

# Flight International

21-27 February 2017

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## Max effort

Boeing faces battle on three fronts, as latest variant of 737 is readied for service entry **7**

## Single minded

Rivals prepare for New Delhi's lighter fighter contest with big presence at Aero India **13**

## Red alert

Embraer civil aircraft chief Slattery warns US airlines that profitability will not last **16**

30-YEAR ANNIVERSARY

## The airliner that made Airbus

And how Toulouse has kept its money-maker evolving



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### Flight International



#### COVER IMAGE

To celebrate the 30th anniversary of the A320's first flight, Getty Images supplied this suitably retro shot featuring the airframer's corporate colours from 1987 **P24**



#### BEHIND THE HEADLINES

Greg Waldron and Aaron Chong (pictured) were at Air Force Station Yelahanka for Aero India (P12). And US bureau chief Stephen Trimble travelled to Seattle to hear Boeing's latest update on the 737 Max (P7)



#### NEXT WEEK HELI-EXPO

Ahead of the rotorcraft industry's annual gathering, we speak to Bell's new chief for his views on innovation

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Leonardo's AW609 tiltrotor set for icing trials **P22**

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Australia's air force is in a period of rapid modernisation as it takes delivery of increasingly sophisticated aircraft types. But the change is not causing the service's chief to lose any sleep
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Rolls-Royce ready to ramp-up engine output **P17**. Swedish air force displays Gripen D at Aero India **P13**



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## Image of the week

Captured by photographer Matthias Geiger, this Swiss Bombardier CS100 was making a visit to the Alpine resort of St Moritz to mark the world ski championships taking place in the town in early February. Registered HB-JBE, the twinjet is the newest in the carrier's five-strong CSeries fleet

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## The week in numbers

 **45%**

FlightGlobal Dashboard

If Hawaiian Airlines pilots accept it, a new pay deal will see compensation rise sharply to match that at major US carriers

**\$386m**

Pratt & Whitney

Pratt & Whitney is investing in its Columbus, Georgia factory to boost parts production and GTF engine overhaul capacity

 **104**

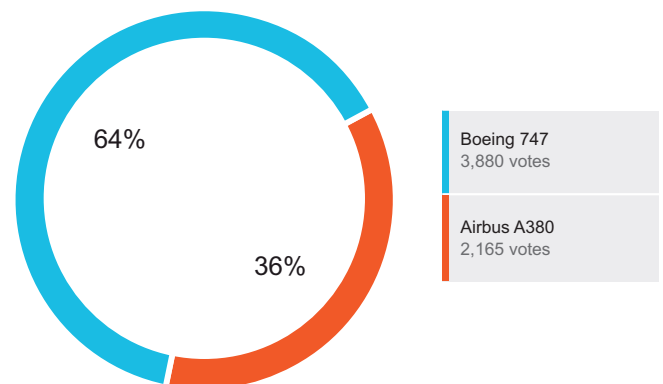
Seradata, ISRO

India's PSLV rocket nearly trebled the record for satellites deployed in one launch: 1 main payload, 103 cubesats

## Question of the week

Last week, we asked: **Which giant will end production first?**  
You said:

**Total votes: 6,045**



This week, we ask: **Boeing 737 Max 10?**

☐ Take that Toulouse ☐ Seattle playing safe

☐ Can't match A321neo

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# Stuck on repeat

Aero India was again the scene of rivals jostling for position ahead of another fighter contest. But procurement failures mean New Delhi needs combat power more than industrial offset

Visitors to Aero India this year could be forgiven for feeling a sense of déjà vu. Back in 2011, the soundtrack to the show was the roar of fighter aircraft as eager bidders put their jets through their paces.

The noise was much the same this time around, with a number of repeat participants in the air display as the Dassault Rafale, Lockheed Martin F-16 and Saab Gripen all took to the skies.

Added to that was the familiar chatter from salesmen promising combat capability and, crucially, industrial partnerships.

Six years ago, Aero India saw the climax of the country's medium multirole combat aircraft (MMRCA) competition for 126 aircraft. This long-running saga had six actors, and featured plot twists and turns worthy of the most serpentine Bollywood epic.

