault of their own, are lower on larger airlines' seniority lists, and whose promotion horizon is limited.

Valuable experience

"We are targeting 45- to 55-year-old pilots and captains, who essentially deserve to be paid that amount of money because of their experience," he says.

He relates the story of a pilot who began his career at a regional carrier. After that airline failed, the pilot took contract work at Middle-Eastern airlines before returning to the USA and joining a US major carrier.

"He's flying with this major airline at 55 years old, as a first officer, with the experience of a captain," Thomas says. "He's been told... he probably won't get to the left-hand seat for eight years because of his place on the seniority list, which means

he'll have two years [in] the left seat" before reaching the mandatory retirement age of 65.

"He'll be flying for eight years with captains who are 35 years old," Thomas says.

Because charter pilots are not subject to the same mandatory retirement age, Connect's pilots can transition to Waltzing Matilda's charter operation after reaching age 65, he adds.

Connect also wants to become known as an innovator.

In June, the company said it had signed a firm order with Universal Hydrogen to acquire up to 100 hydrogen-powered ATR 72-600s, with deliveries scheduled to begin in 2025. Thomas said the carrier wants to be "the world's first true zero-emission airline".

Universal Hydrogen is developing "powertrain conversion kits" intended to allow two types of passenger turboprops – ATRs and Dash 8s – to burn hydrogen, a strategy far simpler than developing a clean-sheet hydrogen-powered airliner, Thomas notes. Universal is using a Dash 8-300 as its initial testbed.

"If we're going to play in the regional space, and it is the first real market to move to zero emissions, we'd like to be the first," says Thomas. "We see the ATR 72 as being the first one to certification.

"Not only will travellers feel good about flying a green aircraft, they will have a better experience than on old regional jets," he says. ▀

"If we're going to play in the regional space, and it is the first real market to move to zero emissions, we'd like to be the first"

John Thomas Chief executive, Connect Airlines

Ryan Finnerty Burlington

The US Air Force (USAF) has outlined plans to spend nearly \$5 billion over 10 years to support the development of an engine for its future generation of air superiority assets, as the Pentagon separately nears a decision on how best to provide a power upgrade for the Lockheed Martin F-35.

On 19 August, the US Department of Defense (DoD) announced that the USAF had awarded five contracts – each worth \$975 million – to fund research and development for a propulsion system to equip “future air-dominance platforms”.

Dubbed the Next-Generation Adaptive Propulsion (NGAP) programme, the more than \$4.8 billion initiative will provide funds to five US aerospace giants: Boeing, GE Aviation, Lockheed, Northrop Grumman, and Pratt & Whitney. The firms have a general timeline to complete the design and prototyping phase of development by 2032.

The USAF’s interest in fielding fighters equipped with adaptive engines stems from the ability of such powerplants to seamlessly adjust their internal airflow and pressure, to deliver both the high levels of thrust and acceleration needed for air combat and for highly fuel-efficient long-range cruise performance.

Fighter thrust

Further details of the NGAP activity have not been disclosed, but its very name is markedly similar to another secretive USAF effort, to design a sixth-generation fighter via the Next Generation Air Dominance (NGAD) programme.

The DoD has revealed little about the concepts being explored to provide a replacement for the USAF’s Lockheed F-22 fleet. However, senior leaders in industry and the military, including air force secretary Frank Kendall, have speculated that NGAD will not be a single aircraft type, but a family of paired systems, potentially also including unmanned or autonomous air vehicles.

According to the DoD’s NGAP contract announcement, the programme also has the goal of “digitally transforming the propulsion industrial base”. Earlier the same month, a USAF official whose

NGAP activity will propel exploration of adaptive powerplant technologies for future combat types



USAF sparks next-generation engine competition

Service contracts five companies to work on early stage of development effort to equip future air-dominance platforms, as decision on resolving F-35’s propulsion challenge draws near

US Air Force

portfolio covers propulsion systems warned that the USA is in danger of falling behind its military rivals in the development of transformative engines.

John Sneden, director, propulsion directorate at the Air Force Life Cycle Management Center, told a conference in Dayton, Ohio that with only two US firms at that time holding contracts to develop adaptive engines, the viability of the USA’s advanced propulsion industrial base would be uncertain and at risk of “collapse”.

“The perception... that’s out there is that we are maintaining, if not advancing, our military advantage in propulsion,” Sneden says. “But the reality is we are essentially

stagnating, and we are starting to lose.”

In 2016, the USAF awarded GE and P&W roughly \$1 billion each to develop improved powerplants for the single-engined F-35, under the Adaptive Engine Transition Program (AETP).

The DoD is still weighing how to address an F-35 cooling issue, which reflects the challenges of a multidecade acquisition programme. There have been substantial advances to the type’s radar, electronic warfare equipment and other sensors in the roughly 20 years since Lockheed and P&W designed the aircraft and its F135 engine. This has resulted in power and cooling demands that already

exceed what the F135 was intended to provide.

"We are currently operating the engine at two times the specification it was designed for," Jennifer Latka, the head of P&W's F135 engine division, tells FlightGlobal. "Over time, all of those systems coming on to the jet require more cooling air to be pulled off the engine to power them."

Latka insists the F135 can handle the increased load, but says additional demand substantially drives up fleet-sustainment costs.

"It's not a capability thing. It's a cost thing," she says. "When the engine is running hotter, which is what happens when you are pulling more of the air from it, it needs maintenance sooner."

Shorter life

The Pentagon's F-35 programme executive officer, USAF Lieutenant General Eric Fick, confirms that assessment.

"From a power and cooling perspective, twice the power and cooling of the engine... has negative impacts on engine life," he said in March. "It forces us to turn up

the wick on the engine, to burn it hotter, which then will decrease the amount of time between engine overhauls."

In July, David Tweedie, GE Aviation Edison Works general manager for advanced combat engines, said the product of its AETP contract, the XA100, will be ready to power F-35s by the end of this decade.

GE estimates the XA100 could save the US government \$10 billion if installed on the USAF's F-35As. It also touts the engine as being a drop-in option for the carrier-variant F-35C, with no need for structural redesign on either model. Tweedie says the new engine would provide 30% more range and 20-40% more acceleration than the F135.

The company also is studying a potential XA100 integration path for the F-35B, and plans to have initial data by "the autumn". The short take-off and vertical landing variant was not included in the AETP design requirements and presents "unique integration challenges", Tweedie notes.

There is substantial debate within the DoD and US Congress about

whether the performance improvements of an engine retrofit would be worth the cost. Indeed, P&W is pushing an alternative proposal to perform a core upgrade on the F135, and use its XA101 developed through AETP to power a sixth-generation NGAD fighter instead.

P&W says its Enhanced Engine Package (EEP) update will provide substantially more power and reduced fuel burn at a far lower cost than installing a new engine, by making improvements to the F135's power and thermal management system (PTMS). Updates include changes to the high-pressure compressor, high-pressure turbine, low-pressure turbine and augmentor, it says.

"The EEP upgrade maintains significant commonality with the current F135 engine and can easily be cut into production as well as retrofit into the fleet during regular scheduled overhauls," P&W says.

Cheaper option

Without providing specifics, Latka says the EEP enhancement can provide PTMS performance beyond what Pentagon leaders say will be needed. "That way, we don't run into this issue all over again in 10 years," she says.

Latka calls the upgrade option a "drop-in retrofit", and adds that P&W could outfit six squadrons with the "tri-variant-common" enhancement by 2030. Installing an all-new engine would result in "bifurcating" the F-35 fleet with multiple propulsion systems, and add billions of dollars in additional sustainment costs, she says.

Excluding development expenses, the EEP will not increase the cost of the USA's F-35 programme, P&W says. It estimates that the update would produce \$40 billion in savings through 2080 - the projected end date for operations involving the fighter - with most of that total resulting from reduced maintenance costs and improved fuel efficiency.

But with the US Navy and US Marine Corps having shown little interest in acquiring a new engine for their F-35B/Cs, Kendall has previously noted that it would be difficult for the USAF to implement the change alone.

A decision on the F-35's future propulsion path is expected to be taken during 2024. ▀

"Twice the power and cooling... has negative impacts on [F135] engine life. It forces us to turn up the wick on the engine, to burn it hotter"

Lieutenant General Eric Fick F-35 programme executive officer, US Air Force



GE says its XA100 will be available for F-35A/Cs by the end of this decade

GE Aviation

MD Helicopters eyes next chapter

New ownership will allow Mesa, Arizona-based rotorcraft manufacturer to turn page on troubled period in its history

Dominic Perry London

MD Helicopters' new owners insist they can breathe new life into the company after completing the acquisition of the US rotorcraft manufacturer's assets on 15 August.

A consortium comprising long-term investors Bardin Hill, MBIA Insurance, and MB Global Partners now owns the Mesa, Arizona-based business and has appointed industry veteran Brad Pedersen as chief executive.

The acquisition ends a tumultuous recent period triggered by the 2018 bankruptcy of companies associated with former chief executive Lynn Tilton and her private equity firm Patriarch Partners, which previously owned MD Helicopters.

To facilitate the sale process, MD Helicopters Inc entered Chapter 11 bankruptcy protection in March, with its assets purchased by a new company, MD Helicopters LLC.

Pedersen - who started his career at MD predecessor Hughes Helicopters - believes the manufacturer can now begin building back its operation, which had been hamstrung by the wider bankruptcy process.

"There has been some reluctance on investment and other things, [but] now we have those constraints removed we can move forward," he says.

MD Helicopters' immediate priorities will be to improve customer support and aftersales, he says, "because I think that's been MD's biggest issue in the last several years". He notes that "if customers can't get the parts, can't fly their aircraft, they are going to buy from somebody else".

Production continues of MD 500-series aircraft, with six or seven units currently on the assembly line, all for civil customers; Pedersen believes output can be increased to 15-20 helicopters in 2023. "We have an orderbook that's growing," he adds.

MD Helicopters continues to pursue sales of the armed MD 530F/G,



Company continues to pursue sales of the armed MD 530F/G

particularly through the USA's Foreign Military Sales process, he adds. Previous export customers for the light-single include Afghanistan, Kenya, Libya and Malaysia.

However, no decision has been taken on whether to resume production of MD Helicopters' NOTAR-equipped MD 600- or 900-series models. That would hinge on "a large enough order or large enough interest", says Pedersen.

Current agenda

He also does not rule out a potential sale of the NOTAR system, if it "makes sense" for customers and the company's owners, but stresses it is not currently on the agenda.

"I don't want anybody to believe we are out there pedalling around trying to sell the NOTAR technology, because we're not," he says.

In the meantime, MD Helicopters will consider "functional improvements" for the MD 530E/F models, which have "been a bit stagnant over the last couple of decades".

Although declining to specify the upgrades under consideration, Pedersen says they would focus on offering "more lift, more useful load... [and] lower operating costs" for customers.

Further out, electrification or the addition of autonomous flight controls to the MD 530 are a possibility,

he says, but cautions: "Let's get the operation stabilised and then we can look at the future."

Despite the optimistic tone, MD Helicopters still faces a significant challenge to convince the market that it will be able to bounce back from adversity.

Acknowledging that rebuilding a business is "not easy", Pedersen highlights his experience in company turnarounds, adding: "We aren't going to have to violate any laws of physics to do it."

"I don't see this as any different to any of the other companies that I've gone into lead and successfully grow. Most of the problems and most of the injuries, the wounds, are self-inflicted."

Steadying the business will be key, he argues: "Once you get the processes and things stabilised, then you can focus on the growth and new products and other things."

Pedersen sees MD Helicopters' niche as a low-cost alternative to the bigger rotorcraft manufacturers for police or utility operators that "don't have a lot of money" and are looking for an aircraft that is "very simple to operate".

"We are very, very affordable," he says. "And with the stability of coming out of bankruptcy, customers can feel confident that we are going to be here for a long, long time." ▶

Carrier says its training is just as stringent as the military programme



AirTeamimages

FAA stands firm on 1,500h rule

Request from Republic Airways for exemption to flight-time regulation has been firmly rejected by agency

Jon Hemmerdinger Tampa

US regulators are not bending on a 2013 rule requiring most new airline pilots to have 1,500h of flight time.

The Federal Aviation Administration (FAA) on 19 September shot down a request from Republic Airways that would have allowed some of its pilots to fly scheduled flights with only 750h of cockpit time.

Republic had argued that the rule is a major contributor to an ongoing flightcrew shortage. However, pilot unions see the FAA's decision as a major win for their members.

"The FAA does not agree with Republic that the public interest would be served by granting this request," the agency says. "The FAA supports the regulatory

requirements that are in place to facilitate the qualification of pilots."

Republic in April requested an exemption from the 2013 rule, which stemmed from a 2009 crash near Buffalo of a Colgan Air De Havilland Canada Dash 8-400. The accident killed 49 people on the aircraft and one on the ground.

Republic and other US regional airlines have said the rule has exacerbated a pilot shortage, forcing them to cut flights. They have also insisted it does not improve safety.

Pilots who accumulate 1,500h in small private aircraft are less qualified, opponents have said, than those who complete formal training specific to airline flying.

"The FAA does not agree that granting the exemption would address a perceived pilot shortage,"

says the agency, calling that argument "overly simplistic".

Republic specifically requested that pilots who complete its in-house flight training programme be permitted to apply for an existing exemption available to current and former aviators from the armed forces, who, after graduating from a US military pilot training school and in receipt of a rating qualification, can fly for airlines with only 750h of flight time.

Indianapolis-based Republic argues its training programme is "equally stringent" as military training, providing "at least an equivalent level of safety".

Trade group the Regional Airline Association (RAA) is still reviewing the decision. "Expanding structured training pathways would improve access for people who can't access a pilot career today," says RAA chief executive Faye Malarkey Black. "None of this changes our sentiment that flight training must continuously advance."

The proposal received mixed reaction, with airlines and some lawmakers expressing support. Unions have firmly opposed it.

Cockpit union the Air Line Pilots Association had been an outspoken critic of Republic's proposed exemption.

"Changing the current pilot certification requirements that are working, or allowing operators to bend the provisions to cut costs, would be a monumental mistake and have real-world, life-and-death consequences," it said in July.

The union has argued there is no shortage of flightcrew, saying airline mismanagement is responsible for "pilot staffing problems". ▶

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Coulson crash pinned on windshear

Firefighting C-130 came down in Australia in 2020 killing three crew following partial retardant drop

Dominic Perry London
Greg Waldron Singapore

A windshear-induced low-altitude stall caused the fatal crash of a Lockheed Martin EC-130Q firefighting aircraft in Australia in January 2020, investigators have determined.

The accident, in which all three crew – two pilots and a flight engineer – were killed, occurred in the early afternoon as the Coulson Aviation aircraft (N134CG) attempted to egress from a partial drop of fire retardant in the Snowy Mountains, New South Wales.

After the retardant drop, witnesses observed the aircraft, in a left turn, climbing for about 10s, to an altitude investigators calculate was around 330ft above ground level (AGL). It then descended over the next 17s, and was last seen at “a very low height above the ground”, says the Australian Transport Safety Bureau (ATSB) in its final report into the accident.

One of two Coulson aircraft deployed to Australia during the 2019-2020 fire season, the EC-130Q was operating from the Royal Australian Air Force’s Richmond base in support of firefighting operations in New South Wales.

Rejected missions

On 23 January, the modified transport – a 1981-built, ex-US Navy H-model airframe – departed RAAF Richmond at 12:05 to tackle a fire near Adaminaby.

Its sister aircraft, a Boeing 737 (N137CG) had already performed a retardant drop at that location but owing to weather conditions had rejected further missions.

During pre-drop orbits of the fire site, the twinjet encountered uncommanded rolls of up to 45° bank angle, and windshear warnings were triggered, the captain

reported. Wind speed was recorded as 50kt (92km/h) at 800ft AGL, and 37kt at the 200ft drop level, with the captain describing conditions as “horrible”.

Although a “birddog” spotter aircraft had also rejected a tasking to Adaminaby, the EC-130Q nonetheless continued to the location. But having made several circuits at 2,000ft AGL, the crew determined conditions, with poor visibility and strong winds, were too poor to continue that mission. Instead the four-engined turboprop was routed to the Good Good fire, around 31nm

190ft

Height above ground level from which the EC-130Q released 4,500 litres of fire retardant

(58km) to the east. No birddog was operating at the site.

Arriving on site at around 13:07, the EC-130Q performed three circuits of the drop zone – located on the eastern side of a roughly north-south ridge – at 1,500ft, 500ft and 1,000ft AGL.

At 13:15 a partial drop was performed on a heading of 190° from an altitude of around 190ft AGL; the aircraft’s ground speed was recorded at 144kt. During the drop some 4,500 litres (1,200USgal) of fire retardant were released over a period of about 2s.

Video recordings of the drop, captured by firefighters on the ground, showed the EC-130Q initially climbing away in a slight left turn to about 330ft AGL.

No flight-data recorder was installed on the aircraft, but ADS-B data detailed it as climbing for around 10s, to about 170ft above the drop height, says the ATSB.



Bridges/Wikimedia Commons

Further analysis of the video revealed the aircraft rolling from about 18° left to 6° right and descending, at a rate later estimated to be up to 2,000ft/min. A “significant left roll” was observed shortly before the impact at 13:15:37, which triggered a large fuel-fed fire.

The wreckage trail extended for 180m (590ft) along gently sloping terrain on a heading of 100°. Subsequent inspection of the aircraft found “no pre-existing airframe issues” with “no evidence of an in-flight break-up or pre-impact structural damage”. Although the trim settings on the rudder, ailerons or elevators could not be established owing to the damage sustained, investigators found the position of jack screws consistent with a 50% flap setting.

In addition, all four engines were working and the propellers delivering “positive thrust”, post-crash examination revealed.

Coulson’s conversion of the C-130H into the firefighting configuration included the installation of a 15,000-litre retardant tank and aerial delivery system. Data from the aircraft’s loading system showed that before the accident drop, it was carrying 16,109kg (35,500lb) of retardant, plus a

“There were strong gusting winds, turbulence, and mountain wave activity, and these conditions were conducive to windshear”

Australian Transport Safety Bureau



Ex-US Navy Hercules was one of two Coulson aircraft deployed to New South Wales in 2019-2020

907kg pallet of firefighting gel. Including fuel, this resulted in a take-off weight of about 66,818kg.

Using the operator's fuel consumption figures, investigators estimate the aircraft's post-drop weight was 59,265kg. With a 50% flap setting in level flight, that would have led to a stall speed of 83kt, they suggest. However, moderate or severe turbulence would increase that figure to between 101-117kt and 117-143kt, respectively, the report adds.

Challenging conditions

Following the accident, the ATSB received multiple witness reports of the weather conditions at Peak View. They all consistently reported very strong winds from the northwest, with gusts up to 43kt recorded at ground level. However, the wind direction was also being influenced by the terrain. In addition, the area was a well-known location for mountain wave activity, says the ATSB, a phenomenon associated with turbulence and windshear.

Investigators note that the post-drop turn would have taken the EC-130Q from a “predominant crosswind to a predominant tailwind”, resulting in an initial slight decrease in airspeed.

“At the same time, as previously established, there were strong gusting winds, turbulence, and mountain wave activity present at the time of the accident, and these conditions were conducive to windshear.

“If there was an additional increase in this tailwind component from windshear, this would have resulted in a further reduction of the airspeed. There would also be a corresponding decrease in pitch attitude and rate of climb, with a subsequent loss in altitude,” adds the report.

Although the crew had carried out three circuits prior to the drop, the ATSB says the lowest height of 500ft “may not have been low enough for the crew to accurately assess the conditions at the drop height and identify any localised terrain or fire effects.”

Simulator testing revealed that windshear, when present, “consistently resulted in the airspeed

100-123kt

Estimated airspeed for the aircraft at the time of the accident, bringing it within calculated stall range

decaying into the stall speed region”, says the ATSB, and produced similar ground speeds to the accident flight.

Based on its calculations using the last 10s of available data, the airspeed at the time of the crash was 100-123kt, which “presented a significant overlap with the calculated stall speeds”. On that basis “it was likely that the aircraft aerodynamically stalled at a height that was insufficient to recover”, the report says.

Analysis of the video and examination of the accident site showed no emergency drop of retardant, despite this being a standard procedure during such situations.

