

FLIGHT

INTERNATIONAL

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ANNIVERSARY

Supersonic champion

Fifty years since its debut – why Concorde remains unrivalled icon



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Command fail

How unqualified pilot's actions doomed Aeromexico E-Jet **9**

Power battle

GE, Rolls-Royce vie for CRJ929 widebody engine selection **10**



MH-60R shows its strengths for Australian navy **P18**



Commonwealth of Australia

BEHIND THE HEADLINES

Greg Waldron was at the Avalon air show, where Boeing revealed a new unmanned air vehicle for Australia (P15). Meanwhile, Dominic Perry visited Paris, for Dassault's results (P6)



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NEXT WEEK TORNADO

We pay tribute to Panavia's Tornado, as the type leaves UK service. Plus, a show report from HAI Heli-Expo

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Critics mocked it as a loss-maker, but for raw aviation beauty and human inspiration there is nought to rival Concorde, which first flew a half century ago



Anton Aranasjovic/Serbian defence ministry

Serbia to update MiG-29s gifted by Belarus **P16**

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Image of the week

South African airline Comair has begun a fleet renewal programme with its first of eight Boeing 737 Max 8s. Adorned in the livery of British Airways, for whom it operates under franchise, the narrowbody joins the Johannesburg-based carrier's 18 737NGs and seven 737 Classics in use

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Boeing

The week in numbers

 **44%**

Cirium Dashboard

Revenue grew 9.2% but unit costs including fuel soared for AirAsia, where 2018 operating profit nearly halved, to \$298m

€10.5bn

Safran

Safran's 2018 propulsion revenue was up 11.7%, thanks in part to its share of 2,162 CFM56 and Leap engine deliveries

2

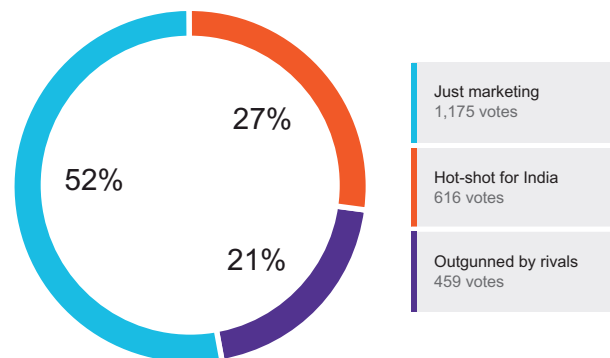
Cirium Dashboard

Bids received for parts of the network and maintenance unit at Germania; the privately held airline went bust in February

Question of the week

Last week, we asked: **Lockheed Martin's F-21?**
You said:

Total votes: 2,250



This week, we ask: **Commercial supersonic flight?**

☐ Gone with Concorde ☐ Powering up afresh

☐ Environmental affront

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Technical perfection

Fast love

Concorde's flying debut 50 years ago marked a significant step in transport evolution. While the supersonic airliner era may now be consigned to history, our admiration for what the Mach 2 design represented remains undiluted

From the beginning of time until about 1840, the distance a man could travel between getting up and going to bed was about 75 miles... then technology produced the aeroplane, and today a man can travel 7,000 miles in his waking hours. When the supersonic era is inaugurated this 12h distance will have become 12,000 miles, which is pretty well anywhere on earth."

This summary of transport evolution appeared in *Flight* as Concorde took to the air for the first time in March 1969. However, the conclusion that followed would unfortunately turn out to be wide of the mark: "one of the basic laws of transport... is that traffic volume increases as journey time decreases".

Concorde did everything that was asked of it from a technical point of view, but sadly that "basic law" did not manifest itself and make supersonic air travel a sustainable business proposition for airlines.

The development and introduction of Concorde by the British Aircraft Corporation and Sud Aviation took more than a decade, from the signing of the Anglo-French Supersonic Transport Aircraft Agreement at Lancaster House in November 1962 to service-entry in January 1976.

There have been many words written about why Concorde failed, or why it was even built in the first place. But suffice to say that the single objective of all involved in its creation was to make "operation of the aircraft a safe and economically-viable proposition".

Jet-airliner economic viability was a rapidly-moving bar in the 1960s and 1970s (as was the environmental one). Aircraft such as the Boeing 707 and Douglas DC-8 – long-haul benchmarks when Concorde was conceived – were facing obsolescence when it arrived in service.

The aircraft that would revolutionise air transport had taken to the air exactly three weeks before Concorde. At the time of that maiden flight, the Boeing 747 faced as much uncertainty as its supersonic rival, with many convinced that speed would win over size.

"Concorde did everything asked of it from a technical point of view, but supersonic air travel wasn't sustainable"

But the jumbo jet's combination of high capacity and high-bypass powerplants – allied to rapidly-rising oil prices – moved the economics dial to a point beyond the industry's wildest dreams a decade earlier. Thus, Concorde's prospects were shattered and just 14 aircraft were delivered – but not before the needle-nosed dart had earned a special place in the hearts of even the most hardened unbelievers.

Many happy returns, Concorde!

See Feature P24

Shear madness

On an August day in the Alps last year, a teenage enthusiast on a pleasure flight aboard a single-engined Piper was offered the opportunity to take the controls, even though he had no experience and the pilot had no instructor qualification.

The heavily-laden aircraft laboured to climb in the warm air, negotiating a course through high terrain at low height and with no margin for recovery, when it suddenly banked sharply and dived into the ground.

Just one of the four occupants, a rear-seat passenger, survived the accident.

What might be seen as an understandable – if ultimately pernicious – lapse of judgement in the context of a relaxed and apparently harmless sightseeing trip takes a wholly more startling and indefensible aspect when translated to the cockpit of a commercial airliner.

Yet such was the case a few months later. That the pilot of the Aeromexico Connect Embraer 190 which crashed on take-off during a storm at Durango had, at least, considerable light-aircraft flight time in his logbook hardly begins to redeem the stupefying decision of the captain – not qualified as an instructor – to hand control of the jet to an individual with zero hours on type.

Nor does the fact that Mexican investigators primarily blamed windshear for the crash – nor that, by a truly extraordinary quirk of good fortune, everyone on board the wrecked regional jet emerged alive before it burned out.

Swiss investigators absolved the teenage aviation buff of responsibility for the fatal Piper crash, stating that he could not be held accountable for seizing a one-time chance to take the controls of the aircraft.

For the pilots in the cockpit at Durango, that excuse just isn't going to fly. ■

See This Week P9



Not so smart

BRIEFING

KASHMIR CLASH CLAIMS INDIAN MIG-21

CONFLICT Cross-border tensions in the disputed region of Kashmir escalated on 26-27 February, with an Indian strike on alleged militant training camps in Pakistan prompting a clash during which an Indian air force Mikoyan MiG-21 fighter was shot down in an air-to-air engagement. Its pilot ejected before being captured by Pakistani forces. Further losses on each side were reported to have occurred during the flare-up.

THAI START-UP AWAITS SUPERJET 100S

FLEET Thai Kom Airlines will receive its first of six Superjet 100 regional jets later this year, following the signature of a deal worth around \$300 million at list prices. Sukhoi Civil Aircraft says the SSJ100s are to be delivered through 2020, in a 100-seat configuration. The start-up carrier will use the type for domestic and international services, supported by Thai company WishV.

GOAIR, SRILANKAN GET SKYWISE SERVICES

CONTRACTS Airbus has secured agreements with GoAir and SriLankan Airlines to utilise the airframer's data platform, Skywise Core. GoAir will be the first Indian customer for the product, while SriLankan will use it for predictive maintenance on its fleet of A320s and A330s.

MISSED LEASE PAYMENTS HIT JET AIRWAYS

FINANCE Jet Airways has pulled two more aircraft from service after it missed lease payments. The carrier revealed the latest groundings in a stock exchange disclosure on 23 February. Four jets had already been grounded on 7 February over non-payment of rentals. None of the affected aircraft have been identified, nor the lessors involved.

BRAZILIAN NAVY ACQUIRES H135 TRIO

ORDER Airbus Helicopters is to supply the Brazilian navy with three H135s. To replace its twin-engined Eurocopter AS355 light utility helicopters, these will perform transport, search and rescue, medical evacuation and naval inspection tasks, and could also support the Brazilian Antarctic Programme.

INDIA CONSIDERS C295 ADAPTATIONS

VARIANTS India's Defence Research and Development Organisation is eyeing airborne early warning and control and multi-mission maritime aircraft adaptations of the Airbus Defence & Space C295, should the nation advance with a planned order for 56 of the tactical transports.

HH-60W DEBUT SCHEDULED FOR JULY

DELAY Sikorsky plans to perform a first flight with its HH-60W combat rescue helicopter in West Palm Beach, Florida by July. The new model had been due to make its debut last October, but this schedule was delayed because of design and manufacturing deficiencies with its fuel tank. The US Air Force plans to buy 112 examples to replace its HH-60G Pave Hawks.

SPACESHIP TWO REACHES NEW HIGH

TESTING Virgin Galactic's SpaceShipTwo, VSS Unity, reached an altitude of 295,007ft and Mach 3.04 during a 22 February test flight above Mojave, California. Its three crew members experienced several minutes of weightlessness.



Bilateral concept failed to advance beyond its initial study phase

DEVELOPMENT DOMINIC PERRY PARIS

UK and France end UCAV programme

Dassault cites Brexit uncertainty, funding pressures for early cancellation, although future convergence is still possible

An Anglo-French project to develop and fly an unmanned combat air vehicle (UCAV) demonstrator has officially ended, with the aircraft having failed to get off the drawing board.

BAE Systems and Dassault – as well as engine partners Rolls-Royce and Safran, plus systems specialists Leonardo and Thales – had been working on the project, following the signing of the Lancaster House treaty between France and the UK in 2010.

Although initial studies were completed, the planned next phase of the UCAV programme had been due to launch in 2017. However, Dassault chief executive Eric Trappier confirmed at an annual results briefing in Paris on 28 February that work with “our British friends” has now ceased.

Trappier remains uncertain why negotiations with the UK Ministry of Defence stalled, but cites Brexit uncertainty and financial constraints as factors.

“I never had a clear answer to that question,” he says. “I have tried to meet with the Ministry of Defence, with the secretary of state and the people in charge of procurement in Whitehall.”

While certain projects in the defence field continue with the UK,

“but not to the same level”, France has since agreed to partner with Germany in developing a Future Combat Air System, to enter service in around 2040. Spain has also signed up for the project.

Dassault will lead the work on a new-generation manned fighter, with support from Airbus Defence & Space, which will be in charge of the unmanned portion of the programme. MTU Aero Engines and Safran Aircraft Engines are jointly developing engines for the aircraft.

The UK, meanwhile, is pursuing its own future fighter under the Tempest programme, with BAE and R-R as industrial champions.

Trappier does not rule out that “in theory” those teams could come together to develop a single aircraft type, while adding: “but in practical terms, I don’t know”. He confirms that Dassault was not approached to participate in the Tempest work.

Meanwhile, Dassault is this year continuing flight tests of the Neuron UCAV demonstrator. Conducted in collaboration with France's DGA defence procurement agency and the country's air force and navy, the latest round of trials is designed to evaluate the aircraft's stealth characteristics. ■



CFM battles to keep pace with Max production
This Week P8

REQUIREMENT DAVID KAMINSKI-MORROW LONDON

777-9 order just part of BA's long-haul needs, says Walsh

Airframers "still have a lot to play for" in fleet modernisation programme, IAG boss states

IAG has stressed that British Airways (BA) still has a requirement for a substantial number of Boeing 777-200ER replacements, following the intense competition which resulted in it ordering up to 42 777-9s to modernise its long-haul fleet.

Group chief executive Willie Walsh states that BA engaged with Airbus, Boeing and engine suppliers GE Aviation and Rolls-Royce prior to selecting a successor for 14 747-400s and several of its oldest current 777s.

"All of them wanted this [order]," Walsh said during a full-year financial briefing. "It's probably the most aggressive approach I've seen, from all four, in terms of them wanting our business."

Walsh says the UK flag carrier needed an aircraft with similar capacity and layout to its 747s, with the 777-9s to be configured with



Flag carrier has ordered 18 examples, with a further 24 as options

325 seats – provisionally with eight first- and 65 business-class, around 46 in premium economy and 206 in economy. The airline has confirmed an order for 18 of the type, with the first 15 to arrive in 2022-2023, with options on another 24.

BA had 35 747-400s at the end of 2018. The GE9X-engined 777-9s will complement its Airbus A350-1000s and some 777-

300ERs in succeeding the jumbos, which will be phased out in 2024.

Four 777-9s will be used to start the 777-200 replacement programme. Walsh says BA has a total of 46 of the earlier model, and that more will need replacing. "All four [manufacturers] still have a lot to play for," he says.

IAG's fleet plan, disclosed last year, showed it needed 44 long-haul aircraft from 2020-2023. ■

EMBARGO DAVID KAMINSKI-MORROW LONDON

MC-21 schedule disrupted by US sanctions policy

US embargoes on the import of advanced materials by Russian manufacturers of composite structures have forced Irkut to push back serial production of the MC-21 twinjet.

"We were supposed to have rolled out a first serial aircraft by the end of this year. Now the timeframe has shifted towards the end of 2020," says Sergei Chemezov, chairman of Rostec, which owns 92% of Irkut's parent United Aircraft.

Introduced in January, the sanctions target an AeroKompozit plant in Ulyanovsk and Obninsk-based Technologiya. Both are involved in the manufacture of carbonfibre components for the MC-21's wingbox and tail fin, and had previously dealt with US-based company Hexcel.

Chemezov says Rostec is acting to secure its supply chain through import substitution. ■

PARTNERSHIP JON HEMMERDINGER BOSTON

Boeing tie-up soars past Embraer's shareholders

Embraer's shareholders have approved a plan to sell majority ownership of its commercial aircraft unit to Boeing, bringing the companies closer to achieving a goal of completing a deal by year-end. They also backed a pro-

posal for Boeing to take a major stake in the company's KC-390 military transport programme.

The partnership was approved by 96.8% of voting shareholders, who combined own a total 67% of its stock.

Outlined in an earlier memorandum of understanding, the agreement would see Boeing acquire 80% of "all aspects" of Embraer's commercial aircraft division – including design, manufacturing, certification, services and sales – and assume "full strategic and operational control and management". The Brazilian company would retain 20% ownership of the new company.

The deal now values Embraer's commercial division at \$5.26 billion, meaning Boeing's 80% stake will cost \$4.2 billion. Seattle had last year assigned a total value of \$4.75 billion to the unit.

Another joint business will promote and further develop the KC-390, with Embraer to have a 51% stake and Boeing the remainder.

"This groundbreaking partnership will position both companies to deliver a stronger value proposition for our customers and other stakeholders and create more opportunities for our employees," says Embraer chief executive Paulo Cesar de Souza e Silva.

Boeing chief executive Dennis Muilenburg expects the deal to "build on Boeing's and Embraer's long history of collaboration, benefit our customers, and accelerate our future growth".

Embraer notes: "The closing of the transaction is now subject to obtaining regulatory approvals and the satisfaction of other customary closing conditions, which Boeing and Embraer hope to achieve by the end of 2019." ■



Deal will transfer control of products including E190-E2

PROPULSION MICHAEL GUBISCH LONDON

CFM battles to keep pace with Max production

GE Aviation-Safran joint venture CFM International has overcome a delay in deliveries of Leap-1A engines to Airbus's

A320neo-family production line, but is still battling a three-week shipment lag for the Boeing 737 Max-powering -1B.