## New Delhi appears to place far too much emphasis on the industrial value of buying fighter aircraft

The Rafale eventually won, but after years of tortuous negotiations, New Delhi ditched MMRCA altogether over disagreements about technology transfer. Instead, 36 Rafales were ordered in a flyaway condition.

Meanwhile, the fleet of Cold War-era MiGs that MMRCA was supposed to replace have steadily decayed, eroding the air force's capabilities.

The other fighter that was meant to be a substitute for some of these aging assets, the Hindustan Aeronautics Tejas, has been a poor performer for years.

It is slowly entering service after decades of development. Measured against its own low levels, the Tejas is making progress. However, by international standards it



Phil Yeomans/Bournemouth News/REX/Shutterstock

The contract's in here, somewhere

is already obsolete.

This year's show saw MMRCA veterans battling for several requirements, namely an ill-defined order for up to 100 single-engined fighters, plus a navy request for information for 57 carrier-borne jets.

Expect two things from both deals. First, a clunky MMRCA-style acronym will be applied to each. Second, the industrial participation, and technology transfer, required of manufacturers will be exceedingly high.

Local workshare is not all bad, and highly skilled aerospace jobs are the delight of politicians globally. That said, New Delhi appears to place far too much emphasis on the industrial value of buying fighter aircraft, rather than the military purpose of their acquisition.

Strategic imperatives cannot be comprised for the sake of economic benefit. If India's new fighter acquisitions fail as dismally as MMRCA, the Indian air force will be staring at obsolescence.

In wartime, a nation's industrial policies will be cold comfort to a pilot parachuting from a crippled jet. ■

**See Show Report P12**

## Lucky 13

A 13th passenger-carrying version of the Boeing 737 is now being seriously pursued in Seattle. If launched later this year, the 230-passenger 737 Max 10 would be 1.68m (66in) longer than the 737 Max 9 and 15.1m longer than the 737-100 that first flew 50 years ago in April.

The configuration being shown to airlines is not the potential stretch-too-far that briefly made headlines last year. That version would have added another 10 passengers, but required a larger engine and a telescoping extension to the landing gear.

If the Max 10 is approved, Boeing will offer five variants of the 737 Max, including the 737 Max 200.

It's difficult, however, to see how the 737 Max 10 makes up significant ground lost already to Airbus' for-

midable A321neo. More than six years after the re-engined single-aisle race began, the 240-passenger Airbus leads the 737 Max 9 by a five-to-one margin.

The hard-fought sales parity achieved by the original A320 family against the 737 Classic and 737NG now seems to be turning into a permanent lead.

This may feel demoralising at the 737's home in Renton, but it is not devastating either. The fact is that the single-aisle market is big enough to sustain a competitor with a long-term share of 40-45%.

The play-it-safe strategy of the 737 Max 10 also leaves Boeing more room to manoeuvre for a potential middle-of-the-market product. ■

**See This Week P7**



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# BRIEFING

## \$1BN LOSS SHOWS BOMBARDIER'S PROGRESS

**FINANCIAL** The first 12 months of Bombardier's five-year recovery plan ended as promised, with the Canadian manufacturer recording a \$981 million net loss, including a \$903 million loss before interest and tax in its commercial aircraft division. Although the company lost nearly \$1 billion in 2016, that performance was sharply improved from a disastrous 2015, which yielded a \$5.34 billion net loss. Bombardier chief executive Alain Bellemare says the company is on track to generate profits from the CSeries programme by 2020.

## DOUBLE FIRST FOR AIR INDIA AND ALAFCO

**DELIVERY** Air India has received its first Airbus A320neo, becoming the ninth Asian operator of the type. The aircraft is the first of 14 that the carrier will lease from ALAFCO. The CFM International Leap-1A engine-powered aircraft (VT-EXF), is also the first re-engined narrowbody for the lessor, which has ordered 85 A320neo-family jets.

See Feature P24

## AIRBUS, EUROFIGHTER ACCUSED OF FRAUD

**LEGAL** Eurofighter and partner Airbus face a claim for damages of up to €1.1 billion in Austria. On 16 February Vienna filed criminal charges alleging it would not have chosen to acquire the fighter aircraft in 2003 had it not been "wilfully and fraudulently" deceived as to the "true" purchase price, operating costs and specifications. Austria, which also alleges that the companies were "in no position and [had] no intention" to deliver as promised, has bought 15 Eurofighters. Airbus says it "sees no foundation" to the allegations.