Tripped switch

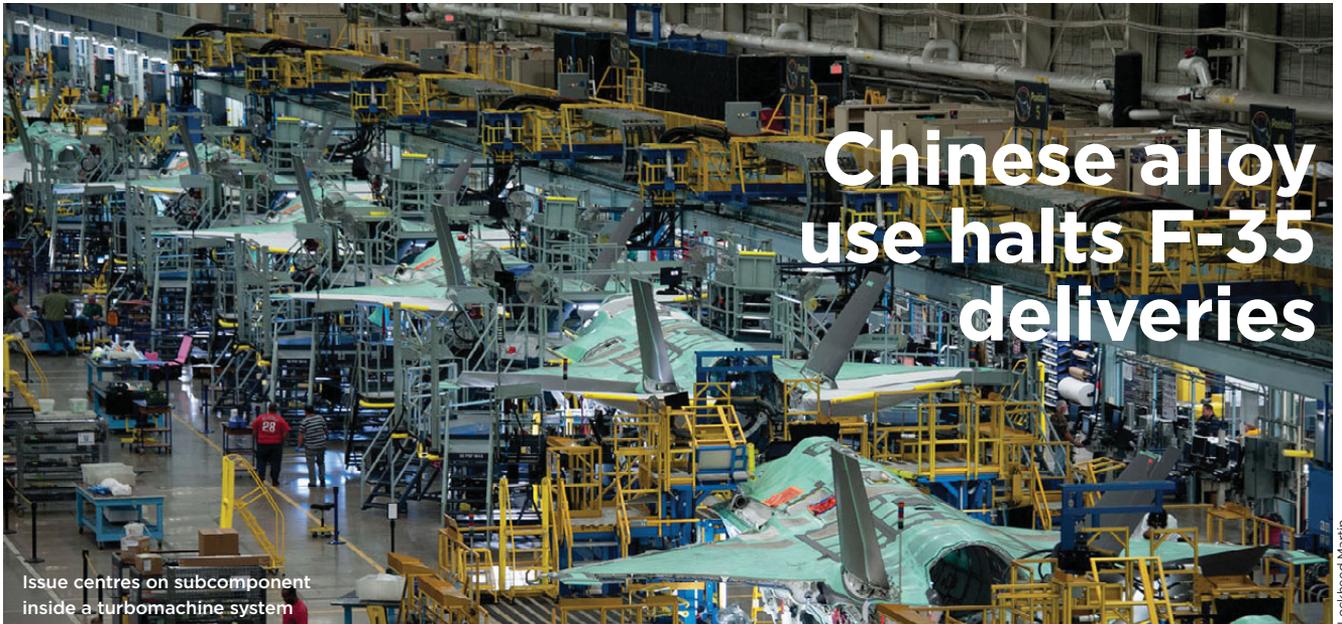
Further analysis of the accident sequence was hampered by the lack of cockpit-voice recorder (CVR) data. Although the aircraft had the requisite recorder fitted, an inertia switch – which cuts power to the device in certain circumstances to prevent over-recording – was probably tripped during a training flight in May 2019. That the CVR was not functioning had not been detected before the accident, the ATSB says.

Coulson's risk management processes were unsuited for large tanker operations, the report adds; the company's windshear recovery procedures for C-130 crews were also inadequate, the ATSB says.

While the operator argued that “the procedures, experience, and training to deal with, and respond to [windshear] conditions were in-built for their aerial firefighting operations”, owing to the nature of the activity, “the ATSB noted that there was no windshear recovery procedure published in the operator's [aircraft flight manual], nor did it contain a section on adverse environmental conditions”.

Windshear incidents were not routinely recorded in the safety reports submitted by crews, says the ATSB. A review of 32 such reports compiled over the 2019-2020 period found that 60% were related to maintenance issues. Only 9% were operationally focused, generally related to aircraft separation issues or retardant overloading events.

Since the crash, the company has implemented a windshear recovery procedure for the C-130, including simulator-based recurrent training. Risk management procedures have also improved, the report notes. ▀



Issue centres on subcomponent inside a turbomachine system

Lockheed Martin

Chinese alloy use halts F-35 deliveries

Temporary suspension to shipments imposed after discovery of subcontractor obtaining component via restricted source

Ryan Finnerty Burlington

The US Department of Defense's (DoD's) temporary suspension of Lockheed Martin F-35 deliveries over concerns about the origins of an on-board component have highlighted a supply issue which is of increasing concern to Washington DC.

Announced by the DoD's F-35 Joint Program Office (JPO) on 7 September, the step followed the discovery that a pump within every F-35's Honeywell-supplied turbomachine system incorporates a powerful magnet made from metal sourced in China.

The magnet is part of a lubrication pump supplied to Honeywell by an undisclosed subcontractor, which sourced materials from another company that acquired Samarium Cobalt alloy from materials mined in China.

Lockheed describes the turbomachine as an integrated power system that combines the functions of an auxiliary power unit and air cycle machine to provide ground power for maintenance and main engine start, as well as compressed air for thermal management.

Honeywell says it "remains committed to supplying high-quality products", and it is "working closely with DoD and Lockheed Martin to... continue to achieve those commitments on products Honeywell supplies for use on the F-35".

The company adds that it has stopped work with the supplier that provided the alloy in question, and anticipates taking delivery from an alternative US source from October.

Lockheed says a review, conducted jointly with Honeywell and the JPO, found that the magnet does not pose any flight safety issues, or "any visibility or access to sensitive programme information".

A statute known as the Defense Federal Acquisition Regulation Supplement (DFARS) sets restrictions on the origins of raw materials used by US defence manufacturers. Its purpose is to prevent the producers of sensitive national security equipment from becoming dependent on overseas suppliers.

Compliance breach

Lockheed says it is doing "everything possible" to determine whether the supply chain issue represents a DFARS compliance breach. If that is determined to be the case, the airframer says a national security waiver of DFARS rules will be required in order to resume deliveries.

Some 88 F-35s had been delivered this year prior to the interruption, and Lockheed expects to ship between 148 and 153 of the fifth-generation fighters in 2022.

The company notes that there are more than 1,700 suppliers to the F-35 programme, providing some 300,000 total parts.

National security concerns related to Chinese metals could

become an increasingly common issue in coming years.

The Samarium Cobalt alloy at the root of the F-35 saga is a metallurgical mixture used in the production of permanent magnets. Samarium is a so-called rare earth element; a class of 17 minerals that are essential in the production of high-end goods, including optics and weapons used by Western militaries.

While these minerals are quite abundant across the planet, their mining, and the refining capability needed to turn raw ore into usable material, is concentrated in China.

The US Geological Survey in 2019 found that China accounted for up to 80% of rare earth minerals imported by the USA.

Washington has moved to increase domestic production of the minerals in recent years, and in 2020 the DoD announced it would provide funding for refinery projects to MP Materials, which operates in California and Texas, and Australian company Lynas. However, those efforts will take years to bear fruit.

Analysts and China-watchers in the West have warned that this situation leaves the USA and its allies vulnerable, should Beijing move to institute export restrictions.

A 2021 report from the nationalist *Global Times* publication noted that while rare earth element exports to the USA are not being restricted, "measures could be taken against foreign companies that hurt China's interests". ■

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Warsaw to buy 96 Apaches

NATO nation scales up attack helicopter acquisition plan, as it rejects rival offer of AH-1Z Viper to replace ex-Soviet Mi-24s

Bartosz Glowacki Kielce
Dominic Perry London

Poland intends to dramatically increase the size and strength of its attack helicopter fleet, after selecting Boeing's AH-64E to meet its long-standing Kruk programme requirement.

Announcing the decision via Twitter on 8 September, Polish defence minister Mariusz Blaszczak said Warsaw has requested "the acquisition of 96 AH-64E Apache helicopters in the latest Guardian version".

To be operated by the Polish Land Forces, the new-build rotorcraft will replace the service's 30-strong fleet of ex-Soviet Mil Mi-24/35s.

Blaszczak – who confirmed the selection after attending a Ukraine Contact Group meeting at Ramstein air base in Germany with US secretary of defense Lloyd Austin – says Warsaw wants to lease Apaches from the US Army to provide a gap-filler capability while its aircraft are being manufactured.

Speaking one day before the selection announcement, Adam Hodges, capture team lead for vertical lift international sales, Boeing Defense, Space & Security, said Poland had been offered the AH-64E Version 6 aircraft, with manned-unmanned teaming capability. "The level of [unmanned air vehicle] interoperability will be detailed on the basis of government-to-government talks, and will depend on customer requirements and the US government," he adds.

With Warsaw requesting technology transfer related to the deal, the airframer notes: "During the procurement process, Boeing



Boeing promoted the AH-64E at Poland's MSPO show in September

established significant co-operative partnerships across Polish government and industry. Our partnership with the Polish Armaments Group in particular will continue to expand as we implement training and sustainment efforts with local industry."

Sustainment opportunities

Hodges says Boeing is now in talks with a number of local companies about sustainment opportunities.

The other contender for the Kruk contract was Bell's AH-1Z Viper, an example of which made a debut MSPO show appearance in Kielce from 5-9 September, along with a UH-1Y transport.

"We understand that Poland has significant needs regarding military equipment and armaments as a NATO country. Bell remains available in case the Polish government needs our helicopters," the company says.

Should the 96-unit purchase be confirmed, it will make Poland the

largest international customer by far for the Apache. Previous plans had called for the acquisition of 32 aircraft to equip two squadrons, with the increased scope of the programme indicating that its land forces could instead stand up six such units with the new assets.

FlightGlobal's World Air Forces directory for 2022 lists Israel and Egypt as having the largest current Apache inventories behind the US Army, operating 48 and 46 examples respectively.

Although the UK will eventually field 50 AH-64Es, its fleet is temporarily reduced as its earlier D-model airframes cycle through a remanufacturing process.

Warsaw has boosted its defence budget significantly since Russia's late-February invasion of Ukraine. Other acquisitions announced during recent months have included an order for 32 Leonardo Helicopters AW149 transports and 48 Korea Aerospace Industries FA-50PL jet trainer and light-attack aircraft. ▶

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Moscow's helicopter units have suffered heavy losses during conflict with Kyiv

Why 'low and fast' matters

Officer tasked with delivering Future Vertical Lift says lessons from Russia-Ukraine war show US military is on right heading

Ryan Finnerty Burlington

The employment of helicopters during the Russia-Ukraine war has underscored the importance of the US Army's rotorcraft modernisation drive, according to the officer leading the activity.

"Low and fast matter," Major General Walter Rugen, director of the army's Future Vertical Lift (FVL) cross-functional team, said on 24 August; exactly six months after Moscow's forces invaded Kyiv's territory.

Rugen says that while it is too early to draw firm conclusions from the ongoing conflict, so far it has validated the US Army's focus on increasing the speed, range and low-altitude abilities of its next-generation aviation fleet.

"Our technology is really stressing how we do that safely," he says of the FVL efforts.

A Sikorsky UH-60 Black Hawk pilot, Rugen cautions that the army does not want that extra flight performance to increase the cognitive load on pilots. One of the programme's goals is to offload some of those tasks to automated systems and sensors, he notes.

"The cockpit can be worried about fighting," Rugen says, referring to pilots focusing on tasks such as operating weapons and intelligence-gathering systems, and communicating with other troops, rather than flying their aircraft.

One tenet of modern warfare that has come into focus for Rugen, however, is the need for greater range.

"We want to be outside of any... weapons system's ability to engage

us, whether that be in our assembly areas or in our refuelling areas, but also at the tactical edge," he says.

Rugen cites the 2020 Nagorno-Karabakh War between Armenia and Azerbaijan, and the ongoing fighting in Ukraine, as examples where stand-off performance provided an advantage.

"Those that didn't have it had much tougher days in the fight, and those that had that stand-off were decisive against long-range fires," Rugen said during a presentation at the Center for Strategic and International Studies in Washington DC.

Extra range

That assessment backs up the FVL programme's focus on securing greater range and speed for the army's newest rotorcraft, which are expected to operate for at least 50 years. By way of comparison, its current Black Hawk was designed in the 1960s and has been serving since the late 1970s.

Rugen says FVL's "number one priority" is finding a new scout helicopter to replace the Bell OH-58 Kiowa that was mothballed because of 2013 cuts to the defence budget. The replacement Future Attack Reconnaissance Aircraft (FARA) will be small, heavily-armed and fast, with the service wanting a speed of at least 204kt (378km/h).

The two finalists in the FARA competition – Bell and Sikorsky – both say they are 90% complete with prototype demonstrator aircraft, which are set to make first flights in late 2023.

With a conventional helicopter layout, the Bell 360 Invictus is expected to better the army's speed requirement, while also

delivering low sustainment costs, the airframer says.

Sikorsky, meanwhile, is pitching the Raider X, which it claims will produce revolutionary speed and power thanks to its coaxial rotor and pusher propeller configuration.

However, before those designs go head-to-head in a fly-off, the army will first select its choice to replace the UH-60 utility rotorcraft.

Known as the Future Long-Range Assault Aircraft (FLRAA), the new type is intended to ferry troops into battle after FARA flights have cleared a path. Given the need to safely deliver soldiers to distant objectives and return home, the FLRAA platform has even greater speed and range requirements.

The army is expected to announce the winner of its FLRAA competition later this year, from a shortlist of the Bell V-280 Valor tiltrotor and a Sikorsky-Boeing team's coaxial/pusher-configuration Defiant X.

Rugen equates the changes coming from FLRAA and FARA to the post-Vietnam War fleet modernisation, which led to the introduction of the Black Hawk and Boeing AH-64 Apache attack helicopter.

He says the FVL programme was born from concerns in Congress that the US vertical-lift industrial base would suffer, and expertise be lost, since upgrades have essentially already maximised the performance of its legacy airframes.

After delivering FLRAA and FARA, Rugen says, the FVL programme has another priority: developing a fleet of cheap, plentiful unmanned air vehicles and loitering drones which could flood a future battlefield and "present dilemmas to our enemies". ▀

BA A350-1000 struck tail during go-around after prolonged float

First officer applied full nose-up pitch during missed approach procedure during which widebody briefly touched down

David Kaminski-Morrow London

UK investigators have determined that a British Airways Airbus A350-1000 suffered a tail-strike during a go-around at London Heathrow when its first officer initially applied full nose-up pitch input after the twin-jet briefly touched down.

The aircraft, inbound from Dubai on 2 January, had been arriving to runway 27L with the first officer flying the final stage of the ILS approach in gusting winds from the southwest.

After reducing thrust at about 50ft and flaring for touchdown, says the Air Accidents Investigation Branch, the first officer applied progressively more nose-up side-stick input as the jet descended through the final 10ft.

The aircraft floated about 5ft above the runway, and then started gaining height, before nose-up input reduced sharply and was then applied again as the aircraft descended.

This prolonged float meant the aircraft used up 900m (2,950ft) of runway and was reaching the end of the touchdown zone.

BA's 'safe landing' policy requires pilots to execute a go-around if the aircraft is likely to land beyond the touchdown zone. This is regardless of runway length, to avoid ambiguity, and aligns with the carrier's view that runway excursions are a greater hazard than missed approaches.

As a result – despite having



Widebody twin was conducting service from Dubai on 2 January

2,760m of runway remaining – the captain ordered a go-around.

But since the A350 was operating at idle power, the engines took several seconds to spool up to go-around thrust, and the aircraft's low height and airspeed meant it briefly touched down instead of climbing away immediately.

The first officer, however, applied full nose-up pitch before partially reducing the input.

This led the aircraft – which has a

fuselage length of 73.8m – to pitch nose-up at a rate of 3°/s, causing its tail to strike the ground as the pitch reached 9°.

Owing to an inspection of runway 27L for any debris from the tail-strike, the A350 conducted its second approach, this time with the captain flying, to runway 27R.

None of the 338 occupants was injured but the aircraft (G-XWBC) sustained skin damage in two areas of its aft lower fuselage, one of which penetrated the copper-mesh lightning protection and up to three layers of carbonfibre. The tail-strike sensor had fractured on impact, as designed, while a toilet waste panel was damaged beyond repair, and three vent pipes were found bent and abraded. ▶

2,760m

Length of runway remaining when A350's captain ordered go-around

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First delivery of supersonic airliner is scheduled for 2029; customers include major US carriers American and United



Rolls-Royce exits Boom project before Overture commences

Departure of propulsion specialist from programme and lack of obvious alternatives poses challenge for would-be airframer

Jon Hemmerdinger Tampa

Boom Supersonic seemingly faces a fundamental dilemma – where to source the engines needed to power its Overture supersonic airliner?

Colorado-based Boom had been partnered with Rolls-Royce on the programme, but the UK propulsion specialist on 8 September announced that it was exiting the project, having completed contracted engineering studies.

That on its own might not matter too much for Boom, but a host of R-R's rivals have also indicated they have no interest in supersonic civil engines, sharply reducing its options and threatening a timeline that foresees a first delivery in 2029.

GE Aviation had been tipped to step in to the Overture programme using a version of the Affinity engine it had been working on to power a supersonic business jet for now-defunct Aerion.

But the engine manufacturer rules itself out: “Civil supersonic is not a segment that we are currently pursuing,” it says.

Pratt & Whitney, another of the relatively few firms capable of developing such a powerplant, declines to comment on the Overture programme. But a top executive stresses that the company remains focused on subsonic engines.

“We haven’t added [civil supersonic] into our overall business

strategy,” P&W chief sustainability officer Graham Webb says. He calls supersonic civil aircraft “tangential” to P&W’s core market, and cites efficiency concerns.

Aerospace analysts say few other engine manufacturers could take on the Overture project. “Nobody else can do an engine in this class, realistically, although Honeywell and Safran aren’t inconceivable,” says Richard Aboulafia with Aero-Dynamic Advisory.

Staying subsonic

But those companies are also apparently out. “Honeywell has no plans right now to develop a supersonic engine for civilian aircraft,” it says.

Honeywell makes small turbofans for business jets and Leonardo’s M-346 light-attack/trainer aircraft.

“Supersonic is not part of Safran Aircraft Engines’ commercial propulsion strategy,” adds the French engine maker.

Michel Merluzeau, aerospace consultant with AIR, says International Aero Engines (IAE) could “theoretically” have an engine for Boom. A consortium including P&W, MTU Aero Engines and Japanese Aero Engines, IAE makes V2500s, which power aircraft including first-generation Airbus A320s and the Embraer C/KC-390.

“That does not, however, mean the engine can be adapted for the Overture [and] can deliver the maintenance, fuel burn and performance required,” Merluzeau says.

The Overture needs “more firm [order] commitments and a firmer industrial roadmap” to attract an engine supplier, he adds. “Without an effective propulsion system, this is a programme that is not going anywhere any time soon.”

The type is conceived as a four-engined airliner able to carry 65-80 passengers at Mach 1.7 over a distance of up to 4,250nm (7,870km).

Despite many questions, Boom founder and chief executive Blake Scholl insists Overture development is on track, and says it will soon announce an engine partner. He points to order commitments from customers including American Airlines and United Airlines.

“We would not have the customer relationships we have if the airplane that we are building was not one that the airlines wanted,” Scholl says.

Boom’s other partners include Safran Landing Systems, Collins Aerospace, fuel-system company Eaton and Northrop Grumman, which is helping with a military variant.

“I feel really good about this – very, very confident we are going to have a great answer. We are looking at multiple offers,” Scholl says.

Announcing its decision to part ways with Boom, R-R said that after “careful consideration” it had decided “the commercial aviation supersonic market is not currently a priority for us and, therefore, will not pursue further work on the programme at this time.”

US military targets accident rate

Stung by the non-combat loss of 186 aircraft and 224 lives in an eight-year review period, Pentagon convenes first meeting of Joint Safety Council

Ryan Finnerty Burlington

The US Department of Defense (DoD) has convened a service-wide aviation safety panel in response to a 2020 investigation that detailed high accident rates across the US military.

Completed at the behest of Congress, the National Commission on Military Aviation Safety (NCMAS) report revealed that US forces suffered 6,000 aviation safety incidents between 2013 and 2018, destroying 157 aircraft and causing 198 deaths. Those figures excluded combat losses.

The NCMAS assessed the destruction as costing more than \$9 billion. However, when expanded to also include 2019 and 2020, the figures grow to 186 aircraft, 224 lives and an estimated \$11.6 billion.

On 26 August, the US military followed through on a recommendation from the report when it held the first meeting of its Joint Safety Council (JSC) – a body established specifically to address defence aviation accidents.

Commercial comparison

The DoD says the JSC – chaired by US Air Force (USAF) safety chief Major General Jeanie Leavitt – will help “bridge the gap between commercial aviation practices and military aviation realities”.

The body, which is scheduled to meet quarterly, consists of representatives from the USAF, US Army, US Marine Corps (USMC), US Navy (USN) and National Guard. It will focus on “regulations and policy reforms, such as safety data standards and safety-related maintenance, supply chain, personnel management and training challenges”, the Pentagon says.

“The Joint Safety Council provides

DoD a dedicated structure to ensure military operational safety remains at the forefront of department risk management decision-making,” says Gil Cisneros, undersecretary for personnel and readiness.

In its 2020 report, the NCMAS – a panel composed of retired military aviators, a former US National Transportation Safety Board (NTSB) member and an aerospace manufacturing chief executive – cited insufficient flight hours, inadequate training, inconsistent funding and risky maintenance practices as the main culprits for accidents. It also noted that aviation squadrons faced a “relentless operations tempo”, owing to the DoD’s global posture.

Notably, the report highlighted the disparity between US military and civilian aviation safety, saying “the overwhelming majority of [military] mishaps could not be attributed to the inherent risk of military aviation”.