737 ramp-up means Leap-1B deliveries must hit 30 a week this year

Safran chief executive Philippe Petitcolin says CFM reached a weekly delivery rate of 15-16 Leap-1As last year, in line with Airbus's requirement. Deliveries are now on schedule, and production has stabilised, he said in a full-year results briefing on 27 February.

But for the 737 Max, "It is a different story," he says, "because Boeing is still in a huge ramp-up and increase of production."

In 2018, CFM reached a rate of 16-18 -1B deliveries per week, while the US airframer's plan required "at least 20" by year-end.

"We are now at a bit more than

20, but we have to grow to 30 engines a week by mid-year 2019," says Petitcolin.

CFM produced 2,162 engines last year: an increase of 13.6% over 2017. This total included 1,118 from the Leap-series, up from 459, and 1,044 CFM56s; a reduction of 400. It will further increase Leap production to more than 1,800 units in 2019, from a total backlog of 15,620.

Petitcolin says he sees "no problem" with further boosting output for the Airbus and Boeing narrow-bodies from 2021, "When we have a sustained production". ■

PROGRAMME
DAVID KAMINSKI-MORROW
LONDON

Boeing deadline for NMA engine thwarts R-R bid

Rolls-Royce has withdrawn from a contest to develop an engine for Boeing's proposed New Mid-market Airplane (NMA), saying it is "unable to commit" to the required timetable with a "sufficiently mature" powerplant.

"This is the right decision for Rolls-Royce and the best approach for Boeing," says Chris Cholerton, the engine manufacturer's civil aerospace president. "We do not want to promise to support Boeing's new platform if we do not have every confidence that we can deliver to their schedule."

R-R will mature and de-risk its UltraFan architecture for future applications, he adds, describing the new-generation design as "the foundation of our future large civil aero engine programmes".

"We had begun its development before the Boeing opportunity emerged and it must undergo a rigorous testing regime before we offer it to customers, which we do not believe can be achieved within the NMA timeframe," he says. ■

See Air Transport P11

ACCIDENT JON HEMMERDINGER BOSTON & DAVID KAMINSKI-MORROW LONDON

US investigators puzzle over Atlas freighter's sudden dive

NTSB chairman says 767 entered fatal descent with no distress call from crew members

US investigators are analysing surveillance footage that revealed an Atlas Air Boeing 767-300ER freighter, bound for Houston, had entered a steep dive before it crashed into Trinity Bay, some 60km from the airport, on 23 February. None of the three occupants survived the accident.

Obtained from a county jail 1nm (1.9km) away from the crash scene, the 5s video clip showed the twinjet in a "steep nose-down attitude", says National Transportation Safety Board (NTSB) chairman Robert Sumwalt. "I saw no evidence of the aircraft trying to turn or pull up at the last moments," he adds.

Air traffic control communications indicate that flight 5Y3591 from Miami was being vectored around a band of poor weather in the 10min before the accident.

The crew had informed approach control that they were descending through 17,800ft, inbound from the east over the Gulf of Mexico. They were instructed to "fly the runway 26L transi-



Twinjet was performing delivery service for online retailer Amazon

tion", before being advised that there was "light to heavy" precipitation moving eastbound. "If you need to go vector around it, we'll be able to accommodate that," a controller told the pilots.

The crew sought to "go on the west side" of the airport, but were informed this would be difficult because of departures heading that way, and replied: "Okay then, we'll go the east side."

Controllers cleared a descent to 3,000ft, but when the jet was at 6,000ft and 240kt (440km/h),

communications and radar contact were lost. "There was no distress call," Sumwalt confirms.

The GE Aviation CF6-powered twinjet, N1217A, was built in 1992 for Canadian International Airlines, according to Cirium's Fleets Analyzer. Atlas Air was operating it for online retailer Amazon's Prime Air.

The NTSB has recovered remains of both wings and landing-gear components from a debris field measuring about 600ft by 300ft. ■



CRAIC powers up
CR929 engine
selection
Air Transport P10

THIS WEEK

INCIDENT DAVID KAMINSKI-MORROW LONDON

'Aspiring' pilot flew E190 before crash

Unqualified crew member was in first officer's seat when twinjet lost height after take-off and struck runway at Durango

Mexican investigators have disclosed that an unqualified pilot had been sitting in the first officer's seat of an Embraer 190, flying the aircraft, moments before it crashed on take-off during poor weather at Durango.

All 103 occupants survived the crash, on 31 July last year, although the Aeromexico Connect aircraft (XA-GAL) was destroyed.

The commission probing the accident found that a crew member travelling in the cabin had been allowed into the cockpit, but took the place of the first officer before the departure.

It points out that the crew member held a multi-engine licence to command Beechcraft King Air turboprops, and was "aspiring" to become an E-Jet first officer, having started initial theoretical training in May 2018 and completing 64h of simulator activity.

He had logged nearly 3,300h on other aircraft, but had no flight experience on E-Jets, and had not completed simulator evaluations required before route training.

But investigators state that the crew member had been sitting in the first officer's seat while the first officer had been assigned to carry out external pre-flight inspection of the E190.

Not only was the crew member not authorised to operate the air-



Captain was not in control until 8s before aircraft impacted ground

craft, the captain was effectively acting as his instructor – a task for which he was also unqualified. The actual first officer sat in the observer's seat in the cockpit.

Prior to departure from runway 03, a thunderstorm had moved into the vicinity of Durango airport. Cockpit-voice recordings reveal that the windscreens wipers were active as engine thrust increased for the take-off roll.

As the aircraft accelerated – with the crew member in control – differences in airspeed indications between the captain's and first officer's instruments became apparent at 80kt (148km/h), indicative of windshear.

The crew member rotated the aircraft at 148kt, according to his instruments, and 152kt according to the captain's, pitching the jet nose-up at just over 10°.

Barely had the aircraft lifted off when a "gear up" command was recorded, with the aircraft little more than 2ft above the runway. The inquiry says this "contradicts" standard operating procedures in windshear, which require the undercarriage and flap configuration to remain unchanged until reaching 1,500ft.

GEAR-UP COMMAND

Flight-data recorder information shows the gear-up command came at a height of 2.1ft and a ground speed of 144kt.

The E190 had reached a height of only 11ft, with airspeed indications starting to decline, when the captain declared he was taking over control. It continued to climb, reaching a maximum height of 30ft, with the captain's airspeed indicator showing 130kt.

While the crew testified to hearing windshear alarms, none was heard on the cockpit-voice recorder. The inquiry found that a "don't sink" alert – which takes priority over windshear alarms – started sounding at about 20ft.

The jet lost height and struck the runway surface, to the left of the centreline, some 2,150m (7,050ft) from the threshold and close to taxiway B. Both engines broke away from the aircraft, which slid along the ground and came to a halt 400m beyond the threshold of the opposite-direction runway 21.

Investigators state that the unauthorised crew member was "performing the functions of the flying pilot" up to a point 8s before the impact with the ground, according to evidence from interviews and the cockpit-voice recorder. No technical issues were found with the aircraft or engines.

Investigators have concluded that the E190 encountered windshear at low altitude during a critical phase of take-off. But while the report primarily attributes the crash to windshear, it highlights the decision to allow an unauthorised pilot to take control of the aircraft, pointing out that the crew experienced decreased situational awareness and failed to adhere to sterile cockpit procedures. ■

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DEVELOPMENT MAVIS TOH SHANGHAI

CRAIC powers up CR929 engine selection

Two propulsion providers shortlisted as decision nears, but workload pressures move certification timetable back

Sino-Russian joint venture CRAIC is “very close” to finalising the engine supplier for its CR929 widebody programme, but has also disclosed that aircraft certification will now not happen until 2027.

GE Aviation and Rolls-Royce are the final two contenders for the propulsion contract, and a letter of intent will be signed during the first half of 2019, before moving into the joint definition phase, CR929 programme director Xie Canjun says.

The pair are offering upgraded versions of current powerplants, but CRAIC expects at least a 10% improvement in fuel efficiency.

Speaking at Comac’s headquarters in Shanghai, Xie concedes that the original plan was to pick the engine supplier by end-2018, but the schedule has had “a slight push-back” because of a heavier workload than expected.

“Basic functionality, what is the range, and passenger capacity, these have all been done”

Xie Canjun

CR929 programme director, CRAIC

CRAIC, a joint venture between Comac and United Aircraft (UAC), has also issued requests for proposals for the aircraft’s other key systems and equipment, with selections due this year.

Xie says the programme has to complete concept design by end-2019 or in early 2020, before moving into the definition phase.

The plan is to freeze the definition in the first half of 2022, leading to a first flight in around 2025. CRAIC has set aside 18-24 months for flight tests, with a target of certification in 2027. The Russian side had previously given a 2025 timeline for first de-



Baseline version can accommodate 280 seats across three classes

livery, which industry observers had thought optimistic.

“The aircraft’s 3D design, dimensions, we have fixed those,” Xie says. “How wide and how long, the internal layout, the aircraft’s basic functionality, what is the range, and passenger capacity, these have all been done.”

PROGRAMME

Chengdu Airlines keeps Comac focused on ARJ21 optimisation

Comac is continuing to optimise its ARJ21 regional jet, following feedback from launch customer Chengdu Airlines.

The carrier has operated over 9,000 flight hours on the type, with 11 aircraft in service, since it took delivery of the first jet in November 2015.

Wang Xingwei, director of the ARJ21 programme, says that the manufacturer is working to improve the configuration of the aircraft’s cabin to put in up to seven additional seats, lowering the per-seat cost.

At present, ARJ21s are configured with either 78 seats in two classes or 90 in an all-economy layout. Comac is working on 85- and 89-seat layouts in two class-

The baseline version of the aircraft, designated the CR929-600, will carry 280 passengers in a three-class configuration, with a range of 6,480nm (12,000km) and a maximum take-off weight of 242t. With a single-class cabin, the jet will accommodate up to 440 passengers.

es, as well as a single-class cabin with 95- and 97-seats.

At the same time, Comac is also close to finalising a cockpit improvement to make alerts more pronounced. The layout of flight controls has also been optimised.

Meanwhile, the Chinese manufacturer is also working to reduce the weight of the aircraft through the use of lighter structural materials, optimising aircraft systems, and using lightweight seats, as well as making the cabling routing more precise.

Wang says Comac’s three main focus areas for the ARJ21 are to make the aircraft easier to maintain, manufacture and operate.

“Commercial aviation is a very competitive and open industry so

A goal this year is securing a launch customer and discussions have been taking place with Chinese and Russian airlines since the start of the project. CRAIC hopes to sell about 1,000 CR929s.

Xie says that around 1,000 employees from Comac are dedicated to the CR929, with UAC expected to deploy a similar number. The duo also have a joint plan where they each contribute 100 employees to work together for a month at a time, either in Shanghai or Moscow.

He says that while the aircraft will compete with the Airbus A350 and Boeing 787, it aims to have better operating economics and be more environmentally friendly. The CR929 also marks the latest chapter in Beijing’s civil aircraft strategy.

“The ARJ21 is an explorer, opening the path for China’s civil aviation development... the CR929 we hope that will be a successful aircraft type. For the CR929, we want it to be a commercially competitive aircraft of international standard,” he says. ■

we need to do it well,” he says.

While there are no plans to change the aircraft’s GE Aviation CF34-10A engines in the near term, Wang concedes that there may be a need to evaluate this possibility in the future.

In addition, Comac will open a second assembly line for its ARJ21 this year, helping to increase output, says Wang.

The new assembly line – capable of producing 30 aircraft per year – will be located at Comac’s Shanghai final assembly centre, adding to an existing facility elsewhere in the city operated by Shanghai Aircraft Manufacturing. That site has limited capacity and can only build a maximum of 15 jets per year. ■



Air Lease set for
\$6.5bn 2019
growth
Air Transport P12



Austrian Airlines

"Restrained branding" in red and white has been applied to A320

MARKETING MAX KINGSLEY-JONES LONDON

Austrian joins retro club with revival of 1980s-era scheme

Vienna-based carrier displays nostalgic livery, while BA unveils next in series as airline celebrates 100th birthday

Austrian Airlines has joined the "retrojet" club with the introduction of an Airbus A320 adorned with the livery the carrier flew in the 1980s.

The aircraft (OE-LBO) has been applied with the distinctive livery featuring an angular chevron, grey belly and traditional red/white/red flag on the tail. This scheme adorned the airline's A310 and Boeing MD-80 fleets during that era.

"Considering the colourful era of the 1980s, it was, all in all, a restrained branding on the part of Austrian Airlines," says the carrier's head of marketing, Isabella Reichl.

Austrian says the retro-look is a homage to the destinations of Tokyo and New York, which are celebrating key milestones this year. The airline is marking the 30th anniversary of its Tokyo services (with interruptions) and a half-century since it began New York flights. In 1989, two A310s named Tokyo and New York were part of the airline's fleet.

Meanwhile, British Airways has revealed that the next aircraft to appear in a retro livery will be an A319 in the colours of British European Airways (BEA).

Having entered the paintshop in Shannon in late February, the A319 retrojet will go into service from London Heathrow later this month. This will follow the earlier introduction of the airline's first retro-liveried aircraft, a Boeing 747-400 in BOAC colours.

The heritage liveries are being rolled out as part of the airline's "BA100" centenary celebrations this year.

The A319 (G-EUPJ) will be painted in the BEA "Red Square" livery which was used predominantly on domestic and European routes between 1959 and 1968. BEA's fleet during that era included BAC One-Eleven and Hawker Siddeley Trident jets, and Vickers Viscount and Vanguard turboprops.

While the top and bottom of wings in the original scheme were red, the A319 will only have red lower wings and the upper surfaces will remain grey to meet current wing-paint reflectivity requirements.

BA says that more replica designs for its in-service fleet will be revealed in due course, while all new aircraft entering the fleet, including the A350, will continue to receive the current Chatham Dockyard design. ■

PROPULSION MICHAEL GUBISCH LONDON

UltraFan scales greater heights via ALPS study

Rolls-Royce has started ground tests of a composite fan system for its UltraFan future engine programme. The UK manufacturer says that the trial began during February in Derby and is scheduled to continue through March.

Tests include fan blade tip clearance measurements, plus engine trials with damaged blades to assess performance after a potential bird strike, and fan flutter.

While R-R tested carbon-titanium fan blades on its Boeing 747 flying testbed in 2014 and during cold-weather rig trials in Canada, the current ground tests for the first time cover an entire composite fan assembly – the Advanced Low-Pressure System (ALPS) – comprising blades, a fan case and annulus fillers.

R-R had said it would use a Trent 1000 – an option for the 787 – as a donor engine for the trial.

The fan components were manufactured using fully automated construction methods at the manufacturer's dedicated composites technology centre.

Tests include fan
blade tip clearance
measurements, plus
engine trials with
damaged blades

Each fan blade consists of around 500 carbonfibre layers with a titanium leading edge for "extreme protection" from bird strikes or other foreign object damage.

R-R previously said that ground trials of the fully integrated UltraFan demonstrator engine are set to begin in 2021. ■



Airbus

ORDERS

Air Vanuatu backs A220 for growth

Air Vanuatu has ordered two Airbus A220-100s and a pair of A220-300s, making it the launch customer for the twinjet in the South Pacific. The order, announced at the start of the Avalon air show in Australia, is the first Airbus purchase by Air Vanuatu, and will form a major part of its future growth plans. The first delivery from the \$345 million deal is due in June 2020.

Cirium's Fleets Analyzer shows that the carrier operates one Boeing 737-800, an ATR 72, three Viking Air DHC-6-300 Twin Otters and two Britten-Norman Islanders.