## FAA APPROVAL LIFTS AGUSTAWESTLAND AW169

**ROTORCRAFT** Leonardo Helicopters has secured US Federal Aviation Administration certification for its AgustaWestland AW169 medium twin. Deliveries to US customers are due to begin later this year, it says. The manufacturer says it has delivered "over 20" examples of the 4.8t helicopter to customers since achieving European certification in July 2015.

## FIRST 787-9 COMPLETION FOR GREENPOINT

**OUTFITTING** Greenpoint Technologies has secured a contract from an unnamed customer for the completion of a Boeing Business Jet 787-8 and a -9. The contract marks the first 787-9 completion project for the Kirkland, Washington-based company and its third 787-8. Greenpoint handed over the world's first VIP-configured -8 to its private owner in 2016.

## KHI READIES FOR 777X WITH NEW FACTORY

**MANUFACTURING** Kawasaki Heavy Industries has completed the construction of a new factory in Nagoya for the production of parts, including fuselage sections, for the Boeing 777X programme. The new plant, located at Kawasaki's aircraft assembly and component facility, will start operations from June 2017.

## JET SET FOR GODIRECT FUEL EFFICIENCY DRIVE

**SOFTWARE** Jet Airways has become launch customer for Honeywell's GoDirect fuel efficiency software. It provides data analysis on fuel consumption and can calculate the optimal fuel uplift against an aircraft's passenger and cargo load.



The first flight-test vehicle has accumulated 100h since November

**PRODUCTION** STEPHEN TRIMBLE WASHINGTON DC

# Bombardier says Global 7000 wait was over weight

Bellemare reveals ultra-long-range jet delayed in 2015 by effort to lighten its structure, triggering supplier dispute

Bombardier launched a costly redesign of the Global 7000 wing in 2015 to reduce its structural weight without altering its aerodynamic profile, chief executive Alain Bellemare has disclosed.

In July 2015, Bombardier blamed the wing redesign for a two-year delay to entry-into-service of the ultra-long-range, high-speed rival to the Gulfstream G650ER.

The design change eventually triggered a legal dispute with wing supplier Triumph Aerostructures, which filed a lawsuit in early January 2017 claiming that Bombardier owes the company money for the extra work and tooling costs associated with the redesign.

Until now, Bombardier has never revealed the reason for the change, leading at least one analyst to assume, in a question posed on a 16 February earnings call, that the shape of the wing was the at the root of the issue.

But Bellemare told the analyst that "there's not much change" to the aerodynamic profile. "It's just a lighter wing," he says.

Bombardier disputes that Triumph's claims for compensation

are due to the wing redesign and, in the meantime, Triumph is continuing to support the programme as the wing supplier for test and production aircraft.

The original, heavier wing is being used on the first Global 7000 flight-test vehicle, which has accumulated 100h since November. The redesigned, lighter wing will be delivered later this year.

Bombardier plans to start flight testing the second Global 7000 before 1 April, Bellemare says.

"The design of the wing is largely completed," Bellemare says. "We're in the final phase of making sure the lightweight wing, as we call it, is being finalised."

Entry into service for the Global 7000 remains on track for the second half of 2018.

Though there may still be "hiccups" in development, Bellemare emphasises the maturity of the Global 7000 so far by comparing it to the first few months of flight testing for the CS100 airliner in late 2013. By comparison, the Global 7000 is "two to three times" more mature than the CSeries at this stage, he says.

"It shows we've been building on the lessons learned from the CSeries," Bellemare says. ■



Boeing workers  
reject union at  
North Charleston  
This Week P8

THIS WEEK

PROGRAMME STEPHEN TRIMBLE RENTON

# Boeing ramps up Renton for Max effort

Narrowbody production line prepared for transition to higher rate, as certification nears for first variant of re-engined 737

At Boeing's narrowbody hub in Renton, Washington, a frenetic period of activity has begun: early March will see the first flight-test 737 Max 9 completed, a multi-airline entry into service for the Max 8 looms in the second quarter, and a production ramp-up to yet another record-breaking level is scheduled to start in May.

On top of all that, Boeing is wrestling with key design decisions on a proposed fourth member of the family, the 737 Max 10.