Igor Kovalenko/EPA/Shutterstock

NTSB data states that between 2010 and 2019, Part 121 Regularly Scheduled Air Carriers in the USA logged just over 300 accidents and 16 fatalities. Its comparable data for general aviation, which includes recreational flying and higher-risk activities such as powered parachutes and skydiving, shows rates more in line with military figures.

The DoD categorises safety incidents, which it calls “mishaps”, into

V-22s have suffered 36 accidents since 1991, including two fatal crashes this year



Three flightcrew were killed when KC-135 tanker crashed in Kyrgyzstan in May 2013



“The Joint Safety Council provides DoD a dedicated structure to ensure military operational safety remains at the forefront of department risk management decision-making”

Gil Cisneros Undersecretary for personnel and readiness, US Department of Defense

classes from A to E, depending on severity. The most serious – Class A – events are those resulting in fatalities or disabilities, damage exceeding \$2.5 million or destruction of an aircraft.

Between 2007 and 2018, the USAF, US Army and USN logged a combined Class A mishap rate of roughly 1.5 events per 100,000 flying hours: substantially higher than the commercial sector’s 0.17 rate, the NCMAS investigation found.

Data deficiency

The USMC’s figures were substantially worse, however, exceeding two Class A accidents per 100,000 flying hours for most of 2007-2018. The service’s rolling rate of such accidents has steadily increased since 2009, even while the other services’ rates remained flat or declined.

In a bid to bring down the accident rate, the NCMAS report recommended that the JSC be formed, to establish universal military aviation standards across the Pentagon’s sprawling bureaucracy. Such a body should be empowered to collect and analyse safety data, which the NCMAS noted was sorely deficient within the DoD.

Congress obliged, ordering the council’s creation. But if the intent was to sidestep the Pentagon’s labyrinthine hierarchy, the NCMAS may yet be frustrated. According to the DoD, its new body falls under the Defense Safety Oversight Council and the Deputy’s Workforce Council and Management Action Group. ▶

How Osprey introduction hit Marine Corps’ loss statistics

While the National Commission on Military Aviation Safety’s report did not provide details about specific accidents, the study’s timeline roughly coincides with the US Marine Corps’ (USMC’s) adoption of the Bell Boeing V-22.

Developed as a high-speed replacement for the service’s Sikorsky CH-53D Sea Stallions, the tiltrotor type achieved initial operational capability in 2007.

The \$71 million Osprey has been involved in numerous crashes, many of them fatal, and the subject of intense scrutiny. Between 1991 and 2022, V-22s suffered 36 accidents, according to the Aviation Safety Network,

a service of the US non-profit Flight Safety Foundation.

Two fatal and one non-fatal crashes involving the type have occurred so far this year, including an 18 March loss in which four personnel were killed during a training flight in Norway.

The family of a marine killed in a 2015 V-22 crash in Hawaii unsuccessfully sued Bell Textron, Boeing, Eaton Aerospace and the federal government over that incident. A USMC investigation found that excessive dust caused a catastrophic engine stall.

Military leaders and the V-22’s designers attribute some of the issues to early difficulties with the

tiltrotor’s revolutionary design, and insist that safety concerns have been addressed. Following an 8 June crash in California that killed five marines, a senior member of Boeing’s vertical lift team told FlightGlobal he is “very confident” in the type, noting its 600,000 safe flying hours.

Cirium fleets data records the USMC as currently operating 301 MV-22s. Other operators are the US Air Force, with 52 CV-22s, the US Navy, which uses 19 CMV-model examples, and international customer the Japan Ground Self-Defence Force, which has fielded four of an eventual 14 MV-22s.

Tired pilots allowed Convair to stall on landing, says NTSB

Investigators believe fatigue was behind 2019 fatal crash of cargo aircraft on approach to Toledo airport in Ohio

Jon Hemmerdinger Tampa

US investigators have concluded that fatigue-induced errors were behind the September 2019 stall and fatal crash of a Convair 440 cargo aircraft near Toledo, Ohio.

In its final report into the accident, which took place in the early hours of 11 September, the National Transportation Safety Board (NTSB) says the crash was caused by “the flightcrew’s failure to maintain the proper airspeed on final approach”.

This led to “an inadvertent aerodynamic stall and impact with trees and terrain”, killing both pilots.

But the NTSB notes that pilot tiredness was a significant factor in the accident, which occurred at 02:39 local time: “Contributing to the accident was the flightcrew’s fatigue due to the overnight flight schedule,” it says.

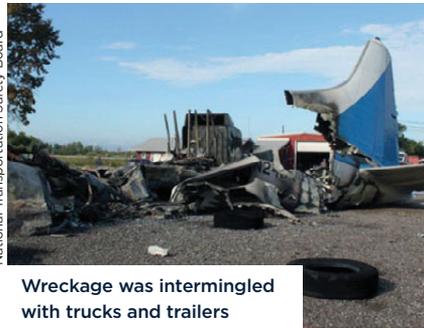
The crew had started their flight the previous evening when they departed Laredo International airport in Texas at 18:38 on 10 September, bound for Millington-Memphis airport in Tennessee, where they landed at 22:10.

After refuelling, the Convair (N24DR) departed Millington at 23:14 for a flight to Eugene F Kranz Toledo Express airport. The pilots began descending several hours later, when about 34nm (63km) southwest of their destination.

At about 02:35, a controller cleared the aircraft for a visual approach to Toledo’s runway 25.

During final approach, the aircraft’s airspeed decayed to 70-75kt (130-139km/h) – at or below stall speed for the aircraft type in a landing configuration, the NTSB says.

“The aircraft became briefly established on final approach before radar contact was lost,” it says. However, the aircraft collided with trees and terrain about 0.65 miles (1km) northeast of the runway arrival threshold.



Wreckage was intermingled with trucks and trailers

Initial strikes were at about 55ft above ground level, says the NTSB, and were consistent with a right bank angle of 20°.

Having continued through the wooded area, “the airplane came to rest in a trucking company parking lot about 0.50 miles from the threshold and near the extended centreline of the runway”, the report adds. A post-impact fire then ensued.

Wreckage field

Wreckage was found “intermingled with the trucks and trailers parked in the lot” and “portions of airplane structure were located in the woods immediately east of the accident site”.

Although large sections of the aircraft sustained fire damage, an examination of the airframe showed no evidence of pre-impact structural failure, says the NTSB. In addition, analysis of both Pratt & Whitney R2800-52W reciprocating

engines found no evidence of pre-crash malfunction; damage to the powerplants and propeller strike marks on ground vehicles were consistent with the engines producing power, it adds.

Meteorological conditions at the time of the accident were benign: visibility was clear with no cloud cover, and there was a 4kt wind from the southwest.

Investigators say that the pilots failed to maintain proper airspeed and did not recognise an impending stall.

“Their performance was likely impaired by fatigue, resulting from both the total duration of the overnight flights and the approach being conducted in the window of the circadian low,” it says.

Operated by Ferreteria e Implementos San Francisco, the Convair 440 was manufactured in 1957 and had logged more than 47,700 flight hours at the time of the accident. ▀

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Domestic blades help Ansat cut Western ties

Sanctions imposed on Russian aerospace industry are accelerating local production initiatives

Dominic Perry London

Russian Helicopters is continuing its efforts to develop locally-produced components for its rotorcraft range in the face of Western sanctions against the country's aerospace industry.

New-generation rotor blades have now been developed domestically for the Ansat light-twin made from polymer composite material, says the manufacturer; they will be installed on the "import-substitution" version of the helicopter.

Although Russian Helicopters touts the "improved aerodynamic properties" and enhanced "flight performance" from the new blades, it is likely their development has been necessary to address the shortfall of Western-supplied composite materials.

Bench testing of the prototype main and tail rotor blades – a joint development between Kazan and Russia's TsAGI central aerohydrodynamic institute – is under way, leading to a first flight of an Ansat equipped with the new blades towards the end of 2023.

Mass production for new aircraft is planned for 2024, with the potential for retrofit also being analysed, the manufacturer says.

Russian Helicopters claims the new blades, which are equipped with limited icing protection, will enable an improved rate of climb, and cruise speed will increase to 126kt (235km/h), from 118kt. Maximum take-off weight will also rise by 200kg (440lb), to 3.8t.

Engine dependence

Despite strong sales, notably for emergency medical services missions in Russia, the Ansat is heavily reliant on Western content, particularly its Pratt & Whitney Canada PW207K engines.

Russian Helicopters was already seeking to add a domestically produced powerplant to the Ansat before the imposition of sanctions, working with United Engine (UEC) to integrate the 650shp (485kW)-rated Klimov VK-650V.

Flight tests of an Ansat equipped with a VK-650V are scheduled for 2023, leading to Russian certification in 2024, UEC said in May.

Meanwhile, European regulators

have certificated the PW207K – but thanks to the continued sanctions against Russia, the approval is largely academic.

Updating the type certification documents for the PW207, the European Union Aviation Safety Agency (EASA) revealed it had validated the K-model variant on 8 August.

Although the engine series powers multiple rotorcraft types, the PW207K has a single application on the Ansat.

Cirium data reveals that more than 100 PW207K-equipped Ansats had been delivered since the start of production.

Russian Helicopters had planned to market the Ansat-M, the latest model of the currently 3.6t type, in Europe as a rugged utility platform.

Speaking to FlightGlobal last year, then-director general Andrey Boginsky said he saw an opportunity to sell the Ansat-M in the West once development was completed.

Marketing aim

The helicopter would provide "an opportunity" to take the competition to Airbus and Leonardo Helicopters on their home turf; in the Russian market his two European rivals "come here and communicate with our customers – we should have such an opportunity too", he said.

Gaining EASA approval for the engine was a key precursor to that marketing effort. P&WC confirms the 8 August update was "the completion of the certification process for the PW207K helicopter engine that began before the sanctions were imposed.

"At this time, there are no other applications being considered for the PW207K," it adds.

The sanctions have killed any hope – certainly in the medium term – of securing business in the bloc. Type certification for the only Russian-built helicopter to be approved by EASA – the Kamov Ka-32 – was suspended in March. ▀



AirTeamImages

Ansat has seen strong sales for Russian emergency medical services operations

Company will make majority of components in-house



Hill Helicopters delays first HX50 delivery as orders ratchet up

Fledgling rotorcraft manufacturer progresses development programme and eyes Midlands site for new factory

Dominic Perry London

UK start-up Hill Helicopters has pushed back the service entry of its clean-sheet HX50 light-single until late 2024 owing to the complexity of the project, which sees the company manufacture virtually the entire rotorcraft in-house.

Speaking during a customer event in August, company founder and chief executive Dr Jason Hill said that based on the engineering work so far conducted “we know the time [required] much more accurately”.

When the programme broke cover in 2020, a maiden sortie was targeted for this year, followed by first customer delivery in August 2023.

But that timeline has now slipped: first flight is expected in late 2023 or early 2024, Dr Hill says; initial customer deliveries are expected “around the end of 2024”, the firm adds.

Hill Helicopters’ strategy is to build a composite, turbine-powered helicopter, initially for private use only, which retails for around £500,000 (\$595,000). It aims to achieve this price point through vertical integration – manufacturing

the vast majority of components in-house, including the GT50 engine – to enable tight cost control, fast-paced development “and the complete freedom to innovate”.

In addition, the HX50 will not be a fully certificated aircraft. Instead, Hill Helicopters will seek an initial type approval from the UK Civil Aviation Authority – equivalent to that for a European Union Aviation Safety Agency CS-27 aircraft. The rotorcraft will be provided to customers with what the company describes as “amateur-built airworthiness approval”.

Kit-built construction

To achieve that, customers are required to assemble 51% of the helicopter – excluding its engine and dynamic components – during a two-week course at Hill Helicopters’ UK facility.

A certificated version of the rotorcraft will follow called the HC50; Hill Helicopters sees no delay to this variant, which should arrive in mid- to late 2026.

Bench runs of the initial GT50 were due to take place this summer, but that milestone will now be achieved in the first half of 2023, the company says.

A total of three pre-production aircraft are to be built; the initial helicopter will perform the bulk of the test flights, while its two sister ships will “be sent off on their travels” to conduct extreme-conditions testing, Dr Hill says.

To date, Hill Helicopters has accumulated orders for 627 helicopters: 516 HX50s and 111 HC50s, up from respective figures of 373 and 59 in late January.

Both the HX50 and HC50 will be built at a new 31,100sq m (335,000sq ft) factory in the UK. Hill Helicopters has identified a site near Cresswell in the English Midlands where it intends to build the factory and has applied for the requisite planning permissions.

Hill Helicopters is developing the HX50 across several industrial units near Rugby, around 15 miles (25km) from the planned factory location.

Testing times

Dr Hill says the plant will be capable of assembling up to 1,000 helicopters per year at full-rate production, but this will be limited to a maximum of 500 in the first year.

Hill Helicopters states that each rotorcraft will require a total of 5h of testing with the engine running: 1h on the ground, 2h of hover tests and 2h of flight testing.

“During this programme of testing, we estimate an average of 10 arrivals or departures from the site per aircraft,” it says.

Customer visits and training flights will also add additional helicopter movements.

However, local residents are for the most part strongly opposed to the location of a helicopter factory on their doorstep, largely on the grounds of noise.

A public consultation on the plans ran until 7 September, with a decision expected shortly.

Accounts for the year ended 31 July 2021 – its first year of operation – show that Hill Helicopters made a pre-tax loss in the period of £3.36 million, following investments in development activities of £1.81 million and recharges from other Hill Group companies of £1.55 million.

Deposits worth £16.6 million were received during the year covering 245 units, the accounts state. In the post-balance sheet period, another £13.2 million for 332 helicopters was received. Hill Helicopters says the 577 aircraft represent a total orderbook value of £240 million. ▀

Hill Helicopters

Beyond carbon

Assessment of an aircraft's environmental performance must be based on more than just exhaust emissions and should also consider how it is built, argues **Professor Iain Gray**

I have been in the industry for 40 years and I still do not always know the difference between the overall environmental impact of one type of aircraft design and another. I could make a subjective call but not a quantitative one – at this stage, who could?

The industry knows the only workable business models for the future will be built on low environmental impact. The whole sector has been galvanised, investing billions. But what makes aviation genuinely sustainable; what kind of definition is being used? For the moment it is looking like a very important but narrow version: a matter of reducing carbon dioxide emissions in flight.

We need to take a far more detailed and holistic view – not just the one rating around the type and level of fuel use. Maybe that means a second rating that demonstrates an understanding – and accountability – for an aircraft's entire lifecycle.

Fuel burn and emissions are always going to be important, but they should not be the only measure. There are many other factors across the life of an aircraft that could leave a heavy footprint on the environment.

Every choice made from the beginning of the design process matters in terms of long-term efficiency and overall sustainability. Which materials are used for a design has implications: will there be a need for rare earth metals, where are they coming from, and what is the impact of the mining operations involved? It is an issue which is becoming more problematic for the automotive sector as the demand for electric vehicles grows and the pressures build on rare earth metals – notably lithium and cobalt – needed for battery production.

What is the footprint from using composites? Is there potential to reduce wasted materials by using an additive rather than the traditional subtractive manufacturing? A typical airframe panel starts with ten or more times material than finally



Cranfield University

goes onto the actual aircraft. Cranfield University research around additive manufacturing projects in the aerospace and oil and gas industries has suggested savings of up to 80% in terms of the quantity needed of an energy-intensive material such as titanium; along with 70% lower manufacturing costs.

Smarter sourcing

Then there is the supply chain. Aircraft tend to be built as a jigsaw of elements and materials flown and shipped in from different parts of the world, raising questions over how far this is necessary, and whether there could be smarter, local sourcing and manufacture.

Different aircraft designs necessitate different maintenance requirements through their life, meaning there is potential for looking at ways to minimise the demand for more new materials – as well as thinking about end-of-life and disposal of the aircraft, and how more elements can be re-used or at least recycled.

These are some of the issues that will be addressed in the 2022 National Manufacturing Debate on 29 November, as part of Manufacturing and Materials Week in the UK, gauging the latest thinking across sectors including aerospace, and setting out best practice and next steps.

Compared with many other sectors, aviation is working with a more rigid set of parameters. Introducing changes to designs, materials and manufacturing processes is not easy – and nor should it be. Design cycles are long and expensive and need to continue to be backed up with demonstration and certification phases. The sector's reputation for safety based on the careful introduction of incremental change is long-established and needs to be protected.

What that means is that senior industry managers need to start building sustainability and environmental impact into their thinking, and at every decision point.

Passengers need to be part of the education process around genuine sustainability. How long is it before the flight-booking process involves looking at an aircraft rating for all-round environmental performance, just like we would when buying a home or electrical appliance? ▀

Professor Iain Gray is Director of Aerospace at Cranfield University

Manufacturing and Materials Week events will run between 28-30 November 2022 at Cranfield University: www.cranfield.ac.uk/events/satm-manufacturing-and-materials-week-2022



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The Israeli air force will receive four Boeing KC-46A tankers by 2026, under a deal worth \$927 million



US Air Force

Lufthansa welcomed its lead Boeing 787, with the -9 (D-ABPA) one of an eventual 32 Dreamliners to be flown by the German flag carrier



Oliver Roessler/Lufthansa

Vietjet Air reaffirmed an order for 200 Boeing 737 Max-family narrowbodies, now covering shipments between 2024 and 2028



Vietjet Air



Embraer launched flight-testing of a first C-390 transport for Portugal. Lisbon has ordered five, to be delivered from 2023

Edelweiss Air will add a fifth Airbus A340-300 to its fleet next July, sourcing the widebody (HB-JMC) from sister operator Swiss



Jérôme/ Shutterstock

Best of the rest

We showcase some of the other notable events covered by the FlightGlobal team between issues



Harbour Air completed a debut 24min flight from Vancouver to Victoria with its De Havilland Canada DHC-2 Beaver "ePlane"

Harbour Air



Leonardo Helicopters' AW249 attack helicopter got airborne, with service entry with the Italian army due in 2025

Next month

Our training special looks at the pilot shortage as US carriers react



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Why mental health must become a key element on checklist for airlines

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Destination Bahrain: Gulf state gets set for first gathering since 2018

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The annual NBAA convention rarely disappoints – and with the US market in robust health and sustainability driving huge advances in technology, this year’s event in Orlando is sure to be memorable



Curtain up

Murdo Morrison London

As pandemics go, business aviation had a good one. With commercial travel disrupted and concerns about catching the virus on busy airliners, many who could afford it switched to flying private – some for the first time. This shift meant the sector became a rare bright light for the wider industry in 2020 and early 2021, and that upbeat trend is continuing as the community prepares for its annual US get together, the National Business Aviation Association’s (NBAA’s) BACE in Orlando, from 18-20 October.

Particularly in the USA, business aviation is as healthy as it has been since before Covid-19. Orders are outstripping deliveries and used aircraft remain hard to find and expensive. Chaos at airports and unreliable airline schedules are convincing converts that their decision to abandon commercial was right. In August, Bombardier chief executive Eric Martel said the airlines’ troubles were continuing to be “accelerators” for business aviation, even with Covid-19 largely in the rear-view mirror.

That does not mean there are no troubles ahead. Soaring fuel costs and inflation generally are causing consumer and small-business confidence to wobble. Europe’s energy crisis – a side effect of dependence on Russian gas – could push the region into recession this winter. There are also shortages and delays throughout the aerospace supply chain (see p50). “It’s setting up as natural cyclical slowdown,” remarks Rolland Vincent of the Rolland Vincent Associates consultancy.

Building margins

For aircraft manufacturers, however, prospects remain broadly positive. While difficulties in sourcing raw materials and skilled staff, combined with worries over the viability of small suppliers, are causing headaches, book to bill ratios of almost two to one mean it is a “great time to build margins”, says Vincent. Weakening demand for charter services would be the first sign of a downturn, he adds, but there is no hint of that happening so far.

Operators bear this out. Jim Segrave, founder and chief executive of FlyExclusive – one of the largest US charter providers – says people who began flying



NBAA is returning to Orlando for the first time since 2018

BillyPax

private during the pandemic are staying loyal. “Once you are in you don’t want to get out,” he says. Parts and crew shortages, threatening dispatch reliability, are much bigger challenges than finding customers. “We have more demand than we can supply,” he adds.

Lou Pepper, chief executive of fixed-base operator Atlantic Aviation, reckons clients new to the sector have expanded the industry by a fifth since the pandemic. “The combination of people wanting to get out of cities and the horrendous service provided by airlines drove people who were not users of [general aviation] to buy hours or charter a plane,” he says. “We always felt that was going to be sticky. Once they tried it, people realised how convenient and affordable it is.”

Greg Pitts, chief executive of aircraft broker Advanced Aviation Team, sees signs of aircraft

drawn a large and enthusiastic domestic audience, only a handful of foreign visitors made it to Las Vegas because the USA was still imposing border closures.