FLEET SOPHIE SEGAL NEW YORK

Air Lease set for \$6.5bn 2019 growth

Lessor to acquire 80 new aircraft this year, in largest expansion so far, as global demand shows little sign of slowing

Air Lease will spend about \$6.5 billion in 2019 to acquire 80 aircraft, as the company embarks on its largest expansion since it was established in 2010.

Executive chairman Steven Udvar-Hazy says the balance sheet will increase to over \$20 billion in 2019 – or net growth of about one-quarter, after sales and depreciation.

During 2019, Air Lease will add four Airbus A350s, nine A330-900neos, and 25 A320neo-family aircraft, along with 12 Boeing 787s, plus 28 737 Max jets. Additionally, Air Lease has



Widebody deliveries over next 12 months include quartet of A350s

agreed to purchase a pair of A330-300s from a third party, with the aircraft scheduled to be

delivered later this year.

“That growth will be funded by a prudent combination of our

liquidity, including operating cash flow, senior unsecured notes issuance, extending bank and [credit] access and aircraft sales,” said chief executive John Plueger during an earnings call on 21 February.

He adds that the growth ahead “will be achieved without sacrificing [the company’s] key financial metrics and investment-grade ratings”.

In fact, the lease terms for the new deliveries will be about 12 years on average, while the aircraft sold will have shorter lease terms, Udvar-Hazy points out.

Air Lease will fund the deliveries with \$3-4 billion of debt, \$1 billion through aircraft sales and the balance from the company’s operating cash flow, says chief financial officer Greg Willis.

Air Lease has an orderbook totalling \$26 billion, which Udvar-Hazy says represents only roughly 3% of the total capital needed to fund the industry’s \$800 billion of aircraft deliveries through 2023. “The needs in our industry are quite large,” he says.

As of 31 December 2018, Air Lease had 275 aircraft, consisting of 207 narrowbodies and 68 widebodies. ■

PRODUCTION

Delivery delays diminish, though powerplant problems persist

Despite improvements to Airbus’s narrowbody production, Air Lease thinks it will continue to experience delays to its deliveries in 2019.

“While we believe Airbus has its industrial recovery plan in place, and that Pratt & Whitney are getting their arms around these issues, we fall just short of saying these problems are fully behind us,” says chief executive John Plueger.

The lessor says it continues to

receive delay notices from Airbus into 2020. While Air Lease predicts these will be in lower volumes this year – and less prolonged than in 2018 – the company says “they’re still happening”.

During the first quarter of 2018, Air Lease sourced aircraft on the secondary market to compensate for delays caused by the engine supplier, with those issues persisting into the second quarter.

At the time, Plueger specifically

noted issues related to P&W’s PW1100G engines. The firm has struggled to ramp up production of geared turbofans amid supply chain shortages and technical issues, including problems with the high-pressure compressor that caused a halt in deliveries last year.

Air Lease executive chairman Steven Udvar-Hazy says while Airbus is behind on A320neo and A321neo deliveries, Boeing aircraft are mostly on time. ■

TECHNOLOGY MAX KINGSLEY-JONES LONDON

Partnership to deliver winning formula on interiors

Formula 1 team Williams has partnered with JPA Design to leverage technology from racing cars to create a more comfortable cabin environment using lighter-weight materials.

Williams Advanced Engineering is the racing team’s technology and engineering services business.

It is teaming up with the interiors specialist to create a UK capability for aircraft interior products that will combine Formula 1-derived technology from Wil-

liams with cabin expertise from JPA Design.

They see the opportunity “to make a step-change in cabin layout, passenger comfort, fuel-saving and carbon emission reductions... through the application of new interior design and lightweight materials”.

The two companies will reveal further details about the partnership in April at the Aircraft Interiors Expo event in Hamburg, where they will showcase an example of the new cabin technology. ■



Pact will leverage engineering expertise from motor racing team



RAAF warms to C-17's Antarctic efforts
Show Report P14

ROTORCRAFT DOMINIC PERRY DONAUWORTH & MARIGNANE

Innovation gives Airbus Helicopters lift

Lingering market softness is driving focus on upgrades and novel technology to boost demand under Even's leadership

After a little under a year in the job, Bruno Even, chief executive of Airbus Helicopters, seems to be settling into the role.

Speaking ahead of his first appearance in the position at the HAI Heli-Expo event – staged in Atlanta, Georgia, from 4-7 March – Even said he is “happy and excited to be there”.

Of course, his good mood has been helped by a relatively robust performance from Airbus Helicopters over the past 12 months, and by a market that no longer appears to be in crisis.

Although Even does not forecast a major recovery in the civil rotorcraft segment until at least 2020, he says the market is now at a “stabilised low point”.

In 2018, the manufacturer delivered 356 helicopters and took in 381 net orders, including a number of sizeable military deals; its revenue was €5.9 billion (\$6.7 billion). While new helicopter sales were strong, Even also notes the “repurposing” of former offshore transport-rolod H225s to “new applications”. Around 50 Super Pumas have undergone this process so far, for users including Ukraine’s interior ministry.

CUSTOMER FOCUS

But the continued market softness has driven a behavioural change at the manufacturer: rather than spending precious resources on developing an all-new helicopter that cash-conscious operators may not want, it is instead focused on delivering upgrades to its existing range.

A pair of such initiatives – one major, one minor – are to be unveiled at Heli-Expo.

Even says the company’s priorities centre on “customer loyalty and innovation”. The former is about becoming closer to its clients and “better understanding their requirements”, he says, while the latter has to deliver value, rather than being “technol-



Radical Racer configuration will be put to the test from late 2020

ogy for technology’s sake”.

For Tomasz Krynski, head of innovation, speaking at the manufacturer’s Marignane site in the south of France, that edict translates to a short-term goal of developing “advanced technologies for the legacy fleet”.

Examples of this include ongoing work on its Eye for Autonomous Guidance in Landing Extension (EAGLE) system, which will help pilots land in difficult conditions. EAGLE combines three high-resolution cameras in a nose-mounted pod. Images from these are fed through a high-speed processor, with the output delivered directly into the helicopter’s digital autopilot, allowing a fully automated approach.

Flight tests using an H225 heavy-twin testbed will begin shortly, says Krynski, although it is also working on a simpler and “more affordable” system for lighter helicopters.

Depending on the outcome of testing, EAGLE could be deployed within two to three years, he says.

Another simple safety boost could be delivered by what Krynski describes as an “electric back-up system” – the addition of a battery and electric

motor that can provide emergency power in the event of an engine failure, allowing a “much smoother autorotation”.

A first version of the system using a 100kW battery was tested in 2012, but limitations with the technology prevented further progress. But since then, batteries have become more capable, and trials of a system with a higher technology readiness level will be conducted next year using an H130 light-single, followed by evaluations of a 240kW model for a larger helicopter six to eight months later.

Although there is a small weight penalty from the addition of the battery and motor, the overall benefit from the increased power available in relation to certification requirements could allow an extra passenger to be carried, says Krynski.

LONG VIEW

But research and innovation goes beyond such short-term technology insertion projects.

The company is developing its Rapid and Cost-Effective Rotorcraft, or Racer, high-speed technology demonstrator as part of an EU-funded project. The com-

pound twin-engined helicopter, which features two rear-facing pusher props and a distinctive V-wing configuration, will fly at the end of next year.

A key efficiency gain comes from an ability to shut down one powerplant while in the cruise at 180kt (333km/h), cutting fuel consumption significantly, even against both turboshafts working at 50% power.

Although it is not a hybrid powertrain, the requirement for a rapid restart of the idled engine has been enabled by a high-voltage electrical system. “This is a really big advantage,” says Krynski.

But for a tangible glimpse of what the airframer thinks the future might look like, a short trip over the Alps is required, to its Donauwörth plant in southern Germany. In a quiet corner of the sprawling factory complex is its Systemhaus development centre, and there, behind an anonymous roller-door, is the first prototype of the CityAirbus project.

Designed to carry four people on relatively short intra-city journeys, the CityAirbus uses batteries to power four pairs of contra-rotating propellers housed in ducted fans.

The vehicle had been due to fly late last year, but the manufacturer now believes the milestone will come within weeks. Flight tests through 2019 will initially be controlled by a pilot on the ground, before transitioning to autonomous missions.

With its muscular, hunched-over shape and carbonfibre construction, the aircraft looks futuristic, and the technologies used – electrical power and autonomy – are a collection of current industry buzzwords. But for all that, Airbus Helicopters has opted – at least for the moment – to use a more traditional material for at least one element of the design: wooden propellers. ■

See Business Aviation P20

AVALON 2019

The Avalon air show – the Australian International Aerospace & Defence Exposition – is always a major military event, where large contractors hobnob with Canberra's political elite and Royal Australian Air Force leadership. The latest edition – held from 26 February to 3 March – did not disappoint, and threw up a big surprise when Boeing and the nation's government announced that they would develop an advanced unmanned air vehicle locally. Greg Waldron reports



Greg Waldron/FlightGlobal

LOGISTICS

RAAF warms to C-17's Antarctic efforts

Strategic airlifters operate in challenging conditions to supply Australian research base with vital heavy equipment

Boeing C-17 strategic transports operated by the Royal Australian Air Force (RAAF) are providing a key capability to the nation's research mission in Antarctica.

The aircraft operate about eight flights per season to Australia's Wilkins Aerodrome during two windows, says Squadron Leader James Gotch. They fly heavy equipment to the continent from

October to November, and bring it out again in February-March. Operating from Hobart, Tasmania, each leg lasts 4h.

The C-17 is not the only aircraft to serve Wilkins, which is operated by the Australian Antarctic Division: an Airbus A319 flown by Skytraders is also used, but it lacks the heavy-lift capability of the C-17.

Cargo includes vehicles, generators, and other essentials to keep the base operational.

Wilkins is suitable for large aircraft operations because it is well inland and about 2,300ft above sea level, which reduces the chance of the ice melting. This means that its 3,050m (10,000ft) runway, carved into glacial ice, does not shift, as airstrips located on ice closer to the coast tend to do.

In preparation for a C-17 arrival, the staff at Wilkins have equipment to help corrugate the ice to improve traction. Even so, the runway is slippery: Boeing's Runway Conditions Reading assigns a dry concrete runway a rating of 23, while the ice runway at Wilkins is rated nine.

The airfield has a limited sup-

ply of fuel, so RAAF C-17s must carry enough for both legs of the mission. Typically, a Wilkins-bound C-17 will depart with 104,000kg (230,000lb) of fuel and 27,200kg of cargo. If necessary, an Airbus Defence & Space KC-30A tanker can be deployed to top up the C-17 en route.

By far the biggest concern facing Gotch and his colleagues is weather. Meteorological data is scrutinised carefully before a mission. A major concern is snow falling on the aircraft while it is on the ice at Wilkins. Should ice form in sufficient quantities, it would make taking off too dangerous. In this case, a rescue aircraft would need to be dispatched from Australia with de-icing equipment. ■

Globemasters land on glacial ice runway



Commonwealth of Australia

DEBUT

C-2 is transport of delight with Avalon audience

Kawasaki Heavy Industries' C-2 medium transport made its first air show appearance in Australia after completing a flight from Japan via the Philippines.

The twin-engined aircraft appeared in the static park near the similarly-sized Airbus Defence & Space A400M.

In fact, the C-2 was one of the rarer large aircraft at the show, with only eight in service with

the Japan Air Self-Defence Force. The service has a budget for five additional examples, and the total fleet is expected to eventually grow to 20.

That tally does not include the electronic warfare variant presently undergoing testing, according to a representative of Japan's Acquisition, Technology & Logistics Agency, which developed the aircraft. ■



Greg Waldron/FlightGlobal

Japan Air Self-Defence Force is expected to eventually field 20 units



Additional
MiG-29s a gift for
Serbia
Defence P16

UNVEILING

Minister lauds team behind Canberra's unmanned 'shield'

Boeing investment in UAV represents a "major coup" for domestic industry, says Pyne

Australian defence minister Christopher Pyne sees the developmental Boeing Airpower Teaming unmanned air vehicle (UAV) as ushering in a renaissance in Australian defence aerospace production.

"This is the first military aircraft Australia has invested in since the Boomerang in 1942 to 1945," says Pyne, referring to a piston-engined fighter developed by the Commonwealth Aircraft Corporation.

"It is a A\$40 million [\$29 million] investment, which is significant, but more importantly it's the decision by the government to invest in the capability here in Australia. Our own ingenuity and innovation, supporting Australian research and development."

The new UAV was designed near Brisbane and, should it enter production, the aircraft will be built in Australia, although Boeing has yet to select a location.

Pyne made his remarks after the unveiling of a mock-up of the UAV at Avalon. At 11.7m (38ft) long, the aircraft resembles a small stealth



Mock-up aircraft resembles a small stealth fighter, with canted tails

fighter, with canted tails and engine intakes with diverterless supersonic inlets. The model's tail and exhaust were later covered, preventing closer inspection.

Royal Australian Air Force and Boeing officials say Lockheed Martin F-35A pilots will be able to command teams of the UAVs in combat missions.

Pyne believes the aircraft could accompany not just manned fighters, but other valuable assets also. "It's not just a protector for the F-35A, but can also be used with the Wedgetail, Poseidon, and other platforms. The concept

is taking out enemy attacks on our much more expensive platforms. It's designed to be a cheaper platform, a shield if you like, protecting our servicemen and women."

Pyne says the agreement with the US manufacturer is a major coup: "When a company like Boeing makes their biggest investment in UAVs outside the United States... then it's a very significant day for the air force, and for all Australians who have dreamed of being part of a big project that makes a difference to our military capability." ■

See Feature next week

DEMONSTRATION

Zephyr breezes into Australia for payload testing

Airbus Defence & Space is gearing up for a series of payload tests operating its revolutionary Zephyr unmanned aircraft from the Western Australian town of Wyndham.

The manufacturer heavily promoted the high-altitude pseudo-satellite at Avalon, with a large model in a special pavilion featuring the slogan "enduring like a satellite, focused like an aircraft".

The work in Australia, says head of Zephyr sales Nigel Chandler, will not be about demonstrating the Zephyr's ability to stay aloft for days on end, but will look at different payloads. The aircraft based in Wyndham will start flying in the coming weeks.

Airbus sees both military and commercial applications for the type, which has a 25m (82ft) wingspan and derives its power from solar panels during the day and batteries at night.

Applications for the aircraft include intelligence, surveillance and reconnaissance missions, as well as a communications relay, for example, in a region crippled by a natural disaster, or a location requiring additional, temporary coverage for a special event. ■

REQUIREMENT

T-X positioned pending Hawk replacement need

Boeing is positioning its T-X Advanced jet trainer and accompanying systems for a long-term requirement when Australia eventually replaces its BAE Systems Hawk 127s.

Confirming initial talks with the Royal Australian Air Force (RAAF), Boeing vice-president international sales Thom Breckenridge says the process is at a very early stage.

"There is no specific [request for proposals] yet, but we understand there is a requirement and we've had discussions."

Although Boeing has held exploratory conversations about the developmental T-X with several nations, Breckenridge believes there will be strong demand in the wider region.

"There is a lot of opportunity in the Asia-Pacific and our focus is working with customers," he says.

He notes that the aircraft is designed with ease of maintenance in mind, featuring a higher wing that engineers can walk under without hitting their heads, and panels optimised to allow internal access.

In 2018, a joint Boeing-Saab team won a competition to replace the US Air Force's Northrop T-38s with the T-X.