But for the first aircraft in the re-engined 737 series, the Max 8, certification is imminent. The revamped twinjet is three flight tests short of completing a year-long campaign to gain US Federal Aviation Administration validation, Boeing 737 Max vice-president and general manager Keith Leverkuhn says.

Boeing has already handed over most of the test records to the FAA, keeping certification of the single-aisle on track for the first quarter followed by entry into service with Norwegian in May.

"We are anticipating certification of the airplane within a matter of days or weeks," Leverkuhn says.

The 737 Max family is still being reshaped more than five years after Boeing unveiled the update to a product that celebrates the 50th anniversary of first flight on 9 April, with aircraft at both ends of the size range receiving a second look.

Last July, Boeing announced a 1.93m (76in) stretch of the original 737 Max 7 design, adding two more rows of seats to the economy cabin.

Taking a page from that revision, Boeing's product development staff are now discussing with airlines a proposed 737 Max 10, with a recently finalised, 1.68m stretch compared with the slower-selling 737 Max 9, adding two rows of economy-class seats.

"So far we're getting some good



Flight testing on the Max 8 is nearly complete, with airframer's attention now moving to larger models

responses from the airlines we're talking to," Leverkuhn says.

A sticking point for the designers remains how to manage the heavier loads on the landing gear. In selecting the 1.68m stretch, Boeing rejected concepts requiring more elaborate changes to compete with the faster-selling Airbus A321, including a switch

a shift from the 737's traditional oleo strut to a trailing-link landing gear design, Leverkuhn says, noting that reliability will be a key criteria in the final decision later this year.

## FULLY ASSEMBLED

As sales and engineering efforts continue on the 737 Max 10, Boeing is wrapping up final systems installation on the 737 Max 9.

During a 13 February factory tour, Boeing displayed a fully assembled aircraft, with test instrumentation and systems still to be fitted. First flight is expected in April, followed by a nine-month flight-test campaign by two prototypes, Leverkuhn says.

The 737 Max remains on the schedule that Boeing outlined more than five years ago, despite a series of interior design changes. The aircraft's performance has lived up to expectations, but concerns developed about the ability of machinists to produce the design amidst escalating production rates.

So Boeing made several changes to make the aircraft easier to build, including re-routing how portions of the wiring are in-

stalled, Leverkuhn says.

With five new or proposed single-aisle designs – including a 200-seat variant of the 737 Max 8 – in development, it is possible to overlook that Boeing is preparing for a historic rate increase in May – often regarded as the most challenging task for any production programme. The "rate break" will increase monthly 737 output in Renton from 42 to 47 aircraft later this year. Keeping that on track while integrating the 737 Max into the assembly flow drove Boeing to make the design changes.

"Looking at rate, we had to do it. We had to make hard decisions early. What we didn't want to do is stumble as we went to our rate build-up," Leverkuhn says.

Boeing expects 10-15% of 737 deliveries in 2017 to involve re-engined models, representing roughly 50-75 tail numbers to multiple airlines. That has caused Leverkuhn's team to "open the aperture" in preparing airlines to absorb the 737 Max.

Rather than concentrating on a single launch customer, Boeing is preparing multiple airlines to launch operations with the 737 Max at the same time, Leverkuhn says. ■

**"We had to make hard decisions early. We didn't want to stumble as we went to our rate build-up"**

Keith Leverkuhn

737 Max vice-president and general manager, Boeing

to a larger engine.

The proposed 737 Max 10 retains the 28,000lb-thrust (125kN) CFM International Leap-1B and accepts a slightly higher maximum take-off weight, Leverkuhn says. The challenge now is to design a landing gear that can absorb the higher loads while fitting into the existing wheel-well with minimal design changes.

Boeing has been evaluating multiple "good ideas", including





PROPULSION DAVID KAMINSKI-MORROW LONDON

# Rolls-Royce keeps 'first half' date for Trent 7000 debut

A330neo launch customer TAP Portugal expects service entry in 2018 first quarter, but engine maker less certain

Rolls-Royce is progressing with Assembly of the initial flight-test Trent 7000 engines for the Airbus A330neo, although a maiden flight date has not yet become clear.

The engine manufacturer, in its full-year financial presentation, gave the entry-into-service date for the aircraft as the first half of 2018.

TAP Portugal, the initial operator, has previously indicated that it expects to receive its first A330neo in the first quarter of that year.