The industry’s push to become more sustainable and the so-called advanced air mobility (AAM) sector will be major themes of this year’s convention, as they were at its European counterpart EBACE in May. While disruptive propulsion technology will doubtless be a topic of discussion, sustainable aviation fuel (SAF) remains the best short-term hope for the industry in its drive to cut its carbon footprint. However, as in Europe, the fuel remains expensive and in short supply at airports.

In August, US President Joe Biden signed into law the Inflation Reduction Act, which includes a tax credit for producers of SAF, a move NBAA welcomes. “We have long advocated for this blenders’ tax credit as a vital step to fulfilling our industry’s pledge to achieve net-zero CO2 emissions,” says president and chief executive Ed Bolen. “Implementation of this credit marks genuine progress towards increasing SAF production, promoting greater availability, and reducing costs to end users.”

536

Turbine aircraft delivered in the first half of 2022 (including 289 business jets) – compared with 485 in first half 2021

availability “loosening up” after a year in which sourcing equipment had become very difficult. He believes this was largely down to private owners being cautious about releasing their aircraft to third parties during the pandemic. However, he too believes demand for charter will hold up, despite high prices. “We get a lot of charter requests from people who don’t want to deal with airlines,” he says.

Although the General Aviation Manufacturers Association (GAMA) will not publish aircraft sales for the third quarter until after the NBAA convention, half-year figures indicate an industry in strong recovery after a significant dip in 2020. Airframers shipped 536 turbine aircraft, including 289 business jets, in the six months to end-June, compared with 485 (264 of them jets) in the same period in 2021. For the last full year, GAMA reported 1,237 deliveries (710 jets) against 1,087 (644) in 2020.

This year’s convention returns to its alternate-year home, Orlando, for the first time since 2018 after the Covid-19-forced cancellation of the 2020 edition. This will also be the first NBAA BACE in three years that will be fully open to overseas exhibitors and attendees. While the return of the show in October 2021

New environment

The USA is meanwhile making strides towards creating the operational and regulatory environment for a new breed of electric vertical take-off and landing (eVTOL) air taxis, with Congress recently passing the Advanced Aviation Infrastructure Modernization Act. The legislation authorises funding for so-called vertiports and other public transport facilities to support AAM operations. Two workshop sessions at BACE will focus on the AAM opportunity for the business aviation sector.

The Orlando event will also feature the Emerging Technology Zone, highlighting AAM aircraft and technologies. “These platforms hold the promise to revolutionise short distance, zero-emissions transport in the near future,” says NBAA director of aircraft displays Joe Hart. “NBAA-BACE, like business aviation, always has an eye to the horizon. We’re excited about showcasing these promising emerging technologies that point our industry’s way to a bright future.”

According to the organisation, every mainstream manufacturer is attending, with exhibition space close to sold out by mid-September. Airframers often hold their cards close when it comes to revealing what newer types they will be displaying, even days before the event, but NBAA has no doubt that the static exhibit at Orlando Executive airport will feature “the most advanced and dynamic aircraft line-up ever seen” at the business aviation show. ■

Long-range leaders

A trio of manufacturers developing a new breed of ultra-long-range business jets are battling to bring key suppliers up to pace as they respond to soaring demand for private travel



Bombardier plans to have the Global 8000 ready for service entry in 2025

Jon Hemmerdinger Tampa

Divergence between supply and demand has left manufacturers of large-cabin business jets with flush backlogs – and plenty of problems that need solving.

In short, demand is through the roof but supply is stuck at ground level.

That is the reality facing companies such as Bombardier, Dassault Aviation and Gulfstream – and, indeed, their counterparts in the commercial aviation sector.

Despite the Covid-19 pandemic (or perhaps because of it) business jet makers have been rapidly taking new orders for the \$70 million-plus machines that occupy the upper echelon of the private-travel market, adding billions of dollars to their backlogs. Demand has also prompted the three main players to up their games by rolling out even-more-expensive models, including those that crack the 8,000nm (14,800km)-range barrier.

But such strong underlying dynamics belie real challenges. Owing to factors including Covid-19, inflation, economic slowdowns and geopolitical tension, business jet manufacturers are coping with significant supply chain troubles. Those challenges have left them scrambling to maintain production at current levels and raised questions about their ability to meet demand.

Daily battle

“Manufacturers in the large-cabin segment will find themselves unable to execute to keep up with demand at a time of surging orders,” says analyst Brian Foley, founder of aerospace consultancy Brian Foley Associates. “There will be few alternatives for those wanting delivery of a new large-cabin aircraft in the near future.”

Foley’s observations are mirrored in recent comments made by executives at the airframers.

“Supply chain is definitely... an ongoing issue for the industry,” Jason Aiken, chief financial officer of Gulfstream parent General Dynamics, said during a 27 July earnings call. “It’s a daily battle.”

“Dealing with supply chain pressure is a new normal,” Bombardier chief executive Eric Martel said

“Over the last few months, we have been very active in... assessing where it makes sense to repatriate or consolidate small work packages or parts, to ensure our production line can operate as efficiently as possible”

Eric Martel Chief executive, Bombardier

on 4 August, also during an earnings call. “Over the last few months, we have been very active in... assessing where it makes sense to repatriate or consolidate small work packages or parts, to ensure our production line can operate as efficiently as possible.”

The airframers join companies across aerospace in facing parts shortages. Insiders say pandemic-disrupted logistics networks (and China’s lockdowns) are to blame, as are a lack of enough skilled workers, and economic sanctions against Russia imposed by Western powers in response to Moscow’s February invasion of Ukraine. The aerospace industry shrank rapidly in 2020 because of the pandemic and has struggled to regain footing.

As a result, Foley notes, business aircraft manufacturers are largely keeping 2022 production output flat at 2021 levels. They have far to go before returning to pre-pandemic production rates.

Bombardier, for example, delivered 49 aircraft in the first half of 2022 and anticipates ending the year with more than 120 deliveries, including about 40 of its



Gulfstream's G800 boasts a maximum range of 8,000nm

flagship Global 7500. Similarly, the company delivered 120 aircraft last year. By comparison, the Montreal manufacturer delivered 142 business jets in pre-Covid 2019.

Martel says suppliers in various areas of the chain are struggling to ramp up. He also cites “risk” associated with the supply of engines. Executives at other manufacturers have also recently highlighted such equipment troubles, including Boeing chief executive David Calhoun, who has cited engine shortages as a central factor limiting 737 production.

Martel insists Bombardier is working through supply shortages. He says the company aims to increase production by 15-20% in 2023, which would equate to somewhere around 140 aircraft deliveries.

“We have been extremely meticulous in planning, in detail, every ramp up, taking into account that we don’t want to have too much backlog – or not enough,” Martel says. “On top of it, we are taking great note of what the strains in the supply chains are today.”

In a proactive move, Bombardier this year acquired Schrillo, a California company that produced a Global 7500 wing component. Schrillo had been struggling financially – so to prevent a shortage, the airframer simply bought the firm, including its machinery, intellectual property and inventory. Schrillo’s staff are now Bombardier employees, it says.



Dassault Aviation

Supply chain issues could impact late 2025 schedule for arrival of Dassault's in-development Falcon 10X

】 Gulfstream's 2022 delivery target mirrors Bombardier's. The Savannah airframer delivered 47 jets in the first half of 2022 and expects to hand over roughly 123 aircraft this year, nearly flat from its 119 deliveries in 2021, General Dynamics has said. Those figures remain significantly depressed from 2019, when Gulfstream handed over 147 aircraft.

Supply-driven production constraints are at work, say executives. In January, General Dynamics chief executive Phebe Novakovic said Gulfstream was dealing with short supply of wings, which it makes in-house.

Gulfstream has, meanwhile, worked through other complications. In May, the US Federal Aviation Administration (FAA) significantly limited G500 and G600 operations, prohibiting the jets from landing in wind speeds exceeding 15kt (28km/h) and wind gusts of more than 5kt. The move was in response to two hard landings during windy conditions caused by erroneous activation of the jets' angle-of-attack (AoA) "limiter" function, which is designed to prevent stalls.

Development delays

Gulfstream developed a software fix which the FAA and European Union Aviation Safety Agency approved in mid-September. But the problem has trickled into its delivery stream.

In the second quarter, the airframer handed over only 22 aircraft. It had planned to deliver four more – all G500s/G600s – in the period, but customers deferred taking those aircraft pending "removal of the FAA wind directive". Gulfstream did, however, deliver nine G500s/G600s despite the operating restrictions.

The issue also has affected Gulfstream's development and certification of its flagship G700 and G800 ultra-long-range jets. General Dynamics had in April warned about possible delays to those certification programmes, citing FAA scrutiny of software.

Then, in July, Aiken said Gulfstream had reassigned "flight sciences engineering resources" from the G700 programme to work on resolving the G500/G600 AoA problem. As a result, the G700/G800 certification delay has "become a reality", he said.

Gulfstream now expects the G700 will be certificated by mid-2023, with the G800 to follow about six months later. Previously, it was aiming to achieve the milestones by the end of 2022 and mid-2023 respectively. The company's first test G800 made its flight debut in late June, before being flown to the UK to attend the Farnborough air show in mid-July.

Dassault is facing similar supply chain and production hurdles. In July, the French company cited Russia's war in Ukraine and lingering Covid-19 effects as causing inflation and "uncertainty over the supply of energy, electronic components and materials".

The company, which also has a large defence aviation business, described the supply chain as "weakened". It called out shortages of raw materials, including aluminium and titanium. Sanctions against Moscow have thrown the titanium market into disarray, as Russia had been among the world's leading suppliers.

"We need to safeguard existing sources, or urgently find reliable alternatives. We are endeavouring to build up inventories to secure production for the coming years," Dassault added. "We have placed

orders, but we will need to monitor physical deliveries over the next few weeks.”

Amid such pressure, the airframer delivered 14 Falcon-series jets in the first half of 2022 – up significantly from six shipments in the first half of the previous year.

For full-year 2022, Dassault expects to deliver 35 Falcons. That would be up from 30 examples handed over last year, but down from 40 in pre-pandemic 2019.

The airframer has also been dealing with company-specific challenges on top of industry and geopolitical troubles.

“Dassault missed the order surge” of recent years, says Foley, after cancelling development of its 5,200nm-range Falcon 5X in 2017. It shuttered the programme following problems with the type’s Safran Aircraft Engines Silvercrest turbofan.

Seller’s market

Dassault replaced the 5X with the 6X, launched in 2018, but the debacle put the company behind competitors, Foley says. The 6X, with 5,500nm of range, competes in the same segment as Gulfstream’s G500 and G600, and Bombardier’s Global 5500 and 6500.

In May, Dassault announced a six-month delay to the 6X’s service entry, to mid-2023, blaming supply chain trouble.

Production constraints aside, business jet makers are having no trouble at all selling aircraft.

Dassault logged orders for 41 Falcons in the first half of 2022, up from 25 in the same period last year.

The company ended June with 82 Falcons in its backlog, worth €4.3 billion (\$4.3 billion), up from a €2.9 billion backlog with 53 orders one year earlier.

Bombardier’s backlog surged by 37% in one year, to reach \$14.7 billion at the end of June. It holds orders equating to two years of production, Martel says.

Demand, he adds, has been particularly strong from US customers. Bombardier also sees “improving” sales activity from Europe despite the Russia-Ukraine war, and has seen reviving demand from the Asia-Pacific region following a two-year Covid-induced slowdown. Broadly, Martel calls the pandemic an “accelerator for people moving towards private jet” travel.

Similarly, General Dynamics’ aerospace business (which is anchored by Gulfstream but includes aviation services provider Jet Aviation) closed June with a backlog worth \$18.8 billion, up 39% in one year.

Amid roaring demand, the large-cabin competitors have continued bettering each other by rolling out larger and longer-range models.

82

Dassault’s backlog of Falcon-family orders at the end of June 2022, equivalent to \$4.3 billion in value

G500 (pictured) and G600 deliveries were slowed due to FAA operating restrictions



AirTeamimages

“There’s a lot of talk out in the market about interest rates, inflation, the stock market, recession potential and so on”

Jason Aiken Chief financial officer, General Dynamics

Gulfstream set a new range standard in October 2021 when it launched the G800, with an advertised maximum range of 8,000nm.

Not to be outdone, Bombardier shot back in May by revealing plans to bring the long-promised Global 8000, also with 8,000nm of range, to service in 2025. The platform will be a modified version of the Global 7500, which has 7,700nm of range.

Dassault is also targeting the ultra-long-range market with its in-development Falcon 10X, a 7,500nm-range aircraft pegged for a late 2025 service entry. But in July, Dassault warned of delays, saying the 10X “calendar is tight because of difficulties related to Covid, with its impact on the supply chain”.

Still hot

There is some evidence the large-cabin segment has cooled of late, amid inflation, a US recession and stagnant economic growth in Europe, says aerospace analyst Richard Aboulafia of AeroDynamic Advisory.

“It was white hot. Now it’s just hot,” he says. “It has eased a little bit.”

But if souring economic conditions are worrying the leaders of business jet manufacturers, they are not showing it. Martel does not foresee a spike in order cancellations and says Bombardier is “in a great position” to weather a potential economic slump.

General Dynamics’ Aiken agrees. “There’s a lot of talk out in the market about interest rates, inflation, the stock market, recession potential and so on,” he said in July. “We have not yet seen any impact of that, in terms of our order pipeline.

“We remain very confident and steadfast in our outlook for the next couple of years,” he adds. ▀

Eyeing a lucrative gap in the market for a 4,200nm-range jet with large-cabin comfort, Gulfstream has embarked on its G400 development with lofty expectations

Sweet spot

Jon Hemmerdinger Savannah
Cutaway **Tim Hall**

Gulfstream's in-development G400 will round out the airframer's family of large-cabin business jets, filling a market niche seen by many observers as ripe with opportunity.

The Savannah company revealed development of the up to 12-passenger G400 at an event in October 2021. That same night, it also disclosed the development of a larger, 19-passenger jet called the G800, which perhaps received the most attention because, during the event, it rolled out the first G800 test aircraft.

Today, there is no G400 to lay eyes on; Gulfstream has yet to unveil the first flight-test example, though assembly is ongoing.

High spec

Still, the smaller type stands to make considerable waves in the wedge of market space it occupies – the lower end of the large-cabin segment. Jets in this category are not ultra-long-range globe-crossing machines, but rather incredibly high-end aircraft with spacious cabins designed more for continental than transoceanic flying.

Analysts say the space has grown stale in recent decades. They note that, initially at least, only two other jets will compete directly with the G400, and both are updates of decades-old platforms.

That gives Gulfstream an advantage, says the airframer's president, Mark Burns.

"Most of [the] airplanes that are in that space now have been there for a while," he tells FlightGlobal. "This is a new generation of airplane – much more efficient engines, much more efficient operations, lower ownership costs."

Gulfstream, a division of General Dynamics, aims to deliver the first G400, priced at \$34.5 million, in 2025.

Boasting a 4,200nm (7,770km) range, the G400 fills a gap in Gulfstream's line-up, occupying space between its super-midsize, 10-passenger G280 and the 19-passenger, large-cabin G500.

The G500 and G600, launched by Gulfstream in 2014, are the G400's sister ships. Burns says the company's long-term plan always called for development of the third family member.

The three jets – known internally by Gulfstream as its "Advanced Aircraft Programs" – share fuselage cross-sections and other technologies, such as the airframer's Symmetry Flight Deck, which includes touchscreens, active-control sidesticks and a "Predictive Landing Performance System" that warns pilots of possible runway overruns.

Gulfstream's other large-cabin jets include the G700 and G800 – ultra-long-range, Rolls-Royce Pearl 700-powered sister ships that compose a separate aircraft family. It is developing and testing these in tandem and aims for the first G700 to enter service by mid-2023, with the G800 following in early 2024.

The G400 will have twin Pratt & Whitney Canada

"This is a new generation of airplane – much more efficient engines, much more efficient operations, lower ownership costs"

Mark Burns President, Gulfstream

Deliveries of the up to 12-passenger
G400 are due to start in 2025



▶ PW812GA engines – certificated by Transport Canada in mid-September – each developing almost 13,500lb (60kN) of thrust. The new model will hit its maximum 4,200nm range when cruising at Mach 0.85. Maximum cruise speed will be M0.88.

By comparison, the G500 has a range of 5,300nm, and the G600 6,600nm. Those jets have different variants of the PW800: 15,140lb-thrust PW814GAs for the G500 and 15,680lb-thrust PW815GAs for the G600.

The G400 will be the smallest Gulfstream large-cabin model, although not by much. The type will measure almost 26.3m (86ft 3in) from nose to tail. Its cabin will stretch 11.07m from front to back, excluding the baggage compartment. Those figures are each about 1.5m shorter than the G500's specifications. The G400's cabin will be 1.88m high and 2.31m wide – the same as on the G500 and G600.

Capable of cruising at 51,000ft and M0.9, it will need 1,520m of runway to get airborne at its maximum take-off weight of almost 31,700kg (69,850lb).

Lab testing

The jet's characteristics are "very similar" to those of the G450 – a 4,350nm-range model that the company stopped producing in 2018 – says Gulfstream senior vice-president of innovation, engineering and flight Vicki Britt.

As with Gulfstream's other jets, the G400's complex systems undergo rigorous testing in a Savannah research and development facility called RDC III. The site houses several labs at which technicians test the integration of various systems, including avionics, flight controls and a data concentration network (DCN) – a hub through which major systems connect.

The labs vary from bench test facilities – to evaluate systems integration with the DCN, for example, or whole-aircraft integration – and iron bird rigs where Gulfstream combines digital and mechanical systems.

Along with developing new aircraft, Gulfstream has been expanding its service offerings in recent years, adding aftermarket capability in Appleton (Wisconsin), Fort Worth (Texas), Mesa (Arizona), Palm Beach (Florida), and Van Nuys (California) in the USA and Farnborough, UK.

Five G400s will participate in the flight-test and certification programme, including one employed for cabin testing, Britt says. By comparison, Gulfstream is using only three test aircraft, including one for the cabin, for its G800 programme. That is partly because some certification work completed for the G700 will carry over to the G800 – a benefit made possible by the many similarities between the two jets, Britt says.

The G400's certification will be more involved owing to several factors. Those include the amount of time elapsed since the US Federal Aviation Administration certificated the G500 (in 2018) and the G600 (2019), and the G400's use of a different engine variant, says Britt.

In recent years, "the rigour with which we have had to do some of our testing, especially in the labs, significantly increased the workload," she says.

"The 400 will have to go through more than the 500 and the 600... from a software testing standpoint," Britt adds. "There [are] some things that haven't been addressed from a certification standpoint."

The G400's cabin accommodates two-and-a-half distinct living areas, and Gulfstream offers nine-, 11- or 12-passenger cabin configurations. Depending on the selected arrangement, it has sleeping accommodations for four or five people. The cabin has five windows per side and electric-controlled shades.

"It's probably just the right product at the right time," says Gulfstream director of interior design Tray

"The rigour with which we have had to do some of our testing, especially in the labs, significantly increased the workload"

Vicki Britt Senior vice-president of innovation, engineering and flight, Gulfstream



Fuselage barrels will be built at the G500/G600 plant in Savannah

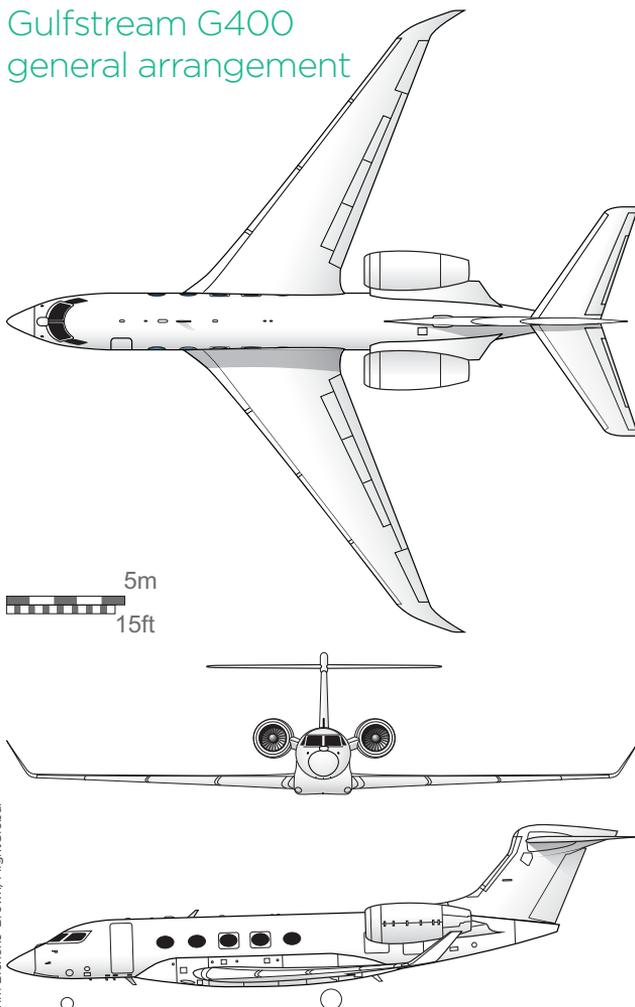
Gulfstream



Potential customers can explore options for 11.07m-long cabin using dedicated mock-up

Gulfstream

Gulfstream G400 general arrangement



Tim Bicheno-Brown/FlightGlobal

Crow. “I think the market is looking for something like this, with a really wide cabin.”