Cirium's Fleets Analyzer shows that the RAAF operates 33 Hawk 127s in the fast-jet training role, with an average age of 18 years. ■



Current assets are an average of 18 years old

ENHANCEMENT
GARRETT REIM LOS ANGELES

Rotary launcher upgrade boosts B-52's firepower

The US Air Force began testing an upgraded version of the Boeing B-52 bomber's conventional rotary launcher on 11 February. This is designed to power up more munitions at a time, giving crews the ability to quickly select from a greater variety of smart weapons at short notice.

Boeing installed the rotary launcher within the B-52 fleet in 2016, giving the veteran type the ability to drop eight Boeing joint direct attack munitions from its internal weapons bay. It can also carry several Lockheed Martin AGM-158 joint air-to-surface standoff missiles, but the system could supply power to only some of these simultaneously.

"The conventional rotary launcher has a high power draw, so an aircrew could only power up four munitions at a time," says Maj Jason McCargar, a 49th Test and Evaluation Squadron unit project officer. "With this upgrade, it can have eight ready at once."

The ability to supply a full power load to all munitions on the rotary launcher, in addition to another 12 under the B-52's wings, has the potential to improve the type's lethality, and reduce the number of aircraft needed to complete missions, the USAF says.

Separately, Rolls-Royce has announced plans to build its F130 turbofan in Indianapolis, Indiana, if selected for a B-52 re-engining programme. The USAF wants to acquire 650 new engines to help extend the life of its ageing bombers.

R-R says the facility is nearing the completion of a \$600 million modernisation initiative, which would optimise production of an engine in the F130's size class.

A 17,000lb-thrust (76kN) variant of the BR725 powerplant, this already equips the air force's Bombardier Global Express-based E-11A and Gulfstream-model C-37 fleets. ■

ACCIDENT GARRETT REIM LOS ANGELES

A-29 pilot lost control after bomb release tipped balance

Failure to compensate for weapon's weight caused spiral dive and death of crew member

US Air Force investigators have found that a fatal crash involving a Sierra Nevada/Embraer A-29 Super Tucano during the service's light-attack experiment in June 2018 was caused by pilot error.

The turboprop entered an uncontrolled spiral dive after the pilot released a 227kg (500lb) GBU-12 bomb and failed to properly compensate for the sudden change in weight balance, according to an accident investigation board report released on 22 February.

Once in the dive, the pilot did not apply adequate recovery control inputs to stop the spiral, investigators found. He was killed after ejecting from the aircraft at only 700ft above the ground and 1.5s before impact, as opposed to the 5,000ft minimum height recommended in the A-29's flight manual for uncontrolled situations.



Experimental flights formed part of an assessment by US Air Force

The aircraft's weapons systems officer survived with minor injuries, despite ejecting at 2,000ft.

Following the accident, the USAF suspended further experimental flights, and eventually ended its test programme. It also had been evaluating Textron Aviation's Beechcraft AT-6 Wolverine from Holloman AFB in New Mexico during the activity.

The light-attack experiment had been intended to identify a more affordable platform for the US Department of Defense, allies and partner nations than using more expensive combat aircraft.

The process remains on hold, as the USAF's leadership ponders expanding the types and number of aircraft under consideration for the programme. ■

FLEET IGOR SALINGER BELGRADE

Additional MiG-29s a gift for Serbia

Serbia formally accepted four RAC MiG-29 fighters donated by Belarus, in a ceremony at the latter's 558th Aircraft Repair Plant in Baranavichy on 25 February.

Maintenance and overhaul work, to be funded by Serbia,

along with the replacement of some avionics and the installation of new navigation and communication equipment, will take up to 18 months to complete. Belgrade expects its first modified aircraft to be available before year-end.

Serbia's defence ministry says the aircraft are "in the first third of their service life and well maintained". In preparation for the fighters' availability, five Serbian pilots have undergone conversion training in Russia, with another two having received instruction at its Batajnica air base.

Having had almost no serviceability less than two years ago, Serbia's operational MiG-29 fleet currently totals 10 aircraft. This includes four airframes in its inventory at the time of NATO's Operation Allied Force campaign against the nation in 1999, and six donated by Russia in October 2017. The last of these was made available in January. ■



Donated fighters will undergo modification in Baranavichy, Belarus



Australian navy
strengthens capability
as Romeo delivers
News Focus P18

PROCUREMENT DOMINIC PERRY DONAUWORTH

Airbus Helicopters proposes H135 as lowest-risk option

Light-twin meets instrument flight rules requirement for US Navy contest, but configuration could harm chances

Airbus Helicopters insists its offer for the US Navy's TH-XX trainer contest provides the "lowest risk" of any bid, despite proposing a twin- rather than single-engined rotorcraft.

The airframer, which is bidding its light-twin design for the 130-unit competition to replace a fleet of Bell TH-57 Sea Rangers, notes that the service's request for proposals is "engine agnostic".

"We can offer the lowest risk here. If it was more driven on a commercial basis it might be different, but we are sure that we are making with the H135 the best offer, and best platform to train future students for the navy," says Martin Schneider, the company's vice-president and H135 programme director.

Speaking at the manufacturer's Donauwörth site in Germany, Schneider said the need for additional certification work by its rivals represents a "big development schedule", adding risk

to their proposals.

The H135 already meets one of the contest's key requirements, thanks to its instrument flight rules (IFR) certification from the US Federal Aviation Administration (FAA). Leonardo Helicopters is seeking similar certification for its proposed TH-119 light-single – a derivative of its commercial AW119 – which it has frequently touted as the navy's simplest solution. The same constraint faces Bell's 407 light-single, although the company could potentially pitch its IFR-qualified twin-engined 429 instead.

The USN intends to witness performance demonstrations of the competing helicopters in April or May, leading to a contract award around six months later. Deliveries will run over a four-year period from fiscal year 2021.

If selected, Airbus Helicopters will build navy H135s at its facility in Columbus, Mississippi, where it currently produces its



Airbus Helicopters

Rotorcraft would be produced at airframer's existing Columbus site

H145-derived UH-72A Lakota for the US Army, and H125s for the civilian market.

"We have done all the homework on how that works and taken the initial decisions to prepare for the ramp up," says Scott Tumpak, head of governmental programs and contracts at Airbus Helicopters Inc.

"We are positioned to meet [the navy's] schedule at very low risk." The H135's flight-hour cost also is "pretty attractive" when compared with "at least one of our single-engined competitors", he claims.

However, with auto-rotation landings to the ground notoriously expensive to perform in twin-engined helicopters because of their higher weight and resulting wear and tear on the

platform, it is unclear whether the navy could be willing to follow the army's lead by removing the requirement from its training syllabus.

Australia, Germany and the UK have previously ordered the type for military flight training use.

Leonardo, for its part, says that it is on course to obtain IFR certification for the TH-119 by April. "We are almost through with company testing, having completed more than 95% of the flight-test plan without any issues. We are very pleased with the performance of the TH-119 with the Genesys Aerosystems cockpit, which has exceeded our expectations."

A final testing phase with the FAA will now take place ahead of validation. ■

PRODUCTION GREG WALDRON BENGALURU

Indian partners form up to manufacture Ka-226T

Russian Helicopters has signed agreements with five Indian companies to help produce the Kamov Ka-226T in the country as part of a 200-aircraft army order.

Sixty of the rotorcraft will be manufactured in Russia, and the remainder in India, says Russian Helicopters, which has signed memorandums of under-

standing with Bharat Forge, Dynamatic Technologies, Elcom, Integrated Helicopter Services and Valdel Advanced Technologies covering the fuselage,

landing gear and rotor blades.

The manufacturer also plans to offer the type for New Delhi's 111-unit naval utility helicopter requirement. ■

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ROTORCRAFT ELLIS TAYLOR HMAS ALBATROSS

Australian navy strengthens capability as Romeo delivers

Maritime helicopter's success enabled by new training concept and US fleet commonality

When the Royal Australian Navy (RAN) became the second operator of the Lockheed Martin/Sikorsky MH-60R "Romeo" helicopter in 2013, it represented a major step up in capability and training for the service's combat aircrews.

Acquired via the US Foreign Military Sales (FMS) mechanism, Australia's 24 Romeos replaced 16 obsolete Sikorsky S-70B-2 "Bravo" Seahawks, and came backed up with a comprehensive training, logistics and support package from the US Navy (USN) and its industry partners.

As the Romeos brought a big jump in capability and technology, the navy also moved away from its previous approach of having all training conducted within an operational squadron. Instead, it now has 725 Sqn dedicated to training, and 816 Sqn as its operational unit.

Often referred to as "the schoolhouse", 725 Sqn is based at a dedicated facility at HMAS Albatross in Nowra, New South Wales, around 200km (124 miles) south of Sydney. Here, it trains Romeo

pilots, aviation warfare officers, sensor operators and maintainers to provide the key aerial anti-submarine and anti-surface warfare capability for the RAN's fleet of frigates and destroyers.

IN-DEPTH COURSE

Commander Stan Buckham, 725 Sqn's commanding officer, says it takes around 12 months to train an aircrew member to operate the Romeo, which reflects the complexity of the platform, the wide variety of missions it is involved in and the operating environment it works in.

"We train them up and we send them to sea, so it is all-important that our training is rigorous enough to ensure they meet the standard to do the job at sea – which, to tell the truth, could be in combat," he says.

Most of the syllabus for 725 Sqn's training programme is similar to that of the USN, albeit with some changes to accommodate the different way that the RAN operates its rotorcraft. As an example, Australia's Romeos are crewed by a single pilot, with the

lefthand cockpit seat filled by an aviation warfare officer who focuses on tactics, and a sensor operator in the rear. In use with the USN, both front-seaters are pilots, with one taking responsibility for tactical operations.

Australian navy crews are also trained for a broader range of secondary missions, including vertical replenishment, search and rescue, medical evacuation and even aerial firefighting using an external Bambi bucket.

Buckham says the changes are around the context that the RAN operates in, but the learning objectives are the same as the US curriculum. The two services use the same terminology, systems and platforms, which has boosted their interoperability, he notes.

"The beauty of being in lock-step is an Australian crew in an Australian helicopter can fly with an American crew and achieve that same mission. Same language, same weapons systems – it is plug and play," he says.

In embracing the USN's system of training, the RAN made a quantum leap in its use of simulators

and synthetic training aids, as well as its involvement with industry.

As part of the FMS arrangement, CAE provides, operates and maintains eight training devices for 725 Sqn, including two full-motion, Level D-certificated cockpit simulators, or tactical operational flight trainers. It also includes weapons and tactics trainers for rear-crew sensor operators.

Alongside this equipment are a number of maintenance trainers, including two built around former USN SH-60B airframes that allow a number of mechanical, hydraulic and avionics faults to be simulated, giving the Romeo's maintainers hands-on experience in a training environment. There are also separate aids for weapons loading, winch and gunnery training.

CAE also provides training support services, including instructors, operator support and courseware revision services, similar to that provided to the USN.

Captain Grant O'Loughlan, deputy commander of the RAN's Fleet Air Arm, says the involvement of CAE has been vital to en-



Ellis Taylor/FlightGlobal

Equipment available to 725 Sqn unit includes dedicated avionics maintenance weapons loading trainer



CityAirbus charges towards first flight
Business Aviation P20



Versatility suits MH-60R well for a wide range of missions

Commonwealth of Australia

abling the service to gain the most out of the Romeos and the crews that operate them.

“[Having] CAE with our simulators, support staff and instructors, they are a fundamental input for us,” he says. “Without them we could not train our crew on time and to the level that we require to get them to sea.”

IDEAL MIX

Buckham says that for a crewmember that has never flown a Seahawk before, around 70% of their training is done in the simulator, with the remainder performed using the eight MH-60Rs that are allocated to 725 Sqn.

“We’ve now got an unparalleled level of live, synthetic and virtual training to make sure our men and women are provided the best training that we can afford, or that we have knowledge of,” says O’Loughlan.

Buckham adds that for new recruits, “this is what they expect; this is what they grew up with.”

At the end of 2018, the RAN’s Romeo fleet reached full strength,

with eight flights stood up: each comprises a helicopter, two sets of three flightcrew and 11 maintainers, which will embark on a ship for a deployment that may stretch from nine months to two years in duration.

Buckham says, however, that the navy is still evolving and improving its training, as well as the capabilities the Romeo offers. “We are still trying to evolve and understand what this beast of a machine can do – it is awesome,” he adds.

That approach to training is allowing the RAN to get the most value out of its Romeos, which are now an essential part of its battle structure.

“What it brings to the fight is unparalleled, and ships do not want to go to sea without their embarked maritime combat helicopter. It gives the commander so much choice, opportunity and capability that is fundamental to the way we operate in the RAN today,” says O’Loughlan.

The Romeos returned a dipping sonar capability to the

RAN’s helicopter fleet, with the rotorcraft sporting a Raytheon AQS-22 low frequency sonar, in addition to being able to carry and deploy a range of sonobuoys.

The type also uses a Telephonics APS-153 multi-mode maritime surveillance radar that features automatic periscope detection and discrimination. The helicopter’s Photonics AAS-44C multispectral targeting system can fuse infrared, day and/or low-light images, and also works as a laser designator, target marker and rangefinder.

Romeos also have a Lockheed ALQ-210 electronic support measures system, complemented by an integrated suite of self-defence measures.

On the weapons side, the type has two pylons that can carry up to eight Lockheed AGM-114N Hellfire air-to-surface missiles or Mk54 lightweight torpedoes. Work is also under way to integrate BAE Systems’ Advanced Precision Kill Weapon System laser-guided rocket. From a door mount, it can also carry GAU-21 or MAG 58 machine guns.

VITAL SYSTEM

Together, the systems and weapons of the Romeo have become a valuable tool for the navy when embarked on a frigate or destroyer, says Buckham.

“The helicopter is a system on that ship, in that ship, that extends its capability. That is why every CO [commanding officer] of a ship wants an MCH [maritime combat helicopter]. They want that capability – it is a force multiplier.”

Future developments are also on the way. Upgrades are likely

to come down the track, given that the USN plans to keep its Romeos in service out to the 2040s. Australia will gain access to these upgrades through the FMS programme.

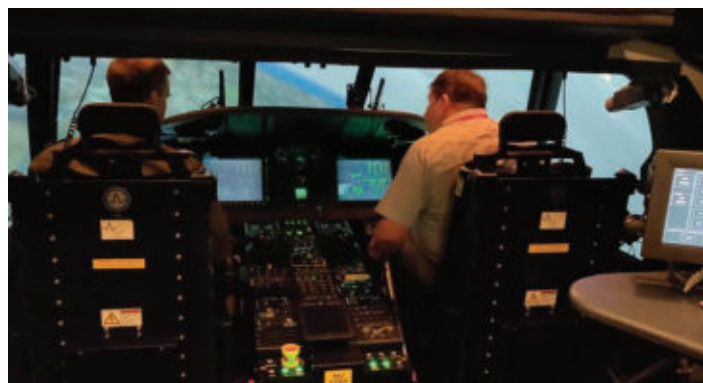
While there is a perception that being tied to the FMS model could be limiting, O’Loughlan says the benefits far outweigh the disadvantages, especially considering its past experience with the Bravo.

“The problem with our last Seahawks was that it was a bespoke design, 16 airframes only. Nobody else in the world operated them, so it became very costly for us to maintain and upgrade,” he says. “We are now tapped into a system of around 500 [Romeo and MH-60S Sierra] airframes. We are able to tap into that and the engineering support and logistics, and that makes our lives much easier.”