R-R has not clarified whether the difference in phrasing is indicative of a further slip in the schedule, but its use of "first half" for the entry-into-service timeframe is similar to that voiced by Airbus commercial aircraft chief Fabrice Brégier in January.

Brégier had mentioned that

TAP planned services in "spring 2018" and that the A330neo development effort was "compatible" with this.

R-R has already conducted ground tests of the powerplant and says assembly of the first flight-test engines is continuing.

## CERTIFICATION

### New process speeds up vibration testing

Airbus is planning to use a quicker technique to validate ground-vibration responses on the A330neo, having tested the procedure on the A350-1000.

The airframer says the testing is designed to assess the aircraft's behaviour under certain flight conditions.

Airbus convened a team to find ways to optimise and simplify the process, in order to



Airbus is progressing with ground tests as it awaits the first engines

Chief executive Warren East says the Trent 1000-TEN for the Boeing 787 is on schedule for service entry in the second half of

this year, as is the Trent XWB-97 engine on the Airbus A350-1000.

"On the new A330 with the [Trent] 7000 engine – that is about six months behind," he adds. "But it's on a similar trajectory, and that [aircraft] will fly with its new engine for the first time over the coming months."

The engine will not be installed on a testbed aircraft but fitted straight to an A330neo certification airframe.

Airbus still states only that the maiden flight will be in the first half of this year.

R-R attributes higher R&D charges last year to increased spending on key programmes, particularly the Trent 7000. ■

See Air Transport P17

EMPLOYMENT STEPHEN TRIMBLE WASHINGTON DC

# Boeing workers reject union at North Charleston



South Carolina plant builds all three variants of the 787 Dreamliner

Nearly 3,000 employees at Boeing's eight-year-old campus in North Charleston, South Carolina have rejected a second attempt by the International Association of Machinists and Aerospace Workers (IAM) to represent staff at the site.

The vote means the complex that assembles 787s and engineering propulsion systems for the 737 Max will stay non-unionised for now, but the union remains committed to organising at the site.

"Ultimately it will be the workers who dictate what happens next," says IAM lead organiser

Michael Evans.

Of the 2,828 workers who cast ballots, 74% voted to reject IAM representation, Boeing says.

Joan Robinson-Berry, vice-president and general manager of Boeing South Carolina welcomes the result. "We have a bright future ahead of us and are eager to focus on the accomplishments of this great team and to developing new opportunities," she says. "It is great to have this vote behind us."

The vote came two days before the roll-out of the first 787-10 in a ceremony that was due to be attended by US President Donald Trump. ■





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Boeing looks beyond offset work to closer industrial ties  
[Show Report P12](#)

THIS WEEK

DIRIGIBLE MURDO MORRISON LONDON

# Repaired Airlander set to resume tests

Hybrid airship now "structurally complete" following crash that damaged cockpit, with a return to flight due in weeks

The developer of the Airlander hybrid airship says it has repaired damage to its cockpit, sustained when it crashed on its second flight last August, and is looking to get the world's largest flying structure airborne again in the next few weeks.

"Airlander is now structurally complete ahead of hangar exit and resuming the flight test programme. A rigorous testing and training programme has now commenced to prepare for Airlander taking to the skies again," Bedford-based Hybrid Air Vehicles (HAV) says.

The accident, in which neither pilot was hurt, took place on landing at the end of a roughly 100min sortie near HAV's facility at Cardington on 24 August.

The flight-test programme is likely to entail the completion of about six flights, or 20h, during the first phase, before a second, 80h effort sees the aircraft taken to 10,000ft and flown at 65kt.

A final test phase of up to 200h will introduce night flights and operations outside visual flight rules, and of a distance of more than 75nm (140km) from the Cardington facility. ■



Damien Guarnier/Lockheed Martin

## MILESTONE

### Roll-out offers first sight of LM-100J

Lockheed Martin has rolled out the first LM-100J commercial freighter from its assembly line in Marietta, Georgia, completing a milestone ahead of a first flight scheduled for later this year. Lockheed launched the LM-100J programme three years ago to adapt the C-130J Super Hercules for the cargo market, replacing older L-100s. Lockheed has orders for multiple examples of the Rolls-Royce AE 2100DC-powered type, including commitments from ASL Aviation Group and Bravo Industries. The air-framer plans to obtain US Federal Aviation Administration certification in 2018, with deliveries beginning late that year.