Crow oversees Gulfstream’s cabin mock-up centre, which houses G400 and G700 demonstration cabins. During a visit to Savannah by FlightGlobal earlier this year, Crow offered a tour of the G400 mock-up.

“As you can see, a very spacious cabin, especially for where this aircraft sits in the marketplace,” he says.

The mock-up was in the 11-passenger configuration. Standing in the galley, Crow pointed aft, calling out features. The cabin has four club seats forward: two on each side. Amidships, it has a right-side divan and two left-side club seats, while aft are another pair of club seats, both forward-facing.

Seating options

Crow explains that the 12-passenger configuration lacks the divan, but that six of its seats can form a conference area in the aft cabin. Its nine-passenger configuration, meanwhile, features six club seats and a divan, plus a second lavatory.

With its 4,200nm range potential, overnight trips, including transatlantic crossings, are absolutely part of the G400’s mission profile, Crow says. However, the jet’s capabilities make it ideally suited for trans-continental US hops or routes within Europe and Asia.

Gulfstream will build G400s in the same Savannah facility that houses G500 and G600 assembly, and using similar techniques. The company developed the site, and the processes, from the start to incorporate G400 requirements, says director of operations technology and support Steve Ritchie.

The G400 “predominantly is based off the 500”, he notes.

Ritchie stands in a quiet room overlooking the busy assembly floor. “Other than some very specific tools that we have had to make for the shorter fuselage”

G400 offers nine-, 11- or 12-passenger cabin configurations and can sleep four or five people



Gulfstream



Gulfstream



Gulfstream



Gulfstream

section, [G400 production] is relatively similar," he says. "It's just more volume required for the site."

He explains that G400 production - as for the G500 and G600 - will incorporate improvements Gulfstream developed for the G650. For instance, the company altered the design of some fuselage components to allow for increased use of automated riveting. Also, some parts arrive at the assembly site with more pre-drilled holes and other pre-fabricated features that make actual assembly easier.

Structural similarity

"By embedding those holes or features into the part when it is manufactured, you no longer need a separate tool," Ritchie says. "It improves quality. That's really where our focus is."

"The [G400's] producibility, and the structural approach to building the aircraft, is very, very similar to the 650," he adds.

During our visit, several G500s and G600s were taking shape at the assembly site. Fuselage sections form as they move from station to station along the assembly floor. Workers, assisted by machines, form main barrel sections that compose fuselages. The

work involves attaching fuselage frames to fuselage panels and adding structural brackets.

The G400's fuselage is made from aluminium, while components such as pressure bulkheads, horizontal stabiliser skins, wing-to-body fairings and engine pylons and cowlings are made from composites, says Ritchie. Aerostructures specialist GKN Aerospace produces the jet's rudders and wing skins.

Gulfstream had considered investing in an automated "levelling system" for joining fuselage sections, but decided to take another path.

"We looked at it and we said, 'We don't need to go to that level of expense or complexity,'" Ritchie says.

Instead, Gulfstream developed "precision-build carts". These hold fuselage barrel sections (forward-mid, centre-mid, and aft-mid), and allow workers to bring sections together using "joining fixtures", Ritchie says.

"We build up the fuselage sections, we join them together. We bring them to systems integration", where workers wire the jets and install other internal equipment, he says.

Next, teams add the wings, and the whole structure takes the unmistakable shape of a Gulfstream

large-cabin jet. The company manufactures G400, G500 and G600 wings and empennages in an adjacent facility in Savannah.

“We bring the wing across from the next building,” Ritchie says. “We take the fuselage... join it to the wings and put all the other major components on, like the landing gear, the engines. The empennage comes over and gets installed.”

Jets then move to Gulfstream’s flight-test facility for fuelling and engine runs. First flights follow. After receiving airworthiness certificates, it begins completion work, which it performs in Savannah and at facilities in Appleton and Dallas, Texas, Ritchie says.

Gulfstream has started constructing the first G400 test article but has not said when that jet will be complete. It will build fuselage barrels for G400 test aircraft in the G500/G600 facility, then move the barrels to another part of the Savannah site, where workers will complete remaining assembly work.

Parallel lines

As Gulfstream transitions to G400 production, it plans to transfer all production work to the G500/G600 site, assembling all three models there. To accomplish that, the airframer plans to expand the facility to include another parallel production line, Ritchie says.

In terms of market segment, the G400 sits wedged between the upper echelon of large-cabin jets including the G500, G600 and Bombardier’s Global-series, and super-midsize aircraft such as the G280.

“It’s sitting in really a unique place... a sweet spot, kind of, between those two worlds,” Crow says.

That market position has seen little innovation or development in recent decades, say aerospace analysts. They note that essentially only two other in-production jets compete in the G400’s space: Bombardier’s Challenger 650 and Dassault Aviation’s Falcon 2000LXS.

Gulfstream had, previously, had a stake in the segment with its G450. Cessna also had its eye on the sector with the Citation Hemisphere, but ceded the

space when it shelved development of the aircraft in 2019 amid engine troubles.

“The [Challenger 650] is the oldest business jet in production, and the [Falcon] 2000 is around the second oldest,” says aerospace analyst Richard Aboulafia with AeroDynamic Advisory. “Gulfstream found a golden opportunity.”

The Challenger 650’s lineage stretches to the 1970s. The type is based on the Challenger 600, a jet developed by long-defunct Canadair that made its maiden flight in 1978. Bombardier acquired the programme when it purchased Canadair in 1986. It has since rolled out new variants, including the Challenger 605, which completed its debut flight in 2006.

Bombardier updated the type in 2014 by introducing the Challenger 650. Powered by twin 9,220lb-thrust GE Aviation CF34-3B powerplants, the type can carry 12 passengers and has range of 4,000nm. Including all derivatives, Bombardier has delivered more than 1,000 of the jets.

Dassault’s Falcon 2000LXS, launched in 2012, is the French airframer’s update to its baseline Falcon 2000, a jet that entered service in 1995. The 2000LXS has twin 7,000lb-thrust PW308Cs and range of 4,000nm. Globally, nearly 650 Falcon 2000s remain in service or storage, according to Cirium fleets data.

Deliveries of jets in the G400’s category have been limited in recent years. In 2021, airframers handed over just 20 jets in the segment, down from 57 in 2015, according to Aboulafia. He defines the segment

“It’s sitting in really a unique place... a sweet spot, kind of, between those two worlds”

Tray Crow Director of interior design, Gulfstream

Gulfstream G400 specifications	
Dimensions	
Length	26.29m
Height	7.72m
Wingspan	26.31m
Cabin (L x W x H)*	11.07 x 2.31 x 1.88m
Accommodation	
Passengers	12
Powerplant	
Engine (x2)	Pratt & Whitney Canada PW812GA
Engine thrust (x2)	13,496lb
Performance	
Maximum take-off weight	31,683kg
Maximum zero fuel weight	21,387kg
Range (at Mach 0.85)	4,200nm
Maximum operating Mach speed	MO.9
Operating ceiling	51,000ft

Source: Gulfstream / *Excluding baggage compartment

as encompassing business aircraft with list prices between \$35 million and \$45 million.

But Aboulafia predicts a slight renaissance. He expects deliveries of G400-class jets will accelerate in the coming years, hitting 50 in 2028.

Burns declines to say how many G400s Gulfstream might ultimately sell, but predicts the market will be substantial, noting the sales success of the predecessor G450.

“This is going to be a large space... a lot of customers,” he says. “At 4,200nm, there is a strong case for this airplane for a lot of people – private individuals and corporations.”

Crow expects G400 buyers will include customers upgrading from midsize jets and existing operators of large-cabin types.

“We also anticipate large fleet owners using this for their regional or domestic missions,” Crow adds. “This will be a game changer. There has not [been] anything new in this market sector in 20 years.”

● *This issue should contain a cutaway poster of the Gulfstream G400. If yours is missing or damaged, please contact flight.international@flightglobal.com*

Gulfstream G400

Structure and general

- 1 Glassfibre honeycomb construction, upward hinging rotome
- 2 Titanium birdstrike barrier panels
- 3 Forward pressure bulkhead
- 4 Curved two-piece windshield, electrically deiced – PG Aerospace
- 5 Two fixed flightdeck side windows (one each side of aircraft), electrically defogged
- 6 Two-crew flightdeck with seat for third crew member (optional)
- 7 Instrument panel housing four 330 x 254mm (13 x 10in) liquid crystal displays
- 8 Overhead panel
- 9 Pilot's LCD head-up display (optional)
- 10 Flightdeck centre console
- 11 Side consoles
- 12 Fuselage is of an all-metal semi-monocoque construction with clad aluminium alloy skin, frames and stringers. The fuselage consists of a nose section, forward mid-section, centre section, aft mid-section and tail section
- 13 Air stair door, hydraulically actuated 2,1 x 0,9m (82 x 35in)
- 14 Graphite/thermoplastic composite floorboards
- 15 Machined aluminium alloy floor beams and seat track rails
- 16 Ten elliptical windows – 523 x 714mm (20,6 x 28,1in). The windows are constructed of stretched acrylic (inner) and new craze resistant polymer (outer) panes. These are acoustically isolated from the inner heated pane – PG Aerospace
- 17 Window mounting structure
- 18 Window emergency exits, can be opened from inside and outside the aircraft – 660 x 812mm (26 x 32in)
- 19 Auxiliary pressure bulkhead – graphite/epoxy composite construction
- 20 Baggage compartment door, opens inward and upward – 900 x 914mm (39 x 36in)
- 21 Rear pressure bulkhead – graphite/epoxy composite
- 22 Rear machined bulkhead – aluminium alloy
- 23 Tailcone – glassfibre honeycomb construction
- 24 Dorsal strake – composite
- 25 Vertical stabiliser consists of three machined spars joined by machined chordwise ribs. The aluminium alloy chemically etched skin panels with bonded aluminium alloy doublers and stringers are riveted to the ribs and spars
- 26 Pivot point for horizontal stabiliser
- 27 Leading edge of vertical stabiliser has two main sections with single-skin with nose cap ribs – aluminium alloy
- 28 Horizontal stabiliser consists of tip to tip upper and lower skins with left and right beams joined at the front and rear spars
- 29 Front spar – graphite/epoxy construction
- 30 Rear spar – inboard part titanium, outboard part graphite/epoxy
- 31 Machined aluminium alloy ribs
- 32 Four-piece aluminium alloy leading edge

- 51 Wing leading edge in five sections – aluminium alloy
- 52 Winglets – graphite fibre and aluminium honeycomb construction
- 53 Passenger cabin
- 54 Four single passenger seats with optional legrests
- 55 Four single passenger seats
- 56 Three console tables with folding leaf
- 57 Two single folding tables
- 58 Cabin window ledges
- 59 Lower sidewall panels
- 60 Upper sidewall panels
- 61 Cup holders
- 62 Galley area – both sides
- 63 Lavatory
- 64 Baggage compartment
- 65 Miscellaneous storage
- 66 Divider between cabin and lavatory with hinged door
- 67 Storage cupboard, starboard side
- 68 Vanity unit
- 69 Storage cupboard, port side
- 70 Three-passenger divan

Avionics, electronics and sensors

- A1 Weather radar antenna – Honeywell
- A2 EVS II camera – Kollsman (optional)
- A3 Glideslope antenna
- A4 Multifunction probes (MFP) – four
- A5 Ice detector probes – two
- A6 TCAS antenna
- A7 Total air temperature probes – two
- A8 SXM antenna (optional)
- A9 Right hand avionics equipment rack
- A10 Right hand avionics equipment rack
- A11 TCAS omnidirectional antenna
- A12 ATC 1 and 2 antennas
- A13 ADF antenna
- A14 VHF 1 antenna
- A15 VHF 2 antenna
- A16 VHF 3 antenna (optional)
- A17 Iridium satellite telephone antennas
- A18 GPS antenna – two
- A19 RADALT antennas – four
- A20 Positioned under wing on WTBF
- A21 DME antenna – two
- A22 Wing inspection light
- A23 Baggage electric and avionics bay
- A24 GSM security system and antenna (optional)
- A25 ELT antenna
- A26 Dual magnetometers
- A27 HF antenna
- A28 Aft baggage bay electronic equipment rack
- A29 Overwing emergency lights – three both sides
- A30 Satellite communication system (optional)
- A31 Flight data recorder
- A32 S3amp+tr, 28A-DC NiCad batteries – two
- A33 60Hz converter
- A34 Horizontal stabiliser motor control electronics
- A35 Battery chargers
- A36 60Hz converter (optional)

- C6 Alleron remote electronic unit
- C7 Hydraulic control manifolds
- C8 Alleron remote electronic unit
- C9 Alleron motor control electronics
- C10 Fly-by-wire spoiler actuators – one per spoiler panel. One EHSAs per inboard and midboard panel. One EBHA per outboard panel
- C11 Flap tracks – four per flap surface
- C12 Flap actuators – two per surface. Actuators interconnected via a rigid transmission drive system and powered by a hydraulically powered drive unit mounted within the wheel well area – manufactured by Moog
- C13 Torque tube driveline connecting the hydraulic drive unit to the flap actuators – Moog
- C14 Tailplane trim actuator – electrically powered
- C15 Elevator of graphite/epoxy composite construction, the elevators are mounted on hinges attached to the tailplane rear spar
- C16 Rudder of graphite/epoxy composite construction, mounted on hinges attached to the fin rear spar
- C17 Fly-by-wire rudder actuators – total of two. One EHSAs and one EBHA – active/active operation
- C18 Rudder EHSAs manifold
- C19 Rudder hydraulic actuator manifold
- C20 Rudder electrical backup hydraulic manifold
- C21 Fly by wire elevator actuators – two per elevator. One EHSAs and one EBHA – active/active operation
- C22 Elevator electrical backup hydraulic manifold
- C23 Elevator hydraulic actuator manifold
- C24 Elevator EHSAs manifold

Instrument panel and displays

- D1 Pilot's overhead circuit breaker panel
- D2 Co-pilot's overhead circuit breaker panel
- D3 Pilot's reading light
- D4 Co-pilot's reading light
- D5 Electric power control panel
- D6 Overhead touchscreen 1
- D7 Overhead CPCs, bleed air, doors and engine control panel
- D8 Overhead touchscreen 2
- D9 Overhead touchscreen 3
- D10 Pilot's map light
- D11 Co-pilot's map light
- D12 HUD controls (optional)
- D13 Pilot's warning inhibit panel
- D14 Standby flight display
- D15 Flight guidance panel
- D16 Standby flight display
- D17 Co-pilot's warning inhibit panel

Environmental control system

- E1 Conditioned air ducting to cockpit
- E2 Wing anti-ice ducting
- E3 Cabin footlevel ducting for conditioned air
- E4 Cabin return air
- E5 Cockpit air outlets
- E6 Crew and passenger oxygen bottles (second oxygen tank is optional)
- E7 Conditioned air ducting
- E8 Fan bleed air
- E9 Engine bleed air ducting
- E10 Twin air conditioning packs – Honeywell
- E11 Ram-air inlet
- E12 Ozone converter
- E13 Trim air valves – 2
- E14 Precooler
- E15 Air conditioning ducting
- E16 Bleed air supply duct
- E17 Air conditioning pack exhaust
- E18 Aft compartment vent
- E19 Ducting to wing anti-ice
- E20 Piccolo tubes in wing leading edge
- E21 Supply duct for engine inlet anti-icing
- E22 Spray ring for engine inlet anti-icing

Fuel system

- F1 Two integral wing tanks Total useable capacity 14,028l (3,706 US gal)
- F2 Fuel lines to port engine
- F3 Fuel lines to starboard engine
- F4 Top hat section fuel vent
- F5 Gravity filler point – on each wing
- F6 Fuel cap covers
- F7 Vent tube
- F8 50mm (2in) vent float
- F9 Pressure relief valve

Powerplant, APU, pylon and nacelle

- P1 Pylons constructed of graphite/epoxy skins, machined aluminium alloy ribs and aluminium alloy leading edge. Top surface of pylon designed to withstand walking loads
- P2 Pratt & Whitney Canada PWS12GA turbofan engines
- P3 Nacelle air intake – carbonfibre composite with aluminium alloy lip skin
- P4 Cowl doors of carbonfibre composite – both cowl doors hinge for access to engine
- P5 Forward engine mount
- P6 Aft engine mount
- P7 Thrust strut
- P8 Inner fixed panel on nacelle – composite
- P9 Target type thrust reverser – hydraulically actuated

- P10 Thrust reverser doors
- P11 Fire extinguisher bottles
- P12 Honeywell HG7400(G) auxiliary power unit (APU)
- P13 APU air inlet
- P14 APU air inlet with door open
- P15 APU exhaust
- P16 Engine remote oil fill reservoir
- P17 Inlet frame – titanium
- P18 Inlet acoustic inner barrel – composite
- P19 Inlet bulkhead – titanium

Undercarriage and hydraulics

- U1 Hydraulically actuated nose undercarriage manufactured by UTC. Nose-wheel steering supplied by Collins Aerospace
- U2 Graphite/epoxy composite nose undercarriage doors, forward doors are shown open, they are normally closed when the undercarriage is down and locked
- U3 Wheels, brakes and anti-skid system – supplied by Meggitt
- U4 Hydraulically actuated main undercarriage manufactured by Collins Aerospace
- U5 Main undercarriage doors – graphite/epoxy composite, Manufactured by Daher
- U6 Main undercarriage fairing door, attached to and closes with main undercarriage leg – graphite/epoxy composite, Manufactured by Daher
- U7 Ram air turbine – on starboard side of aircraft – Hamilton Standard
- U8 Bottles for emergency extension of undercarriage
- U9 Radial main landing gear tyres – Goodyear
- U10 Radial nose landing gear tyres – Goodyear
- U11 Hydraulic reservoirs
- U12 Hydraulic auxiliary pump
- U13 Hydraulic filters
- U14 Hydraulic power transfer unit

- 33 Machined aluminium alloy leading edge riblets
- 34 Horizontal stabiliser tip – machined aluminium alloy with integral ribs. Has small machined cap on upper part of trailing edge
- 35 Single piece graphite/epoxy upper and lower skins with integral spanwise stringers. Access panels in upper skin
- 36 Horizontal stabiliser centrebox
- 37 Vertical stabiliser fairing
- 38 Aluminium alloy support structure for fuselage for wing to body fairing (WTBF)
- 39 Fibreglass and carbon/epoxy composite WTBF – Daher
- 40 Fuselage to wing attachment points
- 41 Main frames connecting wing to fuselage
- 42 Wing is in two sections joined at the centreline and mounted under the lower fuselage
- 43 Forward wing centre box – aluminium alloy
- 44 Machined two-piece front spar – aluminium alloy
- 45 Machined two-piece rear spar – aluminium alloy
- 46 Main landing gear sponson beam cantilevered off the inboard rear spar – titanium
- 47 Machined shear web-type ribs – aluminium alloy
- 48 Machined one-piece aluminium alloy upper wing skin with riveted stringers
- 49 Machined three-piece aluminium alloy lower wing skin with riveted stringers – access ports for wing box access
- 50 Carbonfibre composite wing trailing edge panels

- A37 HF receiver (optional)
- A38 HF antenna couplers
- A39 HF antenna couplers (optional)
- A40 Cockpit voice recorder
- A41 VOR/LOC glideslope antenna
- A42 HD camera (optional)
- A43 Satcom antenna (optional)
- A44 Satcom diplexer (optional)
- A45 Elevator remote electronics unit
- A46 Elevator motor control electronics
- A47 Logo lights
- A48 Forward fixed fully sealed LED landing light modules integrated into the wing to fuselage fairing – two
- A49 Three sealed beam taxi lights
- A50 Navigation and strobe lights
- A51 Static discharge wicks