There is also a mechanism for the USN to certificate “Australian-unique modifications” to the helicopter if required. One of those has seen its examples fitted with instrument landing systems, something that the USN is now planning to retrofit to its own Romeo fleet.

For now, however, the RAN stresses that it has a co-operative partnership with the US service on the type, which as the prime user, also has staff stationed at HMAS Albatross, and they are in constant dialogue.

Buckham says that industry and USN support has allowed the Romeos and their crews to become a key part of the RAN in a relatively short amount of time. “It wouldn’t work any other way,” he notes. ■



Ellis Taylor/FlightGlobal

CAE provides two full-motion tactical operational flight simulators

TECHNOLOGY DOMINIC PERRY DONAUWORTH

CityAirbus charges towards first flight

Electric urban air taxi weeks away from maiden sortie, with ground tests on propulsion system steadily progressing

Airbus Helicopters is closing in on a maiden sortie for its CityAirbus electrically powered urban air taxi, with the milestone expected within weeks.

The type had been scheduled to get airborne in late 2018, but the manufacturer decided “to go a bit slower” because of the complexity of systems integration, said Marius Bebesel, head of the CityAirbus programme, speaking at the manufacturer’s Donauwörth, Germany plant on 19 February.

“On a vehicle level we are ready to go, it is more about the ground station and monitoring – it has been a bit more fine-tuning than expected,” he says.

Ground run speeds of its eight contra-rotating propellers have been progressively increased, says Bebesel, with the most recent tests taking them to 750rpm; around 1,000rpm is required at take-off.



Each ducted-fan pod contains a pair of contra-rotating propellers

“We have two more weeks of ground runs and then we will do a first take-off here in Donauwörth,” says Bebesel.

CAUTIOUS APPROACH

“Then to open up the flight envelope, we will move to Manching [Bavaria]. We would like it to be quicker, but we need to go through

ground tests step by step.”

Initial sorties will be controlled by a pilot from the ground station, while in future, autonomous flights are to take place, with the vehicle following a series of pre-planned waypoints.

Although a ducted fan design, with two pairs of 2.8m (9ft 2in)-diameter propellers per pod, the

upper of the two sits noticeably above the carbonfibre duct itself, which is also a relatively narrow structure.

Bebesel says the design has proved to have “tremendous efficiency” in the hover; the aerofoil profile of the duct also generates about 400kg (880lb) of lift, he says.

However, in future, some modifications to the design of the ducts or fixed-pitch propellers may be necessary to improve efficiency in forward flight, Bebesel says.

One change already being evaluated is a switch from wood to carbonfibre propellers. The components currently fitted onto the prototype have been developed by Germany’s MT-Propeller, but Airbus Helicopters has already produced a set in composite.

These have been installed on a “whirl tower” test cell and should be “more efficient and lightweight” than the wooden components, according to Bebesel, despite pointing to the “more forgiving” nature of the current material.

SAFETY FEATURES

Bebesel says the propulsion architecture – comprising four batteries, four electrical distribution boxes and eight direct-drive electrical motors – will be able to cope with the failure of up to two motors; additional failures are considered statistically improbable, he says.

Maximum take-off weight for the CityAirbus is 2.2t and it is designed to carry four passengers.

CityAirbus is one of two urban air mobility projects being pursued by the company, with the Vahana tilting wing design, produced by the company’s A3 Silicon Valley offshoot, already flying.

Airbus has yet to commit to taking either architecture forward as a commercial product. ■

PRODUCTION DOMINIC PERRY MARIGNANE

Oil and gas market weakness could undermine H160 ramp-up

Continued weakness in the oil and gas market has left Airbus Helicopters uncertain of how quickly it will be able to ramp up output of its new H160 medium-twin.

In 2018, the airframer took 15 orders for the 6t-class helicopter, which was in line with its internal target. “Our objective was to sell more, but the difficult situation in the oil and gas market impacted

sales of the H160 last year,” says Bernard Fujarski, the head of the programme.

Airbus Helicopters currently plans to produce 30 H160s per year from around two years after first delivery in 2020.

However, Fujarski says the lack of oil and gas sales could impact that schedule. “If we are not able to sell into oil and gas it will prob-

ably change our plan regarding the industrial ramp-up.”

Last year’s bookings included an initial commitment from launch customer Babcock, but the operator has yet to decide whether those aircraft will be configured for offshore transport or emergency medical services missions. Apart from that deal, none of the 2018 orders were from the oil and gas sector.

But Fujarski is confident that offshore sales will emerge as operators look to replace a large pool of ageing aircraft, including Leonardo Helicopters AW139s and Sikorsky S-76s. “We believe it will come, it is just a question of when.”

Certification of the H160 is on track for late this year, with a handful of tests still to be wrapped up. In addition, European approval of the aircraft’s Safran Helicopter Engines Arrano powerplants should be achieved in April, Fujarski says. ■



Manufacturer recorded 15 orders for 6t-class helicopter in 2018



Brakes applied
after orders glut
[Data View P22](#)

ANALYSIS KATE SARSFIELD LONDON

New types plus US growth lift market to revived outlook

Light jets made most headway amid mixed 2018 results, while midsize models struggled alongside sector's top tier

The business jet market experienced a modest rise in shipments in 2018. While performance across each segment was mixed, there is a widespread consensus that the industry has finally turned a corner, aided by a strong US economy and the introduction of a plethora of new and reinvigorated aircraft models.

In its latest annual industry review, released on 20 February, the General Aviation Manufacturers Association (GAMA) recorded 703 business jet deliveries in 2018: a 26-unit, or 3.8% rise year on year.

GAMA singles out the light-jet sector as the strongest performer during the review period, with a resurgent US market helping to lift output for this crowded category from 271 aircraft in 2017 to 315 last year. This was a rise of over 16%, and marked the highest tally for this segment since 2010.

Cirrus made the strongest gains, with an output of 63 Vision Jets – almost treble the 22 delivered in 2017. The single-engined personal jet has now entered its third year of production, with Cirrus planning to ship 80 units this year and around 100 per year from 2020 to clear its 540-strong backlog.

The Pilatus PC-24 made its debut within the GAMA report for 2018, with 18 of the superlight

twins shipped between February and 31 December. While this was short of the 23 units planned for the period, the Swiss airframer should more than make up this shortfall in 2019, with deliveries of 40 examples forecast.

LEADING LIGHTS

Cessna continues to dominate light jets, with four Citation-series models contributing 121 deliveries last year – more than one-third of the segment's total. This compared with 113 shipments in 2017, when its line-up also included the now axed Mustang. While handovers of its entry-level M2 fell by five units, to 34, gains were made by the CJ3+, CJ4 and XLS+, reinforcing the value of the iconic Textron Aviation-owned product line to the global marketplace.

Fierce competition at the lower end has impacted Embraer, however. GAMA recorded deliveries of 11 Phenom 100EVs – down six on the previous year – and 53 Phenom 300EVs. While this was a drop of only one, it marked the sixth consecutive year of falls for the type, its data shows.

Embraer attributes the slide to its decision to focus on profitability and price at the expense of higher volumes. This tactic has also impacted its midsize offer-



Latitude was the top-performing Citation, helped by NetJets order

ings, with deliveries of the Legacy 500 down by three, to six, and Legacy 450 shipments flat, at 14. The Brazilian airframer hopes to boost output this year, on the back of a “very strong orderbook” for its new Praetor 500 and 600 models, scheduled for service entry in the second half.

The overall performance of the midsize sector was mixed. GAMA's data shows that deliveries fell by three year on year, to a total of 179 aircraft. Bombardier's Challenger 350 – consistently the strongest performer in its class – recorded a four-unit increase, to 60.

The Latitude was again the most-delivered in the Citation line-up – thanks largely to a 2015 order from fractional ownership company NetJets for 175. A three-unit rise took the annual total for the eight-seat jet to 57 aircraft, but deliveries of the Sovereign+ slid from nine to six, as demand for Cessna's legacy Citation models waned. The aircraft could suffer a similar fate to its midsize stablemate, the X+, cancelled in 2018 after 22 years in production.

Like Embraer, Cessna will be hoping the introduction in the first half of 2019 of its new midsize offering, the Longitude, will bolster its share in this segment.

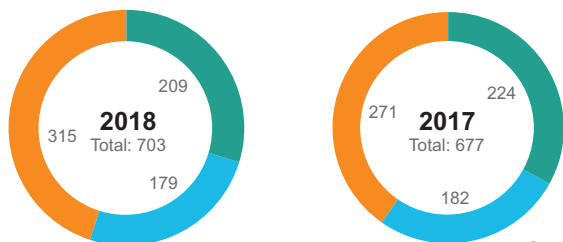
the G500's October entry. The superwide-cabin type contributed nine units to Gulfstream's 2018 tally of 92 aircraft, with the line-up consisting of the G550 and G650/ER. This compared with 90 in 2017, GAMA says, when the last G450s rolled off the line. Shipments are predicted to climb in 2019 to 145, as production of the G500 accelerates, and its G600 stablemate enters service in the second quarter.

Bombardier is also set to boost its high-end business jet performance this year, on the back of new programmes. The Canadian airframer had a lacklustre 2018, shipping 65 Challenger 650ERs and Global-series aircraft, against 68 the previous year. Its flagship model, the Global 7500, entered service in December, with a backlog of some 110 aircraft. It is now ramping up production, and plans to deliver 15-20 of the ultra-long-range jets this year.

The GE Aviation Passport-powered twin will be joined in the second half by new Global family members the 5500 and 6500. They were launched in May 2018 as longer-range versions of the Global 5000 and 6000, with Rolls-Royce Pearl 15 engines, revamped interiors and wings designed by Mitsubishi Heavy Industries. Orders have not been disclosed, but Bombardier says “customer demand has been strong”.

Dassault hopes its in-development, superwide-cabin 6X will have a positive effect on its Falcon output, following a feeble 2018. Strong large-cabin competition saw deliveries of its twin-engined 2000LXS/S and 900LX, 7X and 8X trijets fall by eight, to 49 aircraft. ■

Business jet deliveries by segment



Source: GAMA

Large/VIP airliner

Midsize

Light

Brakes applied after orders glut

2019 began sluggishly, with Boeing dominating modest sales amid no new business for its European rival. Deliveries of 89 commercial aircraft marked 16% rise against January 2018

GRAHAM DUNN & ANTOINE FAFARD
LONDON

January is traditionally a quiet month for commercial aircraft sales, and 2019 did not break from this trend. Information from Cirium's Fleets Analyzer shows there were 27 new orders recorded during the month, along with 11 cancellations, leaving a net total of 16.

This followed a glut of deals closed last December for a combined 783 aircraft, and was also down from the 37 ordered in January 2018.

Unusually for our Data View summary, the new aircraft orders made during January were all for as-yet undisclosed customers. Boeing secured all of this business, which spans 18 787s – 14 -9s and four -10s – plus nine 737 Max-family aircraft.

Business was less promising at Airbus, which secured no new orders, and also saw Qantas formally cancel its long-dormant commitment for another eight A380s. The Australian carrier, which Cirium schedules data shows employs its current 12 superjumbos on services to Dallas/Fort Worth, Hong Kong, London Heathrow, Los Angeles and Singapore, stressed that it remains committed to the examples already in its fleet.

Qantas's confirmation of its axed order came prior to Airbus's 14 February decision to end production of the A380, with final deliveries to occur during 2021.

Rather than take its previously planned additional A380s, Oneworld carrier Qantas intends to order new ultra-long-haul aircraft by the end of the year to meet its "Project Sunrise" requirement, through which it will launch nonstop services from Australia's east coast to London and New York around 2022-2023. Airbus and Boeing have provided data showing that they have aircraft capable of meeting the carrier's needs, with adaptations to their A350-1000 and 777-8 products seen as the most likely candidates.

Meanwhile, the delivery total in the year's opening month comprised 89 commercial air-



Qantas formally axed long-dormant commitment for eight more A380s

craft for 58 customers. While this was only just over one-third of the bumper 255 units shipped in December, it represented a 16% increase on the 77 transferred in January 2018.

Carriers in both the Asia-Pacific and North America regions took delivery of 29 aircraft, while those in Europe received 19. More than 55% of deliveries were made to mainline carriers. A total of 65 narrowbodies were handed over, along with 17 widebodies, five regional jets and two turboprops.

In the narrowbody sector, Boeing delivered 33 737-family aircraft to commercial operators, while Airbus shipped an identical number of A320-family jets, including 28 re-engined Neos. Leading recipients included Delta Air Lines, which took six 737-900s and

three A321s, American Airlines, with a pair of 737 Max 8s and a single A321neo, and China Southern Airlines, which took three A320neo-series aircraft.

Widebody shipments comprised five A350-900s and an A330-300 from Airbus, while Boeing transferred eight 787s, two 777Fs and a lone 767 Freighter.

In the regional sector, Russia's Severstal Aircompany took two Sukhoi Superjet 100s. Turboprop deliveries included a single ATR 42 shipped to Japan Air Commuter, and one Bombardier Q400, handed over to Indian carrier SpiceJet.

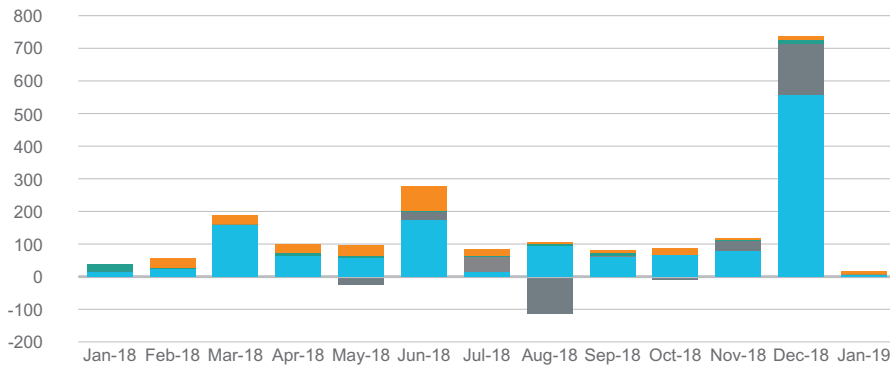
Meanwhile, Fleets Analyzer shows that the global in-service commercial fleet stood at 29,809 units at the end of January: an increase of 1,201 from the same month a year earlier. The Asia-Pacific region accounts for the largest share of this total, with its 9,163 aircraft representing a 31% stake, versus North America's 8,685 (29%).