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## AERO INDIA 2017

It was difficult to escape New Delhi's "Make In India" slogan at this year's Aero India show held at Air Force Station Yelahanka on the outskirts of Bengaluru. The phrase was plastered on everything from corporate brochures to fighter aircraft, as exhibitors fell over themselves to tout their passion for manufacturing aerospace products locally. But as everyone knows, India's procurement processes are notoriously long-running. Aaron Chong and Greg Waldron report



Greg Waldron/FlightGlobal

### MODIFICATION

## Chetak to gain new life in naval unmanned role

Israel Aerospace Industries (IAI) has begun work on a project with India's Defence Research Development Organisation to transform aged Hindustan Aeronautics (HAL) Chetak helicopters into rotary-wing unmanned aircraft for naval applications.

Modifications will see the legacy rotorcraft fitted with a radar as well as an electro-optical/infrared payload, providing better over-the-horizon visibility for Indian warships, says Arie Shory, IAI's marketing director for India.

Shory adds that he expects the first aircraft to fly in the next few years, and says funding has been secured for the initial stages of the programme.

One benefit of the Chetak platform – which is based on the Aérospatiale Alouette III – is the hundreds of airframes built by HAL that can now provide a large pool of feedstock aircraft for the programme.

Shory declines to provide details on the flight-control system for the unmanned Chetak, or the type's likely performance characteristics.

Longer term, he says there will also be an opportunity to transform HAL's newly-developed Light Utility Helicopter – a successor to the Chetak and Cheetah – into an unmanned system. ■

### SUPPLY

## Boeing looks beyond offset work to closer industrial ties

Airframer builds on military sales by establishing local unit for manufacturing and support

Boeing is seeking to improve India's aerospace industrial capabilities, as it further integrates the country into its supply chain.

Pratyush Kumar, president of Boeing India, says the country has gone from being a "sales outpost" for the US airframer to a "full operating business".

**"Something made in India is in all of our platforms that are flying today"**

Pratyush Kumar  
President, Boeing India

He notes that Boeing has 35 direct and 120 indirect suppliers in the country.

"Something made in India is in all of our platforms that are flying today," he says.

A good portion of Boeing's involvement with Indian industry stems from its run of military sales successes in the country. In recent years, New Delhi has bought platforms including the C-17 strategic transport, P-8I anti-submarine warfare aircraft, and AH-64E Apache and CH-47 Chinook helicopters.

Under Indian law, 30% of such acquisitions need to be

reinvested in the form of offsets to build India's defence and aerospace sectors. One high-profile collaboration is Boeing's joint venture with Tata Advanced Systems, which builds the fuselage for the AH-64.

Boeing also announced the establishment of Boeing Defence India, a local operating unit focused on services, support, sales and marketing, sourcing, manufacturing, and engineering.

The company says this will "drive decision making closer to the customer," and allow it to deepen its relationship with the country's defence ministry. ■



Boeing

New Delhi has received eight of a potential fleet of 20 737-derived P-8I anti-submarine warfare aircraft



India to become  
widebody  
battlefield  
Show Report P14

### COMBAT AIRCRAFT

# Rivals jostle as fighter contest emerges

Manufacturers tout "Make in India" and cost credentials, as New Delhi begins process of selecting single-engined type

Two contenders for an emerging Indian requirement for a single-engined fighter were out in force at Aero India, both touting their aircraft's credentials and promising large-scale industrial co-operation.

Saab brought its Gripen to Aero India for the first time since 2011, signalling the Swedish company's determination to win the nascent air force contest.

The requirement could be for as many as 100 jets to replace legacy types such as the Mikoyan MiG-21 and MiG-27, although details have yet to be firmly established. No formal request for information has been issued, but the Indian government has invited initial expressions of interest.

Saab chief executive Håkan Bushke says his company's developmental Gripen E offers the best capability for the single-engined requirement. Moreover, Saab is willing to offer a deeply collaborative industrial partner-

ship in line with New Delhi's "Make In India" initiative.

"We have had production in India since the mid-1970s, but the last seven years we have grown rapidly here," he says. "Today we do aerostructures, camouflage, and ammunition in India."