Flying controls

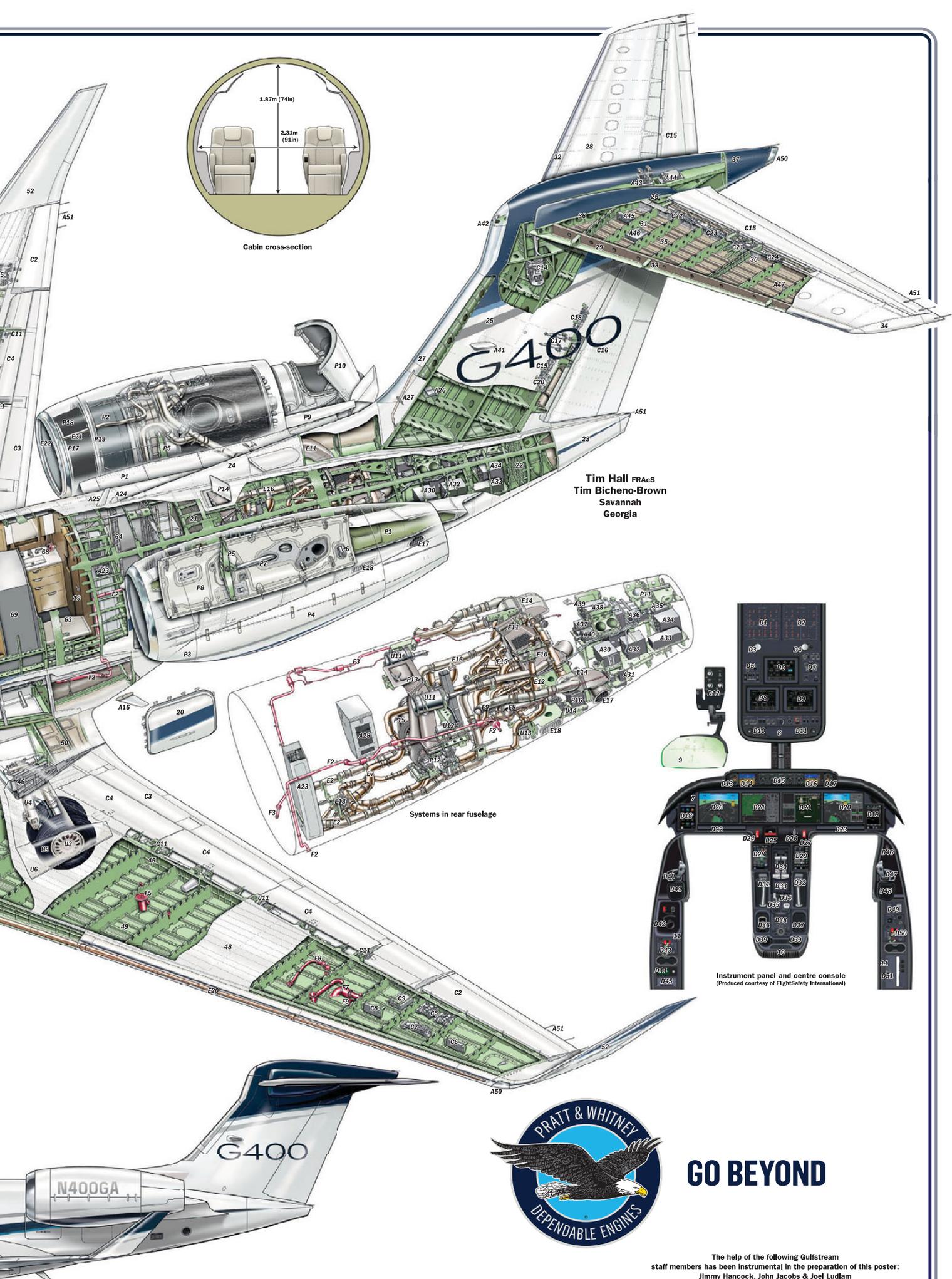
- C1 Rudder pedals
- C2 Alleron – aluminium alloy box beam structure
- C3 Aluminium alloy single-slotted Fowler-type flaps (one flap per wing)
- C4 Spoilers – three per wing; Inboard – speedbrake/ground spoiler; Midboard – speedbrake/ground spoiler/roll spoiler; Outboard – speedbrake/ground spoiler/roll spoiler
- C5 Fly-by-wire alleron actuators – two per alleron. One electro hydraulic servo actuator (EHSAs) and one electro backup hydrostatic actuator (EBHA). Active/active operation

- D19 Touch screen controller 1
- D18 Touch screen controller 4
- D20 Primary flight displays
- D21 Multifunction displays
- D22 Pilot's pull-out tray
- D23 Co-pilot's pull-out tray
- D24 Left fire handle
- D25 Emergency landing gear handle
- D26 Landing gear panel
- D27 Right fire handle
- D28 Touch screen controller 2
- D29 Touch screen controller 3
- D30 Throttle quadrant assembly
- D31 Pilot's cursor control device
- D32 Co-pilot's cursor control device
- D33 Engine fuel control panel
- D34 Flap handle
- D35 Speed brake handle
- D36 Parking brake
- D37 Storage container
- D38 Right control trim panel
- D39 Cupholders
- D40 Pilot's active control side stick
- D41 Pilot's ACS arm support
- D42 Nosewheel steering
- D43 Pilot's oxygen mask
- D44 Aircraft security system control panel (optional)
- D45 Data LAN management unit
- D46 ELT remote switch
- D47 Co-pilot's active side stick
- D48 Co-pilot's ACS arm support
- D49 Oxygen control panel
- D50 Co-pilot's oxygen mask
- D51 Cockpit printer (optional)



**Collins
Aerospace**





Cabin cross-section

Tim Hall FRAeS
 Tim Bicheno-Brown
 Savannah
 Georgia

Systems in rear fuselage



Instrument panel and centre console
 (Produced courtesy of FlightSafety International)



GO BEYOND

The help of the following Gulfstream staff members has been instrumental in the preparation of this poster:
 Jimmy Hancock, John Jacobs & Joel Ludlam

UK start-up Vertical Aerospace is among a small group of pioneers driving the development of eVTOL platforms for market entry later this decade – but can it maintain momentum?

On the rise

Murdo Morrison Bristol

The two prototypes in Vertical Aerospace's engineering centre in Bristol illustrate how the UK start-up – and perhaps the entire electric vertical take-off and landing (eVTOL) segment – has evolved in a few short years.

Tucked at the back is the VA-X2, a demonstrator that made several autonomous flights during 2019 and 2020. Approximately the size of a two-seat helicopter, the aircraft has six pairs of horizontal, coaxial propellers that sit in a circular formation above the fuselage.

In front of it – and fresh from its Farnborough air show appearance in July – is Vertical's latest iteration, the VX4. The contrast is striking. The aircraft is a replica – the real prototype is at the start of a flight test campaign at the nearby Cotswold airport in Kemble, Gloucestershire. However, with its sleek, fixed-wing design and cabin the size of a London taxi passenger compartment, the aircraft resembles something time-pressed travellers would happily step into to complete the first or last few kilometres of a journey.

The X2 itself represented a major reworking of Vertical's original 2018 concept, which used ducted fans, but in looks is typical of the first wave of quirky urban air mobility (UAM) platforms that emerged in the two years before the pandemic. During that time there were at least 100 ventures working on eVTOL designs – almost all of them searching for funding and talent to take their idea from blueprint to flight, certification, and eventually volume production.

Vertical, founded six years ago by UK entrepreneur Stephen Fitzpatrick, is one of maybe fewer than 10 UAM players to have survived that early gold-rush

period (not to mention the pandemic), secured serious financial backing and customer commitments, and either flown or are close to flying something resembling a production-ready aircraft. Others include Embraer spin-off Eve, the USA's Archer Aviation, Joby Aviation and Wisk Aero, plus Lilium Air Mobility and Volocopter from Germany, and China's EHang.

Like Archer and Joby, Vertical is listed on the New York Stock Exchange, and it too has seen its share price trend downwards – in Vertical's case from a high of almost \$13 just after its flotation in December last year to around \$5.5 in mid-September. However, that is often the case with technology disruptors where initial hype turns to a more sober assessment of value and prospects once the inevitable challenges of taking a concept to market and turning a profit become clear.

Capital expenditure

In common with any start-up without a product to sell, Vertical continues to spend without making much revenue. It reported an operating loss of £39 million (\$45 million) for the six months to end-June. However, it claims to have around £158 million in cash, enough to fund operating expenses and capital expenditure for at least 12 months. In addition, it has the option of issuing \$100 million in additional shares, backed by an equity subscription line through Nomura.

It is also sitting on one of the UAM sector's most enviable of what it calls "pre-order" books – with commitments for around 1,400 aircraft from the likes of AirAsia, American Airlines, lessor Avolon, helicopter operator Bristow, charter provider Flying Group, Brazilian carrier Gol, Japan Airlines and Virgin Atlantic. American's contract includes an unspecified



Start-up faces a busy period of testing as it aims for service entry in 2025

Rolls-Royce

pre-delivery payment to secure delivery slots for its first 50 VX4s, out of a possible 350.

Like its competitors, Vertical faces a busy and uncertain 30 to 40 months as it pushes to take the VX4 from flight-testing this year to a planned service entry in 2025. Regulators in Europe, the USA and beyond still have to publish detailed certification roadmaps, training manuals, and operating guidelines for the new sector - and the jump from initial certification to volume manufacturing is where aircraft developers often stumble, as they encounter regulatory challenges or run out of money.

It is still unclear too whether customers will take to UAM in sufficient numbers to make these new platforms viable. This will depend on operators coming up with profitable business models - whether that involves replacing ground transport as a way of getting air travellers to and from their final destination, providing on-demand air taxis, or using them for other purposes such as medevac or cargo. Passengers will also have to be convinced that they are safe.

Michael Cervenka, Vertical's president, is convinced that neither of these will be challenges for the company. Multiple redundancy will ensure that the VX4 is many times safer than a similar-sized helicopter with

its single points of failure, he insists. He also expects that airlines looking to provide rapid, relatively cheap, and environmentally friendly "last mile" transport to their premium passengers will provide the bulk of customers for the aircraft, at least initially.

However, without naming anyone, he doubts whether all the current leading players will make it to the finishing line. "I can see the market consolidating to perhaps half a dozen or even fewer," the former Rolls-Royce executive told FlightGlobal at the Bristol site in early September. "When I joined [in 2019], I hoped we could be in the top 10, but I get the sense that number is reducing and I think we now have a good crack at being one of five."

Potential revolution

The UAM explosion has parallels with the excitement around very light jets (VLJs) two decades ago - another market that promised to change air travel habits by making private jet ownership and charter available at a much lower price point, and accompanied by a boom in provisional orders. The revolution ended badly, with the failure of several start-ups and retreat from the segment by a handful of established manufacturers including Cessna, Diamond and Piper.

However, Cervenka argues the UAM movement is different from VLJs in two ways. Technologically, VLJs did not adopt truly disruptive technology, but were simply smaller products that manufacturers believed they could produce in volume at a lower unit cost. Secondly, the potential market was largely people already using piston general aviation aircraft. UAM platforms such as the VX4, by contrast, offer a "genuine shift in transportation across a range of sectors", he says.

1,400

Vertical has one of the largest 'pre-order' books in the UAM sector, with international customers lining up for the VX4

Vertical conceived its latest design over a year ago, with the company opting for high wings and a large V-tail – combined with four tilting front and four rear propellers – to obtain the necessary payload of four passengers and their luggage plus a pilot, says Cervenka. The additional lift provided by wings also reduces battery use, meaning that on a typical trip recharge times will be just 10 minutes. This turnaround will be crucial for many business models to be viable, he argues.

Improved visibility

The fuselage tapers to the front with room in the cockpit for just the pilot, providing better visibility than a helicopter, says Cervenka. A structural bulkhead separates the double-door, air-conditioned, comfortable cabin, although a glass panel on the final design will allow passengers to look forward. Behind the cabin is a 300l luggage compartment. The variable-pitch front propellers are five-bladed. The rear propellers have four blades and align in a “scissor” layout to reduce drag in cruise.

Building in safety has been paramount, says Cervenka. Fly-by-wire technology coupled with distributed electrics – each propeller is driven by two independent battery-powered motors – means “you can knock out multiple systems and the aircraft will still fly”. Environmental friendliness is not just limited to a light carbon footprint. For passengers the noise generated will be equivalent to that of loud conversation in hover, and in the cruise, a domestic fridge, Cervenka claims.

The mock-up displayed at Farnborough and demonstrated to FlightGlobal in Bristol is essentially



Vertical Aerospace

the same as the flight-test prototype and the final production design, although there will be a number of tweaks to the latter, including a slightly smaller cabin, he says. Discussions with suppliers on final specifications are also ongoing, including with electric motor provider R-R. “We will be in an

“On aircraft such as these the mass including the batteries are 85% of the overall weight, so if your calculations are out by 5% you lose a third of the payload”

Michael Cervenka
President, Vertical Aerospace

optimisation phase with them over the next 12 to 18 months,” says Cervenka.

After a series of ground tests, flight-testing on the VX4 was due to begin this autumn. Unlike some of its rivals, Vertical has opted to “do the hard job” and fly a full-scale prototype at Kemble, with a pilot in the cockpit much of the time. “The trouble is that technology does not scale,” says Cervenka. “You can fly sub-scale but you’re left with unknowns. On aircraft such as these the mass including the batteries are 85% of the overall weight, so if your calculations are out by 5% you lose a third of the payload.”

Flight-testing will start with a series of tethered

Other developers hoping to rise above the competition

From more than 100 would-be disruptors in the years before the pandemic, the number of electric vertical take-off and landing (eVTOL) aircraft developers with a serious chance of bringing a commercially successful product to market has probably slimmed to high single figures. These are some of them.

ARCHER AVIATION

After completing its first hover test flight last December, California-

based Archer Aviation said in June that it was confident of flying “full transition” sorties with its Maker urban air mobility prototype by the end of the year. In August, the business announced that it had completed a preliminary design review of the production version, the four-seat Midnight, which has two long wings, with three propellers mounted on each. Its early customers include United Airlines,

which also in August made a \$10 million downpayment on a conditional order placed in February 2021 for up to 200 of the aircraft.

EHANG

China’s eVTOL champion, EHang, has been conducting demonstration flights of its EH216 prototype for a number of years, mainly in Asia, where it has been netting provisional orders in the likes of Indonesia and Malaysia. It also

flew in the USA in early 2020. The EH216 has a two-seat bubble capsule supported on a frame from which eight retractable arms, each containing an upward- and downward-facing propeller, form a circle. It has been designed for autonomous flight from the start.

EVE

Embraer technology spin-off Eve has been one of the most commercially successful developers, with its



Vertical has secured validation from the CAA and EASA under SC-VTOL rules

Vertical Aerospace

hovers, followed by thrust-borne and then wing-borne flying with full transition from vertical flight to cruise. Vertical has already secured concurrent validation from both the UK Civil Aviation Authority and the European Union Aviation Safety Agency (EASA) for certification under SC-VTOL (special condition for vertical take-off and landing aircraft) rules. It hopes to follow that rapidly with approvals in key markets Brazil, Japan and the USA.

In addition to its household-name potential customers, Vertical has assembled a respectable array of programme partners, including Honeywell on avionics, Leonardo for the composite fuselage, R-R,

and GKN, which is providing the wing and helped the company assemble the initial VX4 in its Global Technology Centre in Bristol. Vertical will deploy Dassault Systemes' 3DEXperience cloud-based design platform for its flight-testing and certification campaigns.

Cervenka says Vertical's philosophy has been to focus on what it does best – integration – and trust the expertise of suppliers. "Building an aircraft company is a tough job, and certificating an aircraft is tougher. It is crazy to try to do it all vertically. There is no point in us trying to write critical software when Honeywell has been doing it for decades," he says. "We also get to leverage these companies' "



Embraer's Eve project has the backing of United Airlines

Embraer

most recent coup being a \$15 million investment from United Airlines in September, with a conditional commitment to purchase up to 200

of its in-development four-seat eVTOL aircraft. This adds to letters of intent for almost 2,000 examples from 22 customers, says Eve.

The company, which went public earlier this year but is still majority owned by the Brazilian airframer, is confident of delivering its aircraft, currently designed with fixed wings and a total of eight lifting propellers and pusher propellers, by 2026. It will offer 54nm (100km) of range.

JOBY AVIATION

Another Californian start-up, Joby Aviation has taken the unusual step of working with the US Department of Defense (DoD) on

one of its technology programmes. Disclosing the deal at July's Farnborough air show, Joby said an injection of cash from the DoD would help fund its efforts to launch a passenger ride-sharing service, based on its eVTOL design. The company has been flight-testing its five-seat prototype autonomously since last year, but in February experienced a crash during an "envelope expansion campaign".

Continued on p64

technology pipelines. Why would we invest in what they are already doing?”

An exception is the batteries, where, after failing to find a suitable supplier, Vertical has put together its own 23-strong engineering team, comprising largely former employees of Dyson, the household appliances company, and Jaguar Land Rover. However, it has signed up Taiwan’s Molicel, a leader in lithium-ion technology, to supply the cylindrical cells that Cervenka says will be easier to certificate because their shape makes them less prone than a pouch design to thermal runaway.

Short-haul services

As well as airlines keen to provide end-to-end services for passengers, Vertical envisages orders for the 85nm (160km)-range VX4 coming from air taxi companies and those looking to provide ultra-short-haul services between cities, such as Manchester and Leeds or Dusseldorf and Cologne. There are also opportunities in the likes of Sao Paulo, the biggest urban helicopter market in the world, given that the VX4 will have a fifth of the operating costs of a similar-sized helicopter, says Cervenka.

“The pace will differ from city to city, and some will be pioneers, but this will be a mass transport

“A third of a helicopter’s cost is maintenance. As the cost of running a battery is really low, we get rid of all that, and electricity is cheaper than kerosene”

Michael Cervenka President, Vertical Aerospace



VA-X2 demonstrator made several autonomous flights in 2019 and 2020

Vertical Aerospace

mode, which helicopters have never been,” he says. “It changes how we think about air travel.” Even traditional helicopter operators may be thinking that way. At Farnborough, emergency medical services (EMS) specialist Babcock International signed with Vertical to investigate the potential of the VX4 for EMS, including civil first-responder operations and military casualty evacuation.

Cost benefits

At a list price of around \$4 million, the purchase price of the VX4 will be around half that of a similar-size helicopter. However, add the extensive maintenance bills for gas turbine engines and gearboxes and the difference in running costs is marked, argues Cervenka. “A third of a helicopter’s cost is maintenance. As the cost of running a battery is really low, we get rid of all that, and electricity is cheaper than kerosene,” he says.

Vertical expects its first full year of production to be low volume but rising to 2,000 per annum by the end of the decade. With almost every aerospace manufacturer currently experiencing shortages of parts and raw materials as well as other logistical glitches, Cervenka anticipates readying the supply

Continued from p63

A second aircraft had joined the flight test programme in January. The design features two tilting propellers mounted on each wing, with two more on the tail. Its range is 133nm with a top speed of 178kt (321km/h).

LILIUM AIR MOBILITY

In a market of mould-breaking designs, the Lilium Jet is one of the most unusual. Described by developer Lilium Air Mobility as the first eVTOL jet, the six-



Lilium Air Mobility

Lilium Jet has vectored thrust engines integrated into its wings

seat aircraft’s unique feature is what the company calls ducted electric vectored thrust technology, with electric jet engines integrated into the wing flaps and

aerofoils. Its range will be 135nm. In March 2022, the German company secured an agreement from fractional ownership giant NetJets to

purchase up to 150 examples. At the Farnborough air show, it added agreements with AAP Group of Norway and helicopter operator Bristow. Its board includes former Airbus chief executive Tom Enders and airline entrepreneur David Neeleman.

VOLOCOPTER

Volocopter is another German company with a former Airbus boss involved. Dirk Hoke, who formerly headed the airframer’s defence business, became its

chain to be a major challenge, but hopes that, by the time Vertical ramps up production, the global supply situation will have improved.

Vertical, which employs 300 people, most of them engineers, has been strengthening its management team as it puts in place plans for volume assembly. It has appointed to its board Mike Flewitt, the former chief executive of McLaren Automotive and vice-president manufacturing for Ford Europe, to benefit from his expertise in volume production. "This isn't automotive, but there are many of the same principles," says Cervenka.

Vertical's headquarters – a leased unit on an unprepossessing inner-city industrial estate – is too small for a factory, but Cervenka is keen on staying in the area when Vertical establishes a production site because of its talent pool and proximity to industry partners and aerospace-focused universities. Airbus, GKN and R-R have a major presence in the region, as do many smaller suppliers. "There would need to be a damn good reason not to do it near Bristol," he says.

eVTOL manufacturers are keen to point out how easy their aircraft will be to pilot. The VX4's controls essentially comprise an inceptor – or joystick – on the right and a lever on the left to control speed. There are pedals to yaw, but the final model will likely

dispense with these. "The commands the pilot gives are unified regardless of phase of flight, making it easy to manoeuvre," says Cervenka. "My seven-year-old daughter could fly this aircraft."

Will eVTOL aircraft such as the VX4 even need pilots? Many envisage a near future where they will fly autonomously, including several of Vertical's contemporaries. Cervenka sees that coming, but not until the late-2030s. "Our strong view is that these aircraft will need to be piloted well into the next decade," he says. This has an effect not just on perceptions of safety, but economics. "The minute you put a pilot on board, you have to carry four passengers to make money," says Cervenka.