In backlog terms, a total of 15,132 aircraft were on order at the end of January. This marked a year-on-year decline of 68 units, with Airbus and Boeing combined accounting for 88% of the total business. ■

16

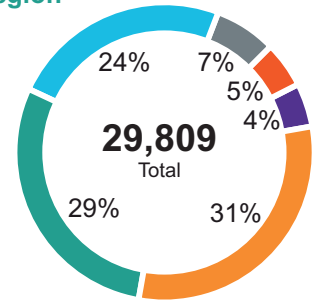
Net total new commitments during January 2019: reduction from the 37 recorded in same month a year earlier

Commercial monthly net orders, January 2018-2019



Source: Cirium's Fleets Analyzer

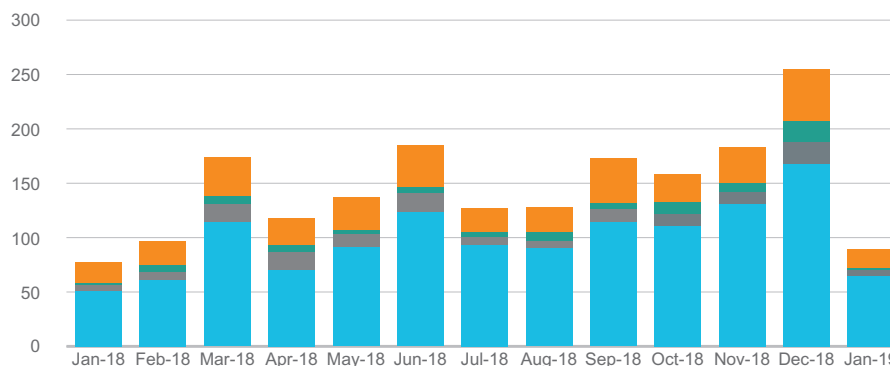
Commercial in-service fleet by region



Source: Cirium's Fleets Analyzer

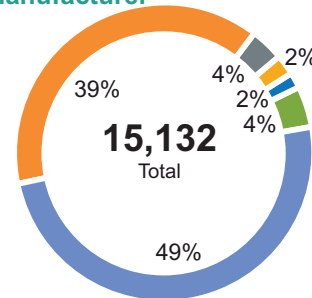
Asia-Pacific 9,163	North America 8,685	Europe 7,085
Latin America 2,045	Middle East 1,492	Africa 1,339

Commercial monthly deliveries, January 2018-2019



Source: Cirium's Fleets Analyzer

Commercial aircraft order backlog by manufacturer

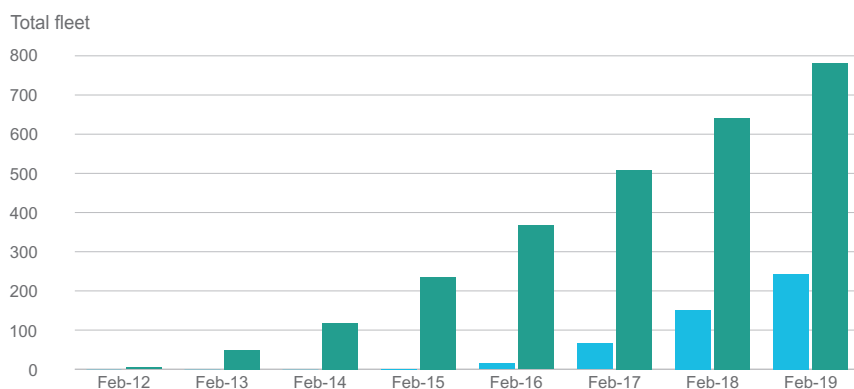


Source: Flight Fleets Analyzer

Airbus 7,499	Boeing 5,836	Comac 541
Embraer 368	ATR 244	Other 644

In focus: fleet development for Airbus A350 and Boeing 787

Fleet development for Airbus A350 and Boeing 787



Source: Cirium's Fleets Analyzer

The Boeing 787 entered commercial service with All Nippon Airways in late 2011, and there are now approaching 800 Dreamliners in service. Over 300 of these are aircraft operated by Asia-Pacific carriers.

Airbus's rival A350 entered commercial service in early 2015 with Qatar Airways. There are now almost 250 of the type in operation, of which more than half have been supplied to Asian carriers.

Some 93 A350s were delivered in 2018, while Boeing handed over the largest annual number of 787s in the programme's history, at more than 140. Both have order backlog figures exceeding 600 units each.

The A350 is powered exclusively by Rolls-Royce Trent XWBs, while the Dreamliner can be powered by either the Trent 1000 or GE Aviation's GENx. ■

WHEN SPEED RULED IN STYLE

Critics may have mocked it as a loss-maker, but for raw aviation beauty and human inspiration there is nought to rival Concorde, which first flew a half century ago this month

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Aviation Images/REX/Shutterstock



POINTS

OF DIFFERENCE

FlightGlobal



Leveraging data to deliver personalized loyalty marketing strategies for airlines

PARKROYAL on Pickering, Singapore, 21-22 May 2019

Loyalty programs were once a simple marketing tool to get customers earning points and flying with the same airline. In recent times, they have morphed into complex but revenue generating, networks of partnerships, tiers and rules – providing a gateway to greater customer data and insight.

This conference looks at the future of loyalty, tackling challenges around customer engagement and redemption; how airlines can add value through experiential and personalized rewards so that they can give loyalty members the opportunity and freedom to earn and redeem points through several avenues.

Key topics

- › The future of lifestyle loyalty
- › Creating hyper-personalised and in-the-moment mobile experiences
- › Who owns the customer?
- › How do airlines monetize their data?
- › Mitigating fraud in loyalty programs
- › Emerging tech and disruptors

Steering committee

- › Georg Baust, Managing Consultant, **Lufthansa Group**
- › Frederic Kahane, VP Customer Loyalty, **Air France-KLM**
- › Nik Laming, GM Loyalty Division, **Cebu Pacific Air**
- › Annich McIntosh, Editor & CEO, **Loyalty Magazine**
- › Seth Miller, Principal, **PaxEx.Aero**
- › Mauro Rodrigues, Information Technology, Commercial Business Solutions, **Tap Air Portugal**
- › Majid Singh, Director of Marketing & Route Development, **Mahan Air**

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To speak, contact Warka Ghirmai **E**: warka.ghirmai@flightglobal.com

Making history

Boeing's 747 may have won the race to make a maiden sortie, but when Concorde finally took off, the world held its breath. We revisit *Flight*'s coverage of that aviation milestone

Spectators for the event in France were joined by many more watching TV coverage



FlightGlobal archive

Over a landscape, heavy with history.
Mapped by names like a roll of honour.
Battles staining the favourite view;
Knights in armour dressed to kill,
Thirsty swords and the whispering missile
Sowing the meadows with broken people;
Lost within the night of time beneath our world.
The past is turning over in its sleep.
But today, from where the future is invented,
There rises now this corporate arrow filled with life;
Out of the field of vision climbing over the spectral rain,
Over the ribbons of rivers dancing down to the sea
And the gentle flocks of cumuli grazing on the hills;
Paramount with power heraldic on an azure shield
Where sunlight like a trumpet fills the air.
No birthday sky has ever held its like before;
First among the finest of the flowering of wings
That will come to pass with flying colours
High above the round horizon, multiplied in volant hosts
Appearing with celestial precision
In a network of pacific speed encircling the earth
Like the shining flight of doves.

ROBERT GORDON

MAX KINGSLEY-JONES LONDON

The world had to wait a long time for Concorde to fly. And when it did, *Flight International* celebrated with three pages of pictures accompanied by bilingual verse by the poet Robert Gordon.

The Anglo-French supersonic airliner programme had been launched in 1962 and the first Concorde rolled out in Toulouse in December 1967. The original first flight target was 28 February 1968 but even the most pessimistic observers did not expect to have to wait another year – and see the Boeing 747 fly – before the elegant delta would finally take to the air.

The first flight by the French-built Concorde 001 took place at 15:40 on Sunday 2 March 1969. At the controls for the 29min sortie was Sud's chief test pilot, Andre Turcat, with co-pilot Jacques Guignard, flight observer Henri Perrier and flight engineer Michael Retif alongside.

Flight International, of course, was by the runway for Concorde's long-awaited moment of truth, and described the scene in our World News report on 6 March 1969: "The historic event was seen by thousands of spectators in the lanes and fields around, and by a far greater audience in France and

Britain through the medium of live television, which included excellent air-to-air views."

Describing the take-off, *Flight* wrote: "The supersonic transport was lined up, power was increased to 80 per cent on the four Rolls-Royce/Snecma Olympus engines, reheat was switched on, and with a rising cloud of smoke behind, she started to roll. After 20sec, with speed approaching 150kt, M Turcat eased the aircraft into a 10° nose-up attitude, speed continued to increase and, with no further perceptible controlling, Concorde lifted off cleanly at 175kt some 25sec and 1,400m from brakes off."

Our correspondent claimed that from his vantage point at the press viewing base near

the unstuck point, "Concorde seemed to be making much less noise than we expected." However, he noted the aircraft was at a light weight (240,000lb/108,000kg) and therefore using less power than would later be normal.

"With undercarriage down and the nose visor in the fully drooped position (this configuration was maintained for the entire flight) the climb was continued straight ahead, at about 3,500ft/min, to 10,000ft," wrote *Flight*.

"After some directional and lateral control effectiveness checks at various speeds every 10kt down to 160kt, Concorde 001 then turned on to a base leg for its approach, and established a powered descent path at 170kt.

"With a Meteor NF.11 chase aircraft still in close company to starboard, and a MS Paris photographic aircraft to port, 001 landed firmly without perceptible flare, smoke from the tyres blowing into the strong vortex and giving a vivid portrayal of this aerodynamic cushion."

Our report ended with comments about how the event was celebrated by some of Concorde's airline customers, which seems rather poignant with the benefit of hindsight: "Most significant of all, perhaps were Pan American's huge full-page advertisements in the British national newspapers proclaiming 'Welcome to Tomorrow'." ■



Photo feature in 13 March 1969 issue followed original World News report

Engineering masterpiece

Capt Ron 'R E' Gillman described Concorde effusively as a 'magnificent achievement' in his pilot's-eye view of its aerial handling characteristics, first published by *Flight* in January 1976 to mark the aircraft's entry into commercial service

Although the narrow-section fuselage and slender delta wing form demanded by aerodynamic considerations result in Concorde resembling an elegant bird, they do present a few extra problems to the pilot.

The flightdeck is even more confined than those of most modern aircraft, and the large-diameter Attitude Director Indicator (ADI) that dominates the instrument panel seems almost out of proportion. Its expanded pitch scale calibrated in degrees is there for a good reason, to help the pilot cope with another problem: the high angles of attack demanded by a slender delta at slow speeds, and the need for accuracy in pitch handling during

take-off and landing.

Once installed in the driver's seat, one is in a similar position to a 747 pilot – 19ft above the ground, 37ft ahead of the nosewheel and 97ft ahead of the mainwheels – and similar points have to be watched when taxiing. On a sharp turn the nose must be swung very wide if the main wheels are to remain on the concrete. Secondly, at this height (equivalent to that of a third-storey window) speed judgement is more difficult. What seems like a crawl is around 40kt, and it is as well to keep an eye on the INS groundspeed read-out.

Concorde, being a thoroughbred, is a bit finicky about the ground over which she is taxied. A natural nodding of the fuselage can

occur, giving a divergent oscillation which is distinctly uncomfortable and which can reach unacceptable proportions. A bump in the runway at Singapore was found to excite the aircraft at the critical frequency, and it had to be removed. Further work is going on to eradicate this problem, including experiments with varying pressures in the main oleos.

CLIMBING OUT

When computing the take-off weight, apart from take-off distances and the net flightpath, account must be taken of tyre rolling speeds and brake energy limits, for at the higher weights above 180 tonnes, VR is in the region of 200kt. An additional factor, taken from the performance graphs, is known as Theta 2, the attitude at V2 on three engines.

When the Rolls-Royce/Snecma Olympus 593s are set to reheat for take-off there is a healthy push in the back; visually the acceleration is not so apparent.

At a brake-release weight of 181 tonnes, VR of 197kt is reached in about 40sec; a long rearward movement of the control column (at a force of some 30lb) is required to rotate to the Theta 2 angle of 13°. Sight of the ground is lost at 10° and from then on the very effective ADI presentation is in constant use. As speed increases the nose is raised to around 18° to maintain V noise (Vs, 250kt), and at the cut-back point the flight engineer moves the throttles back to a pre-set angle on the quadrant and the nose is lowered back to Theta 2, maintaining Vs.

At the top of the noise-abatement climb the engine mode switch is put to CLIMB, the throttles are pushed fully forward, and the nose, which had been dropped to 5°, is raised with the visor. The view through the windscreen, into a long greenhouse formed by the top of the nose and the sloping visor, is distinctly odd.



Taxiing posed challenges based on height, positioning of flightdeck and mainwheels



FlightGlobal archive

Nose drooped 5° for take-off or landing



Max Kingsley-Jones/FlightGlobal

Cramped confines and "greenhouse"-like visor distinguished cockpit from wider types

Speed is increased to 300kt in the terminal area. The controls are light and positive thanks to the autostabilisation system, and all-round vision is good. The rate of roll with full authority over the two outer elevons and a restricted range on the inners is around 18°/sec.

Once clear of the terminal area, the aircraft is accelerated to maximum operating speed (VMO) and climbed until the subsonic cruise Mach number of 0.93 is reached. The optimum level for subsonic cruise varies between 25,000ft and 39,000ft according to weight, but if the height is increased significantly above optimum, the IAS at Mach 0.93 will fall progressively below the minimum drag speed. In fact the drag becomes so high that it is no longer possible to maintain height at subsonic speed; if the IAS falls below 300kt at high weights, reheat and possibly a descent may be necessary to regain VMO.

For the transonic acceleration and the first part of the supersonic climb, reheat is engaged and the aircraft flown at VMO. The centre of pressure moves aft at this stage and the flight engineer pumps fuel back into the rear trim tanks to keep the e.g. within limits. Around Mach 1 large changes in pitch elevon control power and hinge moments occur, but are automatically controlled by the auto-stabilisation system.

TEMPERATURE CONCERNS

Reheat is cancelled at Mach 1.7, climb power is used up to Mach 1.95 and cruise power thereafter. By flying at cruise power up to whatever parameter is limiting, the resultant flightpath will be a cruise climb from 50,000ft, ending at a height which will depend on the weight and the ambient temperature. Maximum operating height is 60,000ft.

Three limits have to be observed at this stage: VMO, MMO and the maximum operat-

ing temperature (TMO) of 127°C. But the problem of temperature shear gives the most difficulty.

Optimum supersonic cruise speed is Mach 2.02 and the overspeed warning comes in at Mach 2.04. As a change in ambient temperature of 2°C is equal to a Mach number shift of 0.01, it does not require much of a temperature shear to set off the overspeed warning. When the nose is raised to reduce the speed the kinetic energy of the aircraft is such that although the IAS falls, the Mach number may remain constant until the aircraft is again levelled. In normal lapse-rate conditions 500ft has to be gained to reduce the Mach number by .01. The extent of the problem can be appreciated. The worst temperature shears are often found near the tropopause in the tropics, where sudden changes of temperature in the order of 12°C are not uncommon.

During the supersonic flight the flight director and the autopilot are normally used in the MAX OP SOFT mode. In an attempt to avoid repeated overspeed warnings this was redatumed to Mach 2; the number of warnings has certainly been reduced but height variations still occur.

The method now in use is to hold the height constant but reduce power to maintain Mach 2. The fuel penalty is negligible but it does throw an added burden on the flightcrew. The manufacturers are looking at a number of possible solutions, including the use of an additional term in the autothrottle to build in an altitude-hold function.

The top-of-descent point is critical for fuel economy. When the moment arrives the attitude is held at the supersonic cruise angle of +3° and power reduced to a setting which depends upon ambient temperature. At Mach 1.6 the rate of descent is slowed down. Below Mach 1 the throttles are set at 34° on the quad-

rant and descent is continued at 350kt.

Low-level holding at 250kt presents no problems, but when decelerating to approach speed the visor and nose have to be lowered completely to give an adequate view of the runway. VREF can vary from 155kt to 180kt and at these speeds the attitude is 11° nose-up. Autothrottle takes care of the speed instability and the auto-stabilisation system deals with the static stability; from the pilot's point of view pitch handling is therefore normal. As the control column is pulled back and the elevons raised some flap effect is lost and initially the aircraft will tend to sink faster. On the approach the aircraft is on the back of the drag curve and any significant excursion below VREF will cause an inordinate drag rise. If Concorde gets seriously low and slow, reheat may be needed for recovery.

DOWN TO EARTH

Landing presents no problem. Although the natural tendency of a slender delta is to pitch up as the angle of attack is increased, the auto-stabilisation feeds in incidence trim so that the pilot exerts a continuous pull force for the flare. After touchdown no further stick movement should be made initially; if the nose is lowered too quickly increased lift from the elevons will tend to raise the mainwheels, causing a skip.

Undoubtedly the skill and ingenuity of the designers and test pilots have served to contain the difficult characteristics inherent in such a vehicle and to present it to the pilot with handling qualities similar to those of a more conventional aircraft. From every point of view Concorde represents a magnificent achievement. ■



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CONCORDE

Structure and general

- 1 Variable geometry drooping nose
- 2 Droop-guide rails
- 3 Droop hinge-joint
- 4 Retracting visor
- 5 Visor-guide rails
- 6 Visor refracting link
- 7 Visor jack
- 8 Outward-opening plug-type passenger door (66in x 30in, still 16ft 5in above ground)
- 9 Service door (48in x 24in)
- 10 Underfloor baggage hold (pressurised) 26ft x 38in x 55in (308 cu ft)
- 11 Rear baggage compartment (pressurised) 26ft door to stbd (429 cu ft)
- 12 Middle passenger doors (port and stbd) 73in x 34in
- 13 Metal-faced floor panels
- 14 Rear emergency doors (port and stbd), 68in x 34in
- 15 Light alloy/balsa sandwich floor panels
- 16 Machined window panel
- 17 Triple-gap window – removable as a unit
- 18 Multi-layer windscreen – removable as a unit

- 40 Stressed (15g upward impact) tank roof
- 41 Vapour seal over tank roof
- 42 Unpressurised aft systems bay
- 43 Pressurised forward systems bay
- 44 Fin support structure – tube and extruded members
- 45 Machined fin spars – riveted to fuselage frames
- 46 Removable leading-edge sections
- 47 Machined ribs
- 48 Chemically milled skin
- 49 Expansion joints between sections
- 50 Removable outer wing – tank 5A, port, and 7A, stbd
- 51 Wing fixing by 340 high-tensile steel bolts
- 52 Quick-look removable inspection panels
- 53 Inspection panels, screw-fixed
- 54 Honeycomb structure (control surfaces, engine nacelles and intakes)
- 55 Seat rails
- 56 Floor supports – permit longitudinal expansion
- 57 Toilet
- 58 Galley unit
- 59 Coat stowage
- 60 Overhead baggage racks with doors
- 61 Passenger-service units on underside of baggage racks
- 62 Pilot heads

- A9 Distribution duct
- A10 Riser to distribution duct
- A11 Duct to forward risers
- A12 Window ventilating air – all windows
- A13 Air-recirculating duct
- A14 Individual punkahs on service panels, adjustable to seating arrangement
- A15 Cabin-air exhaust through roof filter via trim to under-floor
- A16 Heat and sound insulation – glass-fibre and polyester sheet
- A17 Baggage-compartment cooling air
- A18 Cabin-floor-level exhaust duct to ventilate equipment bays
- A19 Flight-deck air duct
- A20 Window demisting
- A21 Equipment venting air
- A22 Equipment-air extraction duct
- A23 Automatic discharge/relief valve – normal diff. 10.7lb/sq in
- A24 Manual discharge valve
- A25 Thrust-recovery nozzle
- A26 Low-pressure venting air between vapour seal and tank roof
- A27 Ground-conditioning connection
- A28 Undercarriage-bay cooling air

Flying controls

- C1 Control cable runs under floor
- C2 Rod linkage to surface power control
- C3 Power control unit mounting

- 19 Forged wing/fuselage main frames
- 20 Stringer carry-through
- 21 T-section spot-welded stringers (front fuselage)
- 22 Z-section spot-welded stringers (rear fuselage)
- 23 Single-flange frames (front fuselage)
- 24 Double-flange frames (rear fuselage)
- 25 Rolled-aluminium RR58 skin
- 26 Front pressure bulkhead
- 27 Rear pressure bulkhead and tank wall
- 28 Spar-box – machined girder side pieces
- 29 Spar-box – machined cap strip/boom
- 30 Pre-stretched, integrally machined wing skin panels
- 31 Lattice-tube pin-jointed ribs
- 32 Machined ribs
- 33 Corrugated – machined tank wall and spars permitting thermal expansion
- 34 Single-web spars
- 35 Forged wing (forward tanks) adjustable mountings
- 36 Pressure-floor curved membranes (to relieve thermal stress)
- 37 Pressure/passenger-floor support beams
- 38 Machined pressure-floor support beams over wheel bay
- 39 Machined pressurised keel box – carrying services

Air conditioning

- A1 Intake-air tapping to heat exchangers
- A2 Primary heat exchanger exhaust air – one per engine
- A3 Secondary heat exchanger – one per engine
- A4 Heat-exchanger exhaust air
- A5 Delivery to cold-air unit
- A6 Fuel-cooled heat exchanger – one per engine, both systems
- A7 Cold-air unit – one per engine – both systems
- A8 Delivery to cabin air-distribution system

Droop nose detail



- C4 Electrically signalled, manual stand-by power control unit
- C5 Twin output from power control unit
- C6 Control-unit fairing
- C7 Elevon
- C8 Flexible joint
- C9 Elevon outer hinges, permit spanwise expansion
- C10 Ram-air turbine
- C11 Retracting jack

Flight Deck

- D1 Captain's seat
- D2 Second's pilot seat
- D3 Third crewmember's panel
- D4 Roof panel
- D5 Third crewmember's panel

Emergency equipment

- E1 Oxygen-bottle stowage
- E2 Drop-down masks
- E3 First-aid oxygen in galley top
- E4 Twelve 26-man life rafts
- E5 Chute stowage
- E6 Windscreen (electrically heated), hydraulic wipers and fluid rain clearance
- E7 Emergency radio
- E8 Fire-suppression bottles
- E9 Direct-vision panel and exit
- E10 Spray mat de-icing

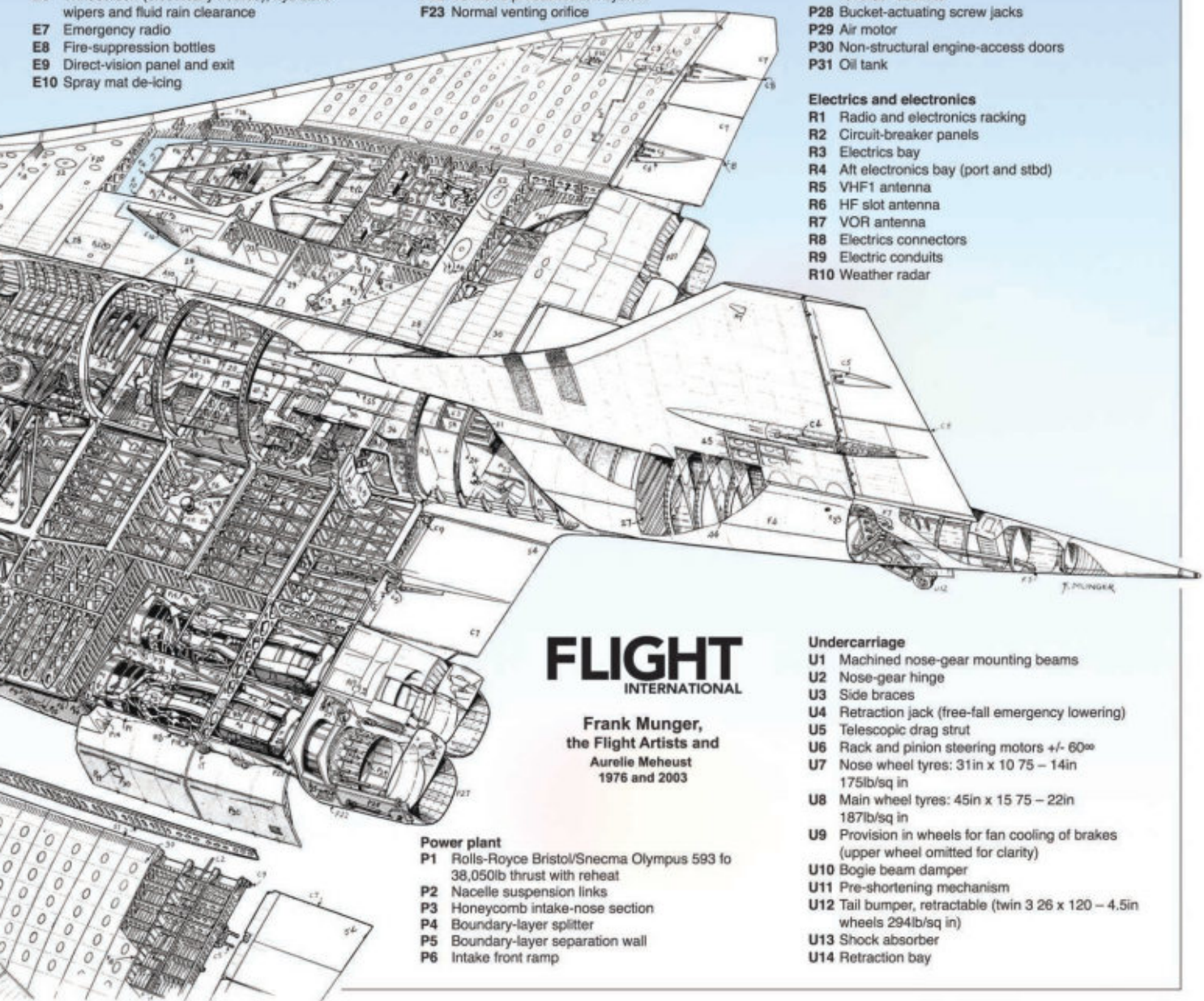
Fuel system

- F1 Forward trim tanks – nos 9 and 10
- F2 Forward collector tank – nos 1 and 4
- F3 Aft collector tanks – nos 2 and 3
- F4 Aft trim tank – no 11
- F5 Fuel jettison
- F6 Tank vent gallery
- F7 Tank overflow and pressure-relief lines – normal venting at F23
- F8 Inlet (to tank) control valve
- F9 Contents units
- F10 Transfer pumps (nos 5A and 7A tanks) in fairing
- F11 Engine-feed system
- F12 Accumulator
- F13 Trim transfer gallery – and refuel and jettison
- F14 Engine-feed pumps
- F15 Transfer pumps
- F16 Air-cooled walls
- F17 Dry bay over engines
- F18 Tank end walls
- F19 Fuel/hydraulic oil heat exchanger
- F20 Fuel tank – no 8
- F21 Fuel tank – no 6
- F22 Vent and pressurisation system
- F23 Normal venting orifice

- P7 Intake rear ramp
- P8 Ramp-control hydraulic motor, gearbox and screw jacks
- P9 Dump-door actuators and linkage
- P10 Spill door
- P11 Access panel
- P12 Inlet flap
- P13 Ramp spill air to lower fire doors
- P14 Fire flaps
- P15 Nacelle suspension links
- P16 Engine front support link
- P17 Engine main mounting – pin-jointed to wing
- P18 Engine thrust struts
- P19 Engine-mounting transverse equaliser
- P20 Aft nacelle support link
- P21 Heat shield – stainless steel/refractory material sandwich
- P22 Aft nacelle sidewall and nozzle-support structure
- P23 After burner ring
- P24 Primary variable nozzle
- P25 Nozzle-mounting spigots
- P26 Pneumatic nozzle-actuator
- P27 Combined secondary nozzle and reverser buckets
- P28 Bucket-actuating screw jacks
- P29 Air motor
- P30 Non-structural engine-access doors
- P31 Oil tank

Electrics and electronics

- R1 Radio and electronics racking
- R2 Circuit-breaker panels
- R3 Electrics bay
- R4 Aft electronics bay (port and stbd)
- R5 VHF1 antenna
- R6 HF slot antenna
- R7 VOR antenna
- R8 Electrics connectors
- R9 Electric conduits
- R10 Weather radar



FLIGHT

INTERNATIONAL

Frank Munger,
the Flight Artists and
Aurelie Meheust
1976 and 2003

Power plant

- P1 Rolls-Royce Bristol/Snecma Olympus 593 to 38,050lb thrust with reheat
- P2 Nacelle suspension links
- P3 Honeycomb intake-nose section
- P4 Boundary-layer splitter
- P5 Boundary-layer separation wall
- P6 Intake front ramp

Undercarriage

- U1 Machined nose-gear mounting beams
- U2 Nose-gear hinge
- U3 Side braces
- U4 Retraction jack (free-fall emergency lowering)
- U5 Telescopic drag strut
- U6 Rack and pinion steering motors +/- 60°
- U7 Nose wheel tyres: 31in x 10 75 – 14in 175lb/sq in
- U8 Main wheel tyres: 45in x 15 75 – 22in 187lb/sq in
- U9 Provision in wheels for fan cooling of brakes (upper wheel omitted for clarity)
- U10 Bogle beam damper
- U11 Pre-shortening mechanism
- U12 Tail bumper, retractable (twin 3 26 x 120 – 4.5in wheels 294lb/sq in)
- U13 Shock absorber
- U14 Retraction bay

Forever an icon

Always a crowd-pleaser, Concorde's elegant lines made it a photographers' favourite. We sample a few images showing the supersonic jet – from epic high to tragic low



Umdade/REX/Shutterstock

Tight space – and no glass to be seen on the flightdeck



Michel Euler/AP/REX/Shutterstock

Investigator inspects debris from the 2000 Paris crash



Sipa/REX/Shutterstock

1967: still in development but looking very fine – and fast



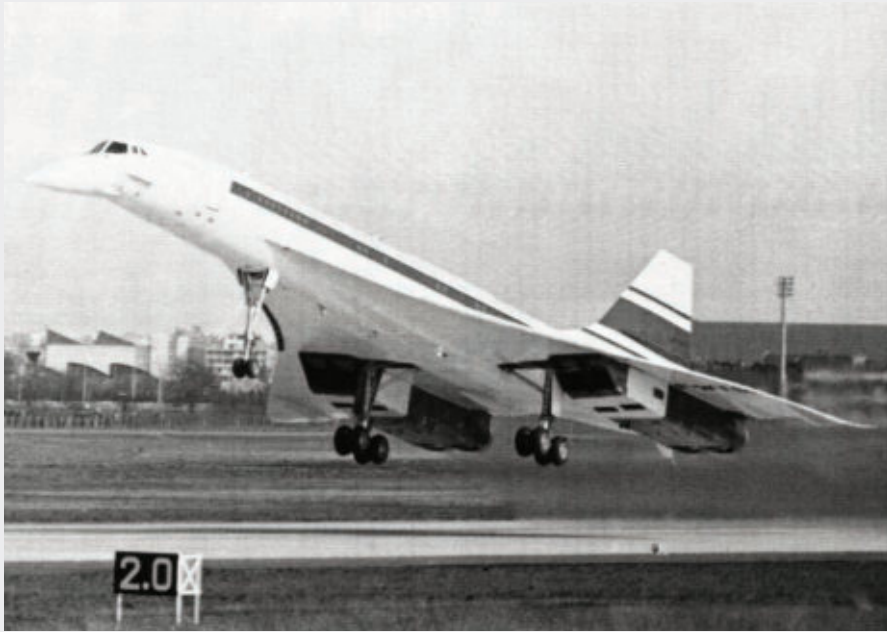
Toshihiko Sato/AP/REX/Shutterstock

Both Air France and British Airways returned Concorde to service after the catastrophic July 2000 crash, but the post-9/11 downturn and rising costs led to retirement in 2003



AP/REX/Shutterstock

1979, Riyadh: HRH Queen Elizabeth II flew on Concorde for a Gulf states tour



2 March 1969: maiden flight from Toulouse-Blagnac; the 29min sortie came a full year behind schedule – allowing Boeing's 747 to get airborne first

AP/REX/Shutterstock



British design classics: on its final flight to Filton, Concorde overflew the Clifton suspension bridge

Lewis Whyld/REX/Shutterstock



26 November 2003: for its final flight, British Airways made the short hop from Heathrow to Concorde's original "home", at Filton

Andy Bush/REX/Shutterstock



For a 2004 design prize display, a Concorde nose cone graced the quadrangle at Buckingham Palace

Adam Butler/AP/REX/Shutterstock



French for "gaffe"? 2002 postage stamp pictured F-BTSC – the one that crashed

Paul Cooper/REX/Shutterstock



Retired Air France example on display at Charles de Gaulle still draws enthusiasts

Sipa/REX/Shutterstock

MURDO MORRISON LONDON

Almost exactly 20 years after the Aerospatiale/BAC Concorde's final revenue flight from New York touched down in London in October 2003, a commercial jet will once again cross the Atlantic at speeds faster than sound. At least that is the ambition of Tom Vice, chief executive of Aerion, one of a trio of US-based start-ups hoping to return aviation to the supersonic age during the next decade.