Training programme

Initially, he says, pilots are likely to be qualified aviators who will undergo a type rating conversion, just as with any new aircraft. Vertical has selected CAE to design a training programme.

Some suggest a key reason airlines are flocking to the UAM sector is that it could provide a pipeline of pilots with 1,500h of experience. However, while Cervenka admits this could be a useful side benefit, "it has not come up in any conversations we have had with the airlines".

The next few years will be a critical time for the fledgling UAM sector. Will investors and customers keep the faith? Will supply chains hold up? Will regulators – and public opinion – play ball? Will passengers flock to this entirely novel form of eco-friendly aviation? Will infrastructure fall into place? It is unlikely that, even if all the above work in the sector's favour, there will be room for as many as 10 competitors

by the second half of the decade.

A Darwinian race is already underway. Vertical is convinced it will be one of those surviving and thriving in this brave new world of air travel. ▶



Vertical Aerospace

At \$4 million, the price of the VX4 will be half that of a similar-size helicopter

chief executive earlier this year. The company is developing a family of eVTOL aircraft, with its latest design, the four-seat, fixed-wing

VoloConnect, making its first flight in May. It was the third type to take to the air, joining the VoloCity and VoloDrone. It is

targeting what it calls a "commercial launch" for the multirotor VoloCity in 2024, with the VoloConnect entering service in 2026. It says the range of aircraft will cater for different missions, with the VoloCity pitched at intracity routes, and the larger VoloConnect focusing on longer urban and suburban flights.

WISK AERO

The Californian company, which Boeing part owns, said at Farnborough that it would reveal this year

its latest four-seat eVTOL air taxi, after displaying an earlier version at the show. The two-seat Cora has 12 wing-mounted lifting fans and one aft-mounted pusher propeller. It flew 400 times before it was decommissioned this year. Wisk Aero said in July that it had logged some 1,600 test flights across its aircraft since its first in 2017. It is one of a handful of eVTOL developers that expects their designs to fly autonomously from entry into service.



Volocopter's four-seat, fixed-wing VoloConnect made its first flight in May

Volocopter

United Airlines Ventures is an investor in hydrogen-electric pioneer ZeroAvia



Fresh thinking

Carriers are moving beyond being simply consumers of new aircraft: through venture-capital or innovation arms, some are backing development of the sustainable technologies vital for zero-emission flight

Mark Pilling London

Despite their geographical and operational differences, US carriers United Airlines and JetBlue Airways, Norwegian regional airline Wideroe, and Spain's Air Nostrum have a common goal: to be pioneers in sustainability, be it zero-emission aircraft, sustainable aviation fuels, or other green technologies. The difference between them and a host of others that lay claim to environmental leadership credentials is the way they are going about it.

The airlines operate corporate venture capital funds such as United Airlines Ventures (UAV) and JetBlue Technology Ventures (JTV), new subsidiaries such as Wideroe Zero, or in-house innovation teams as at Air Nostrum. Each organisation has created a structure designed to allow them the freedom to innovate on a "multi-decade" horizon unencumbered by the day-to-day demands of running an airline.

At the mega-airline end of the scale is United. In June 2021 it launched UAV, a corporate venture fund with an initial budget of \$200 million. It is led by president Michael Leskinen, who arrived at the airline five years ago after a 20-year career in the investment world.

Growth potential

UAV was created after United had signed six major investment and collaboration deals in the first half of last year – including an agreement to acquire Archer Aviation's four-seat electric vertical take-off and landing (eVTOL) aircraft, since named the "Maker". Through UAV, United will invest in small to medium-sized companies developing emerging technologies and sustainable solutions and with strong potential to grow.

Leskinen, who had been vice-president of corporate development and investor relations at the carrier since April 2019, recognises how tricky it can be to find the right innovation pathways. "You get into these big companies and there are lots of conflicting interests," he says. "There is a general conservatism to a firm of this size. Companies across industries find that when they want to shake things up and create that extra level of innovation a very useful tool to do that is a corporate venture capital [CVC] fund. That is the idea behind it, and we have already had some early successes, so at this point it's a proven model."

Obtaining top-level support is critical, and Leskinen has that at UAV. "You need the connection with the senior leadership. We have a board of directors that

consists of Scott Kirby, our chief executive, Gerry Laderman, our chief financial officer, Linda Jojo, our chief customer officer, and Brett Hart, our president. [We deal with] all of them – and sometimes when you are driving innovation there are some conflicting points of view, which is healthy. My subsidiary reports to that board – it gives us a lot of autonomy to try new things."

Innovative spirit

JetBlue took the plunge in creating a corporate venture fund in 2016, explains Amy Burr, who became president of JTV in mid-2021. "Back in 2015 our board of directors recognised that a 15-year-old JetBlue was losing its innovative spirit," she says. "It is hard to maintain that drive to try new things and explore emerging tech when you are operating an airline."

And while there are various ways of structuring a new approach to innovation, JetBlue "chose to do the CVC model because we thought the nice thing about

"It is hard to maintain that drive to try new things and explore emerging tech when you are operating an airline"

Amy Burr President,
JetBlue Technology Ventures



JetBlue Technology Ventures

this is it separates us from our day-to-day operational requirements", Burr says. "Our job every day is to seek out what is happening with emerging tech, what is changing in our industry, how can we take advantage of some of those start-ups that are building new and different ways of doing business. Because we are separated from the airline, it gives us the ability to dive in and not get distracted every time the website goes down, or [the reservation system] has an issue, or whatever it might be."

Expanded sustainability

Since the start, sustainability has been one of JTV's five investment pillars, initially focused on evolving regional travel and autonomous electric aircraft. For example, it invested in eVTOL start-up Joby Aviation in 2017 "before anyone thought about air taxis", says Burr.

This approach has since been adapted. "A couple of years ago we realised the sustainability tack is well beyond just regional travel and well beyond the electrification movement within airlines, so we expanded it to all sustainability tacks."

\$200m

Initial budget for United Airlines Ventures, the corporate venture fund launched in June 2021

Wideroe, meanwhile, realised in 2017 that sustainability would become a critical business transition challenge for the airline. To aid its learning about the aircraft and technologies that were on the horizon, it started Project Zero in 2018 – established within the airline and with a grant from state enterprise Innovation Norway.

“The aim was to really understand what is out there and to find partners to work with,” explains Andreas Kollbye Aks, head of strategy at Wideroe. “During this process we entered a collaboration with Rolls-Royce” focused on electric aircraft technology.

Work between the partners intensified during the pandemic, leading the carrier to expand the project. “One important reason is that when we started this back in 2017, we said to look at electrification is natural and a perfect fit for Wideroe. We thought we can easily introduce these aircraft when they come into our network.”

Aks, who led the team that introduced the Embraer 190-E2 into Wideroe’s fleet, admits this initial view was somewhat naive. The recipe for introducing a current-generation jetliner into an airline for the first time is well used and trusted. Working with R-R provided an understanding that introducing an electric-powered aircraft “is on a deeper level of change”, he explains. “This is new technology – you are very far from being able to copy and paste existing processes and procedures.

“For that specific reason we decided we needed to build a competent team that is willing to really digest this and understand it fully,” Aks says. This team could have been stood up within the airline, but the technology was so novel that Wideroe decided to create a new company: Wideroe Zero was formed in October 2021, with Aks becoming its first chief executive.

Rethinking business

“We also learnt in this process that these new technologies have a lot of opportunities but also many constraints, and you may have to be willing to adapt your business model and rethink the way you do things,” he says. “Then it may be more challenging to do it within the existing company.”

Air Nostrum has been taking a lead on environmental management for years, having appointed a chief sustainability officer four years ago, and beginning its search for a zero-emission successor for 50- to 100-seat turboprops and regional jets to serve its short-haul routes back in the mid-2010s, says Miguel Angel Falcon, managing director at the carrier and the vice-president who heads up its environmental and aircraft planning groups.

In 2014, a zero-emission aircraft seemed a long way off as the company first pondered fleet replacement options. Although it was of a decent size in the regional world, with a fleet of 40 aircraft, management chose to keep its work to introduce a new sustainable aircraft in-house. “Because of our size, it is preferable

to get everybody in the act rather than having a separate unit running the whole show,” Falcon says.

Until recently, there were no alternatives to seriously consider – but that is changing. “We started looking at more alternative aircraft that could meet these challenges and HAV [Hybrid Air Vehicles] was one of them,” Falcon says. HAV is a UK-based firm developing the Airlander aircraft, which at first glance looks like an airship. The company describes Airlander as “a hybrid aircraft that derives its lift from a combination of aerodynamic lift (like an aeroplane), lifting gases (like an airship) and vectored thrust (similar to a helicopter)”.

“It was disruptive in the respect it was a blank sheet of paper design, nothing that resembled a turboprop or a regional jet, and that’s what caught our eye,” Falcon says. In June, Air Nostrum placed 10 reservations on the 100-seat Airlander 10 for delivery from 2026, with the intention of being the launch operator.

The carrier has been engaging with HAV on the



Air Nostrum

“We started looking at more alternative aircraft that could meet these challenges and Hybrid Air Vehicles was one of them”

Miguel Angel Falcon, Managing director, Air Nostrum

Rolls-Royce

aircraft for several years. In addition, two years ago it began working with US-based Universal Hydrogen on its hydrogen fuel retrofit kit for its ATR turboprops, and in March 2021 joined forces with Spanish firm Dante Aeronautical to help develop an electric aircraft in the 19-seat class.

In his team, Falcon has a group of five people focused on novel technologies. “We like to be involved in as many as possible to understand what’s going on and we would like to be able to test the validity of each proposal – and we are not afraid of working with many parties,” he says. “We are open to any option that has a certain credibility because, ultimately, this is going to be a combination of solutions.”

Decarbonisation imperative

Whichever innovation structure they have adopted, each of the four carriers is convinced that their future business success requires early answers in sustainability technology. And this means investing time and money now to be ahead of the game. “Decarbonising air travel is absolutely an imperative. It is a table stakes item for our industry and United Airlines – and

“We can get the experience and the data that airlines have, so we have access to a lot of important knowledge that can be difficult for start-ups”

Andreas Kollbye Aks Chief executive, Widerøe Zero



Widerøe is partnering with Tecnam and Roll-Royce on the nine-seat P-Volt, with a service entry target of 2026

10

Reservations Air Nostrum has placed for the 100-seat Airlander 10, due for delivery from 2026

we are out in the lead in making investments that can achieve that,” Leskinen says.

Choosing where to place bets and the level of risk to take is Leskinen’s job, and he notes “this is not my first rodeo” when it comes to making investment decisions. “We have technologies that are going to make an impact in the short term and we are investing in technologies that are going to change the world in the long term,” he says.

“We have a pipeline of start-ups that is over 300 companies deep right now. We have innovation in three verticals – aerospace, climate and decarbonisation, and technological investments,” Leskinen

explains. There is an executive leading each vertical with a team under them – and each one is expected to complete three to four deals per year.

UAV has its \$200 million pot, but funds from its investments are recycled, and some good early bets have made returns. “As we make investments and those are successful, and we harvest those gains, we get to reinvest, so this will give us the funds to invest for the foreseeable future. I think by the time we get a few years down the pipe we are going to be a billion-dollar fund,” Leskinen says.

Investment followers

That is encouraging, but there is more to it than that. “More critically we are not just BlackRock or Fidelity or another investing fund. We have expertise in this industry that most investors do not, with our test pilot group, with our environmental team with all the operational executives here running the airline – and so when we make investments you see many follow in making additional investments. A \$10 million or \$20 million investment from United can lead to a \$100 million investment round for that company. We use our

How airlines' technology investments could inflate business success

Airlines have differing priorities when it comes to sustainability investment and focus. However, for many, such as Spain's Air Nostrum, the introduction of an aircraft with novel propulsion, to carry nine, 19, or more passengers while emitting zero carbon dioxide is of prime importance.

This explains why it has committed to the 100-seat Airlander 10 from Hybrid Air Vehicles. "It opens lots of possibilities," says managing director Miguel Angel Falcon, who heads up Air Nostrum's environmental and aircraft planning groups, and likes the versatility the aircraft offers. "It doesn't require an airfield, making it almost like a helicopter. In that respect, you have a 100-seat helicopter performance which could operate in many destinations where we are not flying today."

The idea of operating to smaller cities the carrier cannot serve with conventional turboprops with a more fuel-efficient and environmentally-friendly aircraft is very economically attractive, Falcon says.

Wideroe Zero will learn about zero-emission aircraft operations from its partnership with Tecnam on the nine-seat P-Volt, while a mainline regional type of 40 to 70 seats is of paramount importance to replace its current turboprop fleet from 2030 onwards, says chief executive Andreas Kollbye Aks.

Hybrid Air Vehicles



Air Nostrum hopes to be launch customer for 100-seat Airlander 10

reputation and our brand to help these companies raise the capital they need to drive their technology."

At Wideroe Zero, Aks wants the team he is gathering to act with the freedom to innovate with technology and business models, without the need for a return on investment at this time, recognising that the introduction of both will attract competitors. Learning about the emerging technologies is critical on one hand, but equally important is the way businesses will evolve to profit from them.

Direct capture

"Somebody else will do this. I am very focused on giving this group of people in Wideroe Zero the freedom to think on an equal footing with a start-up," he says. "What the industry needs is a think-tank focused on the business modelling of this. We need to really understand how we are going to do this in the future, and we have a huge benefit of being closed-linked to an existing airline. We can get the experience and the data that airlines have, so we have access to a lot of important knowledge that can be difficult for start-ups."

One of the toughest challenges in the sustainability arena is that everybody wants to make progress on decarbonisation now, but the technology is not ready. Burr agrees the horizon for sustainability investments is longer. For example, JTV is interested in direct air capture technology being used to manufacture sustainable aviation fuel. "These are the kinds of things that will come to maturity in the seven- to 10-year range, even 15 years, so we are putting money against these types of technologies to help JetBlue in the future," she adds.

And while investments will be strategic and have financial growth and exit plans attached to them, there is a recognition that not everything will work. "Venture capital is risky," says Burr.

"We are putting money into start-ups. Some will fail but we do accept a certain amount of risk. However, we think we have a great, skilled team who thinks about what the right company is [to back] in each of these spaces."

Leskinen has the same view. "If I didn't pursue investments that were going to fail with some frequency, 75% of what we do I wouldn't do," he says. "But when those companies succeed, I make five, 10, 50 times our money and so when you aggregate that in a portfolio, we should be delivering 25% returns for United Holdings while at the same time we drive innovation."

This is also a time when joint innovation efforts between like-minded airlines can bring benefits. This is the approach Wideroe Zero is interested in taking,

"I am investing in your company because we want to change air travel and I'm going to be your salesman"

Mike Leskinen Vice-president corporate development and investor relations, United Airlines Ventures

The Norwegian company is also examining the potential role for four- to eight-seat electric vertical take-off and landing (eVTOL) aircraft in its fleet via a collaboration with Embraer spin-out Eve.

“Perhaps these aircraft could expand our network, although I see them more as an alternative to existing helicopter operations that can be used on our rural network,” Aks says. The key issues are ensuring low operating costs combined with high utilisation, and finding a price point that the average Norwegian will pay, he says.

Sustainable gap

JetBlue Technology Ventures (JTV) also made an early play in the eVTOL field with its investment in Joby Aviation. In total it has five investments in sustainability-related start-ups, with three more in play, says Amy Burr, president of JTV.

The portfolio includes Air Company, a New York-based start-up with technology that imitates photosynthesis by taking captured carbon dioxide and converting it into impurity-free alcohols with oxygen and water as the only by-products. One day this technology could be applicable to producing aviation fuels.

A gap in the portfolio is a dedicated sustainable aviation fuel (SAF) company. “We are looking at what could be the next generation of SAF technology that is tackling it a little differently and we have a couple of companies in our pipeline,” Burr says.

United Airlines Ventures (UAV) has been one of the most active investors, backing SAF manufacturers, firms with carbon capture technology, eVTOL maker Archer Aviation, and start-ups ZeroAvia and Universal Hydrogen, who are both developing hydrogen-powered propulsion systems.

On SAF, “the right approach is to invest in technology that is going to broaden the feedstock that we can utilise to produce fuel”, explains UAV president Mike Leskinen. “We are looking at technologies that would increase feedstock using other organics like algae.”

In September 2021, UAV, along with Honeywell, invested in Alder Fuels, a “cleantech” company developing technology to produce SAF by converting biomass, such as forest and crop waste.

“There are also power-to-liquid [PtL] technologies and in alcohol-to-jet there are a number of pathways there that potentially make sense,” Leskinen believes, with the latter a “here and now” opportunity. SAF made via the PtL route looks promising, but “it is 10 years-plus out, so we will be very thoughtful on investing in PtL where they have the right path and the right plan.”

Another novel technology that has caught Leskinen’s eye is genetic CRISPR technology and UAV is “pursuing pathways there”. This is where plants are genetically modified to “yield the products you want them to yield” – in this instance, biomass that will be better for making SAF.

10 years

Likely timeframe to maturity for technologies such as direct air capture to manufacture sustainable aviation fuel

and it has held discussions with Air New Zealand, which has similar challenges, Aks says.

The priority is decarbonising air travel, not just seeking competitive advantage. “If you are not a direct competitor of us, join us,” Leskinen says. “And in some cases, even if you are a direct competitor, we welcome this [opportunity].”

For instance, UAV has invested in ZeroAvia, which is a start-up developing hydrogen-electric aircraft propulsion systems. ZeroAvia’s chief executive, Val Miftakhov, was worried about UAV wanting exclusivity on its products, Leskinen explains, but the fund takes the opposite view, going against the grain of the venture-capital industry.

“I said: I am investing in your company because we want to change air travel and I’m going to be your salesman,” Leskinen says.

“I want American Airlines to buy. We want to make sure we get paid and have some benefit from our early involvement, but we want our portfolio companies to sell to everyone.”

Indeed, in addition to UAV, ZeroAvia now counts American, Alaska Airlines and British Airways among its investors. ▀



JetBlue made its first investment in eVTOL start-up Joby Aviation in 2017

Joby Aviation

Full throttle

To mark mid-October's 75th anniversary of the first manned supersonic flight, we revisit our reporting from the time, when Cold War tensions rapidly propelled new fighter technologies



FlightGlobal archive

Yeager's achievement with X-1 was kept secret for months

Craig Hoyle London

The “need for speed” continues to fascinate and inspire mankind, with leading militaries now fielding or striving to acquire hypersonic (Mach 5-plus) missiles, and multiple supersonic airliner and business jet designs being touted by their eager developers.

This rush of activity comes as the aerospace industry prepares to mark the 75th anniversary of the first manned flight to travel faster than sound. But while the ambitions and achievements of today’s would-be pioneers can grab instant headlines and online attention, the post-Second World War scramble to break the sound barrier involved closely-guarded secrecy.

Looking back to *Flight’s* issues of the time, the almost complete lack of information divulged by the USA about its activities and successes highlights the tensions of the time, as the Cold War rivalry began between the nation and the Soviet Union.

Indeed, the date 14 October 1947 only became etched in aviation history several months after the historic event had happened, so reluctant was the newly-created US Air Force (USAF) to go public about its breakthrough. Performed over California using an experimental rocket-powered Bell X-1 – at that time referred to as the XS-1 – released from an adapted Boeing B-29 bomber, the flight achieved M1.06 at an altitude of 43,000ft.

Top Secret

In its online fact sheet about the X-1 programme, NASA notes that “the flight and all data” were declared Top Secret within 2h of the event. “Not until December 1947 would word leak of the achievement, and it was not until March 1948 that the US Air Force officially confirmed the achievement,” it notes.

Writing in the ‘American Newsletter’ section of *Flight’s* January 29th, 1948 edition, our correspondent “Kibitzer” wrote about the uncertain situation, within a review of the previous year’s advances.

“Then came the rumours of success of the Bell XS-1 in its attempt to reach the speed of sound. These were only rumours to start with, but when linked with other apparently unconnected happenings it became obvious that something remarkable had occurred.

“Yet the secrecy ban... still remains. In the end the technical press could bear it no longer, and one aviation paper came out with a definite but unconfirmed statement that the Bell XS-1, piloted by Army and NACA pilots, had, by working gradually up through a series of flights with Mach numbers of .90, .92 and .96, at last gone through the sonic barrier to a Mach number of 1.1.

“The air force would neither confirm nor deny this report, but they were obviously upset by it, inasmuch as they are said to have handed the whole matter over to the Department of Justice to see if any security measures had been violated.”

Despite the uncertainty, the magnitude of the achievement was not lost on our writer, who noted: “Until the air force decide to release details of what has actually happened, it is foolish to make guesses... but if the reports are true it would seem that the sonic ‘barrier’ wasn’t such an insurmountable one after all. This alone is a fact of the greatest importance.”

Then, just two weeks later, our correspondent postulated about the emergence of the US Navy’s Douglas D-558 II.