With the backing of industry heavy hitters Boeing, GE Aviation, Honeywell, and most recently Spirit AeroSystems, the Reno, Nevada-based company's Mach 1.4 AS2 12-seat trijet is the most advanced of the three projects, and perhaps has the best chance of overcoming the environmental, technological, and economic barriers faced by a prospective 21st century supersonic jet programme.

British Airways and Air France had not long resumed their scheduled Concorde services after the fatal accident at Le Bourget and were about to announce their termination altogether when Aerion emerged in 2003. The firm hoped to tap into a market of time-poor business travellers who relied on Concorde's transatlantic services and engage with one or more of several engine manufacturers and airframers known to be considering supersonic projects.

For the next decade or so the firm, financed by billionaire Robert Bass, had a substantial presence at the major business aviation conventions. It enlisted big names such as veteran aerodynamicist Richard Tracy, chief engineer of Bill Lear's LearAvia in the 1970s, and regularly briefed a sceptical media that it was months from a major OEM partnership.

However, long after most of the press had written off Aerion as a vanity project with little chance of getting off the ground, some big suitors started to show an interest. In 2014, Airbus agreed to work with Aerion, giving the start-up its long-promised OEM partner. The airframer would provide the resources of its engineering centre in Wichita, Kansas, and, eventually, its aerostructures plants in Europe.

At the time, Aerion suggested that the European company was less interested in developing its own larger supersonic transport than in the laminar flow technology that went into the AS2's wing. Aerion had designed the wing, according to then-chief executive Brian Barents, to cruise most efficiently at both M1.5 and subsonically at M0.95, one-tenth of a Mach number faster than any current airliner.

POWER PLAY

In 2017, with supersonic projects appearing to become less of a priority at Airbus amid a senior leadership shake-up, it was Lockheed Martin's turn to get involved. At the end of that year, the US defence contractor committed to a

Aerion has secured big-name industry support for its AS2



Boom Technology has raised \$141 million towards its Overture airliner project

Boom Technology

About time?

Three start-ups are developing radical supersonic jets, but is there sufficient need for speed to make them viable?



12-month feasibility study with Aerion into a configuration of the AS2 featuring three high-bypass-ratio GE Aviation engines.

While that tie-up itself ran out at the end of 2018, it paved the way for arguably Aerion's most significant partnership announcement, at the National Business Aviation Association show in Orlando, Florida, in October 2018. GE, long mooted as Aerion's most likely propulsion provider, finally showed its hand, with the launch of the first commercial supersonic engine in five decades.

GE said it was developing the Affinity powerplant for the AS2 as well as potential future projects from other manufacturers. The FADEC-controlled medium-bypass-ratio engine, based on the core of the CFM International CFM56 and mated to a new low-pressure module, will allow efficient supersonic flight over water and subsonic flight over land, GE says.

While Aerion also confirmed at the show that it was working with Honeywell on the cockpit and cabin configuration, a further coup was Boeing's decision, announced in early February this year, to provide "financial, engi-

neering and industrial resources" to the supersonic jet developer, as well as help with flight testing. Boeing also made an undisclosed but "significant" investment in Aerion.

Seattle's interest in resurrecting faster-than-sound commercial flight came as its main rival was backtracking. At Airbus's annual results announcement in Toulouse in the same month, incoming chief executive Guillaume Faury confirmed that the manufacturer does not want to be "distracted" by supersonic efforts, given its commitment to reducing the company's environmental impact.

However, Steve Nordlund, vice-president and general manager of Boeing NeXt, the company's innovation laboratory, insists that supersonics is very much on its strategic agenda as part of a "mobility transformation" initiated by the aerospace group that will "safely and efficiently connect the world faster than ever before".

GE – which built its first supersonic jet engine in the mid-1950s, the J79 that powered the Lockheed F-104 Starfighter interceptor – says it began a process to define a final engine

configuration for the AS2 in May 2017 after two years of "preliminary study". It says the twin-shaft, twin-fan powerplant is potentially part of a family of supersonic engines.

Brad Mottier, vice-president and general manager for business and general aviation at GE, witnessed the very early days of Concorde as an exchange student in Paris. "It was so new and exciting," he recalls. However, half a century later, he says the Affinity is a very different engine to the Rolls-Royce/Snecma Olympus 593 that powered the original supersonic airliner.

"It's a 21st century engine that will feature all the commercial and military technologies that we have been using in all our advanced engines. Compared with the Olympus, this engine takes off without an afterburner, and climbs and supercruises without an afterburner," he says. While GE is not disclosing the bypass ratio, Mottier says it will be the "highest of any supersonic engine".

GE will go through a series of component tests this year before "moving towards a product design review with Aerion in 2020". The engine, says Mottier, has a new low-pressure system, two-stage fan, and exhaust nozzle, but with "basically the same commercial core that we have today", and designed to power "a very efficient subsonic aircraft that will also fly supersonic".

TEAM BUILDING

The latest company to join the AS2 programme is US aerostructures specialist Spirit AeroSystems. It announced on 21 February that it had entered an agreement to "begin immediately" the preliminary design of the AS2's forward pressurised fuselage. The deal will allow Aerion to take advantage of "Spirit's highly efficient manufacturing processes," says Spirit chief executive Tom Gentile.

While Aerion has been making most of the running in terms of securing the support of established industry players, two other start-ups, Spike Aerospace and Boom Technology, are also confident of having their prototypes flying at supersonic speeds early in the 2020s, although details on how they plan to scale up and industrialise their projects are less clear.

In October 2017, Spike flew an unmanned one-tenth scale demonstrator to assess the low-speed aerodynamics of its proposed S-512 supersonic transport. It plans to follow that up with two flights in April and summer, says chief executive Vik Kachoria. The company will work with a prototyping specialist to build a dual-piloted, two-third-scale demonstrator ready for supersonic testing by 2020.

Kachoria says Boston, Massachusetts-based Spike is talking to two potential engine suppliers for the M1.6, 6,200nm (11,500km)-range aircraft and "hoping to make an announcement soon". It has already worked with companies »

» including Aernnova, Greenpoint Technologies, and Siemens on aspects of the design.

Spike has talked about a 2023 target date for customer deliveries, but that does seem highly ambitious given that it is at least two years from having a full-scale demonstrator in the air and is still to announce its plans to industrialise production. In addition, it faces the challenges of certificating what would be the first supersonic commercial jet in over 50 years, as well as securing a launch customer.

Another supersonic jet developer that has made a lot of noise but struggled to meet some of its stated scheduled targets is Colorado-based Boom. At last year's Farnborough air show, chief executive Blake Scholl confirmed that a planned first flight for its two-seat XB-1 supersonic demonstrator, originally set for 2017, had been delayed from late 2018 to 2019.

The company now tells FlightGlobal that its team is "heads down and focused" on the demonstrator, which is powered by three GE J85s, and has "moved to the build stage". It says the XB-1 will "prove in flight the key technologies for safe, efficient travel at M2.2", and will help define the design and engineering of the proposed 50-seat, all-business-class Overture airliner with 4,500nm range.

The company earlier this year secured \$100 million of additional investment, bringing total funding to \$141 million, allowing it to "advance work" on the Overture, says Scholl. Last year, Chinese travel service provider Ctrip.com International also said it was making a "strategic investment" for an undisclosed amount in the start-up.

Boom had announced, at Farnborough, a \$10 million injection from Japan Airlines (JAL), together with a "pre-order" for 20 aircraft. It is the closest any of the three developers have come to winning an actual order, and JAL is the first carrier to make a financial commitment to a supersonic jet programme, says Scholl. Air France and British Airways were

handed their Concorde for a nominal sum.

As part of the deal with the Japanese carrier, which gives it the "option to purchase up to 20 aircraft through a pre-order arrangement", JAL is "collaborating [with Boom] to refine the aircraft design and help define the passenger experience for supersonic travel". The two companies had been in discussions for a year before the July announcement, said Scholl at Farnborough.

While Aerion has no confirmed orders ahead of the programme's formal launch, it has one letter of intent (LOI) for 20 examples from US fractional ownership operator Flexjet, and says it has an undisclosed number of further refundable LOIs. Spike, meanwhile, says it has signed two customers and will be making an announcement in March.

Lockheed is the final player among the would-be supersonic developers, although its motives are different. Alongside its collaboration with Aerion, which ended at the end of 2018, it has been working on its own concept, as part of a NASA project. The company said in November that it had begun milling the first part of its X-59 Quiet Supersonic test aircraft at its Palmdale, California plant.

INITIAL SOUNDINGS

Lockheed intends to fly the X-59 in 2021, with a major objective of the test programme being to collect data from residents on the impact of the quieter sonic boom generated by the aircraft. Those responses will help NASA establish an acceptable commercial supersonic noise standard to replace existing regulations that ban faster-than-sound travel over land.

The company has designed the X-59 to cruise at 55,000ft at about M1.23, replacing the sonic boom with a sound as loud as a car door closing. Lockheed sees reducing the noise experienced by the overflight of aircraft breaking the sound barrier as crucial to opening the door for supersonic jet developers.



GE Affinity engine features CFM56 core mated with a new low-pressure module

The success of the new supersonic start-ups depends on them overcoming many hurdles. Falling at any of them will make their ambitions impossible to achieve. The first is raising sufficient cash not just to convince the authorities that their highly innovative designs are safe for passengers to fly in, but to take them to industrial production and support operators.

Unlike Concorde, there are no taxpayer research and development dollars – NASA studies aside – to pour into bringing a programme to market. In addition, the developers are private concerns, backed by entrepreneurial visionaries with finance raised on the markets, rather than the state-backed combines behind the original supersonic airliner.

However, Aerion's success in attracting endorsement from the likes of Boeing, GE and Honeywell, and Boom's ability to convince one of the world's blue-chip airlines to back its project and raise tens of millions of dollars of additional capital, shows that there is faith out there in their schemes.

There are also technical, environmental and regulatory challenges. Concorde's failure was largely down to the refusal by authorities to permit supersonic flight over land, which restricted its market to the transatlantic. Aerion, Boom, and Spike, as well as their engine partners, will have to come up with aircraft that operate efficiently at subsonic speeds, as well as fly faster than sound.

The final obstacle is the market itself, and the question of whether there are enough passengers out there willing to pay a premium for the gift of time. Many business jets already fly long distances at close to M1, and come with the latest connectivity systems to ensure that those in the back enjoy not only the utmost comfort, but can stay in touch with their business from their office in the sky.

So, are there enough high-net-worth individuals or time-starved senior executives happy to pay that bit more to arrive a few hours earlier, for business or personal reasons? Mottier believes there are. "Business aircraft have got bigger, more comfortable, longer range," he says. "Shortening the time of the flight is the last piece. That's why we're excited to be involved with this project." ■



Spike Aerospace is talking to two propulsion providers for its S-52

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Chunder and Lightning

It is 60 years since the service entry with the Royal Air Force of the English Electric Lightning, the fastest climbing combat aircraft of its era (an era that lasted to the late 1980s).

We came across a clip on YouTube's Aircrew Interview channel with ex-Lightning, and now Virgin Atlantic pilot Ian Black on why the interceptor got its "Frightening" monicker.

Black was already a seasoned pilot in his early 20s when he took off for the first time in a Lightning. "You're so far behind the aircraft you're still in the crewroom," is how he describes the gut-wrenching sensation.

Royal relics

The decision to axe the world's largest airliner after only a decade and a half seems to have settled the debate over whether the Airbus A380 or the Boeing 747 – in the air for 50 years and counting – was the true queen of the skies.

However, the actual *Queen of the Skies* – at least that was the official name bestowed by none other than Her Royal Highness Queen Elizabeth II in a 2004 ceremony in Toulouse – was in fact a smaller quadjet airliner, Virgin Atlantic's A340 G-VEIL.

Sir Richard Branson managed to secure the royal recognition at an event to mark the centenary of the Entente Cordiale between the UK and France, which coincided with the handover of the A340.

G-VEIL lasted only 12 years in



One extremely proud father: Sutter with the 747-8

Virgin's service before retirement in 2016. MotoArt, a Californian company that makes furnishings and decor from old aircraft parts, bought the scrapyards-bound jet and is now offering tags made from its fuselage skin. For each one purchased, MotoArt will donate \$3 to the Virgin Atlantic Foundation.

Some you lose, Toulouse

Meanwhile, crystal ball gazing compared...

"I am convinced we will still produce A380s 10 years from now," Airbus boss Tom Enders said in November 2017.

"I believe the 747 programme is just in its midlife. You'll see



Very, very frightening...

this airplane flying another 20 or 30 years from now. It'll be in production for something like 50 years." Father of the Jumbo, the late Joe Sutter, interviewed for a 1999 documentary.

Cover up

We will not name and shame the aviation book outfit, as your favourite aviation weekly has itself occasionally dropped a clanger. But "a bit tighter on the aircraft recognition please, Hoskins" to whoever gave the nod to the original cover of a tome on the Hercules – preserved for posterity in the firm's hard copy brochure – depicting, albeit in close crop, what is distinctly an A400M.

Someone must have spotted the Herculean howler, because on the web site the image has changed to a C-130.



Queen's greatest bits: pieces of the A340 fuselage are up for sale

Registry office

One of the first essentials in the development of aerial transport is a good system of registration and insurance, similar to that of Lloyd's in relation to merchant shipping. This is to be inaugurated and soon the "Aerial Lloyd's Registry" will actually be in existence.

Danger money

Pointing out that the wages of civilian workers at airfields are often as high as that of a bomber captain, and higher than that of pilots, gunners, and lower ranks "who constantly risk their lives fighting," Mr. R. Purbrick M.P. has asked the Secretary of State for Air to "remedy the disparity."

Destination Moon

Apollo 9 is the first manned flight involving the lunar module (LM). It was due to have been flown last year, but

problems forced a postponement. In order to qualify for the Apollo 11 manned lunar landing next July, the LM trials involving Apollo 9 and 10 must now be reasonably trouble-free.

Delays at Denver

Airlines that have signed up to use Denver International

airport will subsidise the \$100 million in additional costs

associated with the delay in opening the airport. The latest delay is primarily due to problems with the airport's baggage-handling system.

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