“Following a logical line of thought it may be that the Bell XS-1 has forced the navy’s hand. Yet, if it is the XS-1 it can hardly be a contestant for the world’s speed record, for it cannot take-off under its own power on full load, nor has it the endurance.

“Again the logical deduction is that the army have gone for, or are shortly going to attempt, an attack on a Mach number of one – or better. This is borne out by a public statement from one of the heads of research here who forecast sonic speeds within a (or was it ‘the’) year.

“Personally, I doubt if the XS-1 can actually reach such a high Mach number, even at its designed operating height of over 70,000ft. But even if it does better than 0.9 at that altitude it will be a fine effort, and whoever flies it deserves all the credit he can get.

“The only strange thing about all this conjecture is that never before have the army been backward about proclaiming their achievements. Maybe the figures are hard to check, or the attempt is still to come.”

“If the reports are true it would seem that the sonic ‘barrier’ wasn’t such an insurmountable one after all”

Flight January 29th, 1948

Subsequently, we made reference to the achievement as a front cover ‘Outlook’ item in our June 17th, 1948 issue: some eight months after the event.

“Last Thursday, after relating how the Colour had not been Trooped, and telling the awful tale of England’s first innings, the BBC at news time added as a tail piece that an American aircraft had flown faster than sound.

“Some excuse may be admitted for thus dismissing one of the most important events in the sensational history of mechanical flight, for as long ago as last December a report appeared in the American Journal, *Aviation Week*, and was quoted throughout the world, to the effect that the Bell XS-1 rocket-propelled research aircraft had achieved supersonic speed, not once, but several times.

“Now that no less a person than Mr. Symington, American Secretary for Air, has given confirmation of this performance, we must hasten to tender our congratulations jointly to Captain Charles E. Yeager, the pilot named, to the Bell Aircraft Corporation who designed and built the XS-1 (in conjunction with the USAF and the NACA) and to Reaction Motors Inc., for the rocket unit.

“Whether supersonic speed was first achieved in conformity with a long-term programme, whether it occurred by accident or whether the pilot was suddenly overcome by a desire to ‘give her the gun’,]

It is not yet known, but, whatever the circumstances, the achievement ranks as one of man's most remarkable technical accomplishments."

Further details were not forthcoming, meaning that *Flight's* next notable mention came in our 28 September 1950 edition, as a News in Brief item.

"Nearly three years after making the world's first supersonic flight, the rocket-powered Bell X-1 research aircraft was flown, beneath a B-29, towards a final resting place in the American National Air Museum in Washington." This was accompanied by an image showing Yeager and the museum's director alongside the rear of the aircraft.

With the supersonic age now opened, others swiftly followed: 6 September 1948 saw the first such flight made by a British aircraft, the de Havilland D.H.108 Swallow.

Efficacious tonic

An editorial piece in our following issue described the flight – conducted by famed test pilot John Derry – as "One of the most efficacious tonics administered to British aviation in recent years".

"Derry had no firm intention of attempting to exceed Mach 1, the declared purpose of his flight being the collection of data at speeds above Mach 0.96, which he already attained. He put the 108 into a dive at 40,000ft, steepening the angle of descent as the hand of the Machmeter approached the magical figure '1' and holding the dive until the needle passed the limit of its indication," we wrote.

"He had experienced no unusual sensations, but as the speed built up the controls became very heavy, despite the power-boost system now installed. As the 108 decelerated to Mach 0.96 control characteristics returned to normal."

The rapid pace of airframe design and propulsion technology advances have since seen several generations of combat aircraft produced with supersonic performance, including Lockheed Martin's F-35B – the first short take-off and vertical landing type to be capable of the feat.

However, militaries today are exploring the potential of hypersonic technologies, for use in the guided weapons sector.

China in 2021 conducted a test launch of a hypersonic missile, prompting concerns from the US



US Air Force

Lockheed's hypersonic ARRW has undergone flights on a B-52

Department of Defense that Beijing could field an operational system capable of conducting rapid global strikes, or even of targeting the GPS-constellation satellites vital to enabling precision strikes by many of its own munition systems.

Russia, meanwhile, in March 2022 used the Ukraine conflict for the first in-anger launch of a hypersonic missile – the Kh-47M2 'Kinzhal' – from an RAC MiG-31 interceptor. The weapon was deployed against an underground weapons storage facility, Moscow says.

Those demonstrations using M5-plus systems exposed how Beijing and Moscow have stolen a lead over the USA in this weapons class. The USAF currently is funding development work on multiple candidate hypersonic weapons, but has enjoyed only limited success during testing.

Lockheed's AGM-183 Air-launched Rapid Response Weapon (ARRW) has completed two successful launches from a Boeing B-52 this year after suffering earlier setbacks, but the service is shifting funds to what it believes to be a more promising design, the same company's scramjet-powered Hypersonic Air-breathing Weapon Concept.

Experimental charge

The USAF is not alone in trying to catch up with Beijing and Moscow. At the Farnborough air show in July 2022, the UK Royal Air Force's (RAF's) Rapid Capabilities Office announced a pact with Reaction Engines to pursue a Hypersonic Air Vehicle Experimental activity. Drawing on the company's innovative precooler technology, the work will explore the feasibility of designing and operating a reusable platform, although the RAF declines to detail what it considers to be potential operational applications for such a system.

While it would appear to be feasible that a supersonic airliner or business jet could find a niche role with military customers, the idea of manned hypersonic aircraft being introduced is likely to remain the stuff of Hollywood.

In the *Top Gun* sequel *Maverick*, released earlier this year following a pandemic-driven delay, Captain Pete Mitchell is engaged during secretive US Navy flight testing of a M10-capable aircraft named Darkstar – a design created for the big screen by no less than Lockheed's Skunk Works unit.

But while the film does not indicate what sort of mission the platform could be tasked with performing, its reference to such development efforts being threatened as spending is increasingly channelled towards unmanned or space-based platforms is sure to be more fact than fiction. ▶



Rocket-powered X-1 was released from an adapted B-29 bomber

FlightGlobal archive

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Truss-ted Envoy

As we know, the final constitutional duty carried out by Her Late Majesty Queen Elizabeth II at her Balmoral Castle residence, just two days before her passing, was to formally ask newly-elected Conservative party leader Liz Truss to become her 15th Prime Minister.

Truss flew to Scotland in the Royal Air Force's latest Envoy IV, one of two head of state aircraft that will fly the representatives of Brexit Britain around the world.

If you have never heard of an Envoy IV, that is because the jet is in fact a Falcon 900LX, made by Dassault Aviation in France, whose president, Emmanuel Macron, Truss found difficult to name as a friend or foe during recent leadership hustings. "The jury's out," she quipped when asked by an interviewer.

The RAF tactfully rebranded the replacement for the veteran BAe 146 when it took delivery this summer. The search for a UK-built successor was reportedly short.

Meanwhile, the RAF's selection of a Boeing C-17, registration ZZ177, to carry the late monarch's coffin from Edinburgh to London ahead of her lying in state in Westminster was highly apt.

Upside down, the registration can be read as LLIZZ.



Envoy IV: Dassaults in disguise

Crown Copyright

Vulcan on the move

Trustees of a preserved Avro Vulcan are not ruling out a ferry flight to a new location, following a decision not to extend the parking agreement for the bomber at Doncaster Sheffield airport.

The loss-making airport is facing potential closure after its operator initiated a strategic review of the site. But even before the review the Vulcan to the Sky Trust – the charity which oversaw the aircraft's restoration and return to flight – had been told the parking agreement would not be renewed once it expires in June next year.

The aircraft was grounded in 2015, after several years of performing at air shows, but efforts to fundraise for a permanent hangar have not been successful.

From the archive

100

1922 No licence required

At Croydon County Police Court, on October 14, Thomas Baden Powell, 22, of Tunbridge Wells, was summoned by the Air Ministry for flying on August 20 from Croydon to Penshurst without a pilot's licence. Mr. W. Paling, for the Treasury, said that last March the defendant applied for a registration certificate for his machine, but failed to enclose the fee of one guinea, and no registration took place. On August 20 he flew from Croydon to Penshurst, and his machine crashed on arrival. The defendant said he had not undergone any pilot's test. He had flown about twelve times between Penshurst and Croydon, and had not been stopped by anyone. He had been flying for about fourteen months at Penshurst, and had taken up a passenger once or twice.

75

1947 Swiss efficiency

A tremendous amount of time is wasted between reporting to the airline office, or terminal, and the time the aircraft wheels leave the ground. Swissair is a shocking offender. The timetable calls for the passenger to report to the airline office in Geneva at eleven o'clock for a twelve-thirty-five take-off! The journey from the centre of Geneva to the airport can't take more than twenty minutes and the formalities of the Swiss Customs and Immigration authorities can't take more than another twenty. The net result is that the wretched passenger must hang about, either at the terminal office or at the airport, for some fifty-five minutes, time which might be better employed. When an efficient operator like Swissair permits such a waste of time it is hardly likely to help air travel.



Returning to service:
Gunn's Mk1 Spitfire

Top Gunn

GKN is putting £500,000 (\$575,000) towards the restoration of a Mk1 Spitfire, a type the company built fuselage frames for eight decades ago.

AA810 was an unarmed, long-range reconnaissance aircraft shot down over Norway in 1942, while piloted by Alastair "Sandy" Gunn, whose story was later immortalised as one of those who broke out of Stalag Luft III in the film *The Great Escape*.

GKN apprentices will work on the aircraft before its planned return to flight in 2024. The Sandy Gunn Aerospace Careers Programme is behind the project, and says it will use the aircraft to inspire future generations to join the industry.

The work is being done at Sandown airport on the Isle of Wight, close to the Cowes factory where GKN made Spitfire parts during the Second World War.

Gunn was one of 76 men who broke out from the prisoner of war camp in March 1944. Shortly afterwards, he was captured and killed by the Gestapo.

The remains of his Spitfire were found in a bog in Norway in 2018 and returned to the UK.

Its trustees have yet to find a suitable location to house the jet. Two potential sites – yet to be identified – are under consideration.

The trust's chair, John Sharman, says transporting the Vulcan would involve "significant challenges", such as dismantling the jet and rebuilding it.

But he is not ruling out the possibility of securing permission for a one-off short ferry flight to enable the aircraft to arrive intact. Sharman says the trust is "exploring every option", even though the UK Civil Aviation Authority had previously denied further permission for the aircraft to fly again.

"It would be extremely sad to dismantle [the Vulcan], [but] it would mean that, ultimately, [the aircraft] will be preserved and will still be able to inform, educate and inspire future generations of engineers," he adds.



Vulcan to the sky again?
Unlikely but not impossible

1972 The profit barrier

A quarter of a century after Chuck Yeager went supersonic the question is not whether the airlines can break the sound barrier. Concorde, perhaps more advanced for its day than the X-1 was, has proved the technical feasibility of supersonic passenger flight. What the airlines are worried about at the moment is how the operation of subsonic aircraft can make them a profit. We believe that the latest figures, based on data never before published, make the economic case for Concorde. It is not enough to have the "gut feeling" that speed is right and worthy of pursuit for its own sake, even though it was this feeling that launched the subsonic jet airliner—also 25 years ago—and eventually stopped the propellers on all the world's major air routes.

1997 Raptor's first flight

Initial pilot reaction to the Lockheed Martin/Boeing F-22 Raptor is that it is an aircraft "quick in roll and acceleration, yet very stable with excellent control" in formation flying and approach configuration, says chief test pilot Paul Metz. Describing the 58min first flight on 7 September, Metz says that the F-22 rotated at 140kt (260km/h) and "...stopped at 12°, right where I wanted it" for the shallow climb-out, during which it accelerated to 210kt. As the aircraft climbed to 15,000ft (4,600m), the "...amount of buffet on the airframe was surprisingly high", adds Metz, who says that the test team suspects the gear and "particularly flaps". Performance of the Pratt & Whitney F119 engines was flawless. "I didn't even think about them," he says.

Removing barriers

In my opinion as a retired pilot, I do not think that locking the cockpit door and adding some new barriers between the flightdeck and the cabin is the best way to improve the whole safety of flight operation.

In the cabin of a modern aircraft, we find more and more electronics in seats, including television screens for communication, comfort and entertainment purposes, meaning there are panels full of breakers and switches. Those systems are prone to failure, due to overheating and numerous other critical behaviours.

Technical crews may need to intervene in order to secure the operation of a given item through

proper checklists. There are situations, too, when a technical crew may have to check, such as evaluating a leak in the cabin floor or from a wing, or assessing any abnormal flight performance, from a cabin window.

In addition – and not to be disregarded – access to rest compartments, toilets and food storage or galleys requires frequent opening of the cockpit door.

To remain captain in command of the aircraft, as well as to manage the whole crew and passengers, means that you should have the opportunity to move in the cabin, for a short while, when deemed necessary.

In order to get rid of the risk of having a lunatic barricading themselves on the flightdeck, it should remain possible for any crew member to force the cockpit door open at any time.

The best way to ensure maximum safety aboard an aircraft, considering hijacking risk and any other human threats, should lie in providing a proper and thorough screening check of every passenger and cabin bag at the most considered critical moment: prior to boarding.

This undoubtedly occurs when a passenger leaves the waiting area of the terminal and transits the bridge leading to the cabin entry door. Any forbidden item would be identified, removed and its holder taken aside straight away, meaning that no sensitive object would ever enter the cabin.

That surely would eliminate one of the greatest potential dangers in human wrongdoing and lawbreaking on an aircraft?

Jean-Pierre Callu

Via email



Time has come for UK to splash out on aerial firefighting

Hot topic

Having seen the fires in London, south Hampshire and elsewhere in the UK that took place this summer, is it about time we put in place our own capacity for aerial firefighting, or in other words “water bombers”?

According to the National Fire Chiefs Council there were 247 wildfires in the UK last year, but in 2022 there were 442 by a little over halfway through the year.

I spent 2009 in Canada converting the first BAe 146 water bomber and it never occurred to me that a requirement for

such an aircraft would arise in the UK. However, times change and temperatures have risen since then and we need to take measures now to protect lives, property and the countryside while the long-term measures to counter global warming start to take effect.

Two aircraft could easily cover the whole of the UK, and based on a 400mph (347kt) cruise could be on the scene within the hour. If work started now we could have aircraft available for the next summer – or fire season, as it is becoming.

France has more than 20 aircraft in its firefighting fleet,

while the UK currently has not a single one.

I have started a petition calling for the UK government to “establish and maintain an aerial firefighting capability to combat wildfires” to get something done, but it needs support and raised public awareness of what could be put in place.

Two aircraft and the initial year’s operation would cost less than one Lockheed Martin F-35 for the Royal Air Force.

Find out more at petition.parliament.uk/petitions/620876

Richard Thomasson

Newnham, Gloucestershire, UK

There were no fatalities after British Airways 777 suffered uncontained engine failure at Las Vegas in 2015

Stuart Scheinman/Shutterstock



Keep calm and trust your pilots

Lance Cole raises interesting points in his letter 'A burning safety issue' (*Flight International*, August 2022). I was disturbed though by the implication that pilots are uninformed bystanders in the incidents he refers to.

He refers to an "isolated flightdeck"; it may well be that the cabin is more "isolated" from the broader picture being considered by the pilots.

I don't intend to delve too deeply into the cases he mentions, but the incident with the wing burning may well have been correctly handled. With the fuselage not immediately threatened (taking into account the pattern of the flames and wind direction) and, having seen the close proximity of approaching fire crews, the flightcrew judged it safer to stay on board.

In the airline I work for as a widebody captain, cabin crew are trained to only initiate evacuation if the circumstance is "clearly catastrophic". This is defined as a situation when it is probable that the pilots are incapacitated, or conditions inside the cabin are unmanageable and pose an extreme and immediate threat to life.

"The sight of flames" (as alarming as that may be) and "windows warmed" will not qualify.

Pilots are taught to gather information and make objective judgements taking more factors into account than may be immediately obvious to others. What seems dramatic and compelling may well not be the main consideration regarding the best course of action.

For example, a tailpipe fire, which could burn the underside of the wing, requires a drill to blow air through the engine to put the flames out. Time taken starting the auxiliary power unit to enable this could be required, on top of other processes involved. Should the cabin crew precipitously initiate an evacuation in this instance, the pilots would be compelled to stop the drill, allowing the fire to spread.

In other circumstances, non-pilot-initiated evacuation could be an extreme risk, as engines may still be running.

Procedures are written by expert industry insiders – who have far more knowledge than I do – after lengthy consideration. For it all to work, it is imperative the drills are followed correctly and not jeopardised by impulsive passengers who believe they have better ideas.

How is it acceptable to condemn the carrying of cases during an evacuation while, on the other hand, Mr Cole tells us that he would potentially choose to disobey the commands of the crew during an incident? If people cherry-pick which regulations they choose to obey, it will certainly lead to more confusion, danger and fatalities during a major incident.

Protocols are sound as they are, although that is not to say that all incidents run smoothly.

Trust your pilots to arrive at the correct decision by use of their training, and co-operate by obeying those commands passed down the chain to the cabin; that remains the safest way forward.

James Allen

Brackley, Northamptonshire, UK

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Currently awaiting a first officer position on AirAsia's single-aisle fleet in Kuala Lumpur, **Cindy Wong** completed her training thanks to an ambassador scholarship from CAE

A pioneer for 'Women in Flight'

Pilar Wolfsteller Las Vegas

When Cindy Wong was studying for a university degree in psychology in Australia, she did not know what she would end up doing with it – there was certainly no burning desire to become a psychologist.

But when her flight attendant sister mentioned that her airline was hiring flightcrew – and female pilots in particular – Wong snapped to attention.

As many of her millennial peers would do, Wong reached for her phone.

"I started to stalk pilots on Instagram," the now 27-year-old Malaysian says.

She wanted to know all about the career path: what kind of people were pilots? Where did they come from? What were the requirements? Soon, she began charting a path to join their ranks, applying to AirAsia's cadet programme. But her first attempt flopped when she failed the initial assessment tests.

Cadet success

"I was devastated, but I knew this is what I wanted to do," she says. She spent the next year preparing to retake the exams, and was accepted into the programme on her second try. In her batch of 20 cadets, she was the only woman. And then the doubts set in.

"Suddenly being surrounded by 19 guys was really intimidating for me. 'How do I behave? Do I behave like them? Or can I just be myself?'"

"I felt that I needed to perform better than everyone else. I felt intimidated. 'Should I say what I'm thinking? Will I look dumb if I answer like this, you know, because I'm a girl?'"

"My father actually wanted me to do a Master's degree," she says. "He thought that would be easier."

That was four years ago. Covid-19-driven delays extended her training – she endured three lockdowns after finishing ground school in July 2019 – and despite her parents' initial concerns she is now

the holder of a multi-crew pilot licence (MPL), an accelerated-path certification which qualifies her to work as a first officer on Kuala Lumpur-based AirAsia's Airbus A320 fleet.

In the meantime, she has amassed more than 300 total flight hours – 200h in simulators and the rest in a Cessna 172 – and the next step is to wait for a flightdeck seat to open up.

With commercial aviation in Asia still curtailed because of the after-effects of the pandemic, Wong expects she may have to wait up to a year before she can start her first cockpit job.

"You hardly ever hear of any scholarships, especially here in Malaysia, and for women, so this opportunity was amazing"

Wong's aviation journey has an added twist. Like pilot candidates everywhere, she was unsure where she would find the money to finance her training. Airline-sponsored cadet programmes are widely a relic of the past, and training today is often beyond many candidates' immediate financial means.

That is where Canadian training specialist CAE stepped in, with its "Women in Flight" Ambassador scholarship programme.

"You hardly ever hear of any scholarships, especially here in Malaysia, and for women," she says. "So this opportunity was amazing."

Wong applied, and won funding worth MYR400,000 (\$90,000).

CAE has so far selected pilot cadet candidates at six carriers – Aeromexico, AirAsia, American Airlines,



Ready and waiting: Wong is looking forward to her first flightdeck job



CityJet, EasyJet and Southwest Airlines – to receive the scholarships. It currently sponsors one candidate at each of those carriers. The company hopes to extend the programme to further airlines in the coming years.

Public speaker

Wong’s obligations as a “Women in Flight” ambassador include speaking publicly about her experiences, giving interviews and conducting other kinds of outreach.

In July, she travelled to the UK to speak about her aviation journey at the Farnborough air show. She has presented at schools and at other aviation-themed events, hoping to inspire more girls and young women to look into the many career possibilities that the industry offers.

“It’s not just about pilots or cabin crew,” Wong says. “There are so many different roles in aviation, and I think girls are not aware of the wide scope of career paths – instructors, technicians and mechanics, for example. So, I feel there’s a lot of potential when we reach out and say ‘Hey, you can make this a career too. You can be a technician if that’s what you like. Or anything else’.”

Soon-to-be AirAsia first officer Wong is very aware that in a few short years she has gone from pilot fan-girl to being an important role model herself.

And, perhaps, one day, another young woman will look her up on Instagram. ▶

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