Saab also performs some coding for the Gripen E in India.

The aircraft at this year's show was a D-model variant, flown by pilots from the manufacturer and the Swedish air force.

### US COMPETITOR

The Swedish company will face competition from Lockheed Martin with its F-16; the US manufacturer claims that the fighter's economies of scale and large operator base will give the Block 70 variant an edge in any future contest.

Abhay Paranjape, executive director of international business development at Lockheed, says there has been significant engage-



Swedish air force displayed a D-model Saab Gripen at Aero India

ment between the Indian and US governments over the requirement. Despite the absence as yet of any formal process, Paranjape says there is a sense of "urgency" in the Indian defence establishment to recapitalise its air force's ageing fleet.

The programme will require the winner to work with an Indian company to build the aircraft in-country; Bushke says it is too early to specify Saab's preferred local partner.

"We are discussing different possibilities but we also know there are processes going on in the government where they have an idea about how the selection will benefit India," he says. "We are open to that."

One possible obstacle for Lockheed is that its production backlog for the F-16 runs only until September, when an order for the Iraqi air force will be completed.

But Randy Howard, director of F-16 business development, is

confident that additional deals will be struck in the interim for up to 100 new aircraft.

### CUTTING COSTS

In addition, an upgrade effort to bring legacy F-16s to the new V-model standard – equivalent to the new-build Block 70 variant – will contribute to economies of scale for the latter. This, Howard says, will reduce costs for the Indian government should it select the F-16.

Both fighters were unsuccessfully pitched for the previous 126-aircraft Medium Multirole Combat Aircraft (MMRCA) competition, ultimately won by the Dassault Rafale. However, that contest was later cancelled, with New Delhi instead acquiring 36 French-built Rafales.

The shortfall in airframes against the 126 required by under MMRCA has apparently set the stage for the acquisition of a single-engined combat aircraft. ■



Lockheed stresses the F-16's economies of scale and cost benefits

### SURVEILLANCE

# DRDO waits for final sign-off on A330 acquisition

India's Defence Research Development Organisation (DRDO) is awaiting final approval for the acquisition of a pair of Airbus A330-200s that will be modified for Airborne Early Warning and Control (AEW&C) missions.

Initially two of the widebody twinjets will be acquired, but New Delhi expects to place a follow-on order for another four aircraft, says the DRDO.

The A330 was selected in 2015 following a request for proposals

issued by the DRDO. The aircraft will be fitted with an active electronically scanned array (AESA) radar in an external radome.

"This aircraft gives us 360-degree coverage, while the [Embraer] EMB-145 only offers 240

degrees of coverage with its plank array," a DRDO official says.

New Delhi has acquired three EMB-145s, which are equipped with an indigenously produced radar. The air force officially inducted the type at the show. ■





## FLEETS

# India to become widebody battlefield

Big two airframers target twin-aisle orders both from nation's full-service carriers, as well as expanding domestic airlines

Changes to India's aviation sector will see the subcontinent become a key battleground for sales of widebody aircraft for the industry's big two.

Full-service carriers Air India and Jet Airways could both place orders for new twin-aisle jets "within the next two to three years", says Dinesh Keskar, Boeing's senior vice-president of sales in Asia-Pacific, as they look to replace ageing widebody fleets.

Keskar expects expansion-minded Indian domestic operators to form the other part of Boeing's "solid base" of widebody customers.

"Once these airlines reach 20 aircraft, they will want to go overseas," he says. "High risk

**"Once these airlines reach 20 aircraft, they will want to go overseas. High risk brings high reward"**

Dinesh Keskar

Senior VP of sales in Asia-Pacific, Boeing



Jet Airways has a fleet of 10 Boeing 777-300ERs but is likely to require new aircraft in the coming years

brings high reward. With the Gulf carriers and other Asian airlines like Cathay [Pacific] and Singapore Airlines attacking the long-haul market with new widebody jets, local airlines will want to go to where there is money to be made."

Similarly, Airbus believes there is "now an appetite" for Indian carriers to make greater use of widebodies in order to challenge overseas rivals for market

share between the subcontinent and other regions.

Airbus India president Srinivasan Dwarakanath identifies the India-North America market as one of the major battlegrounds.

## FOREIGN DOMINANCE

Between India and the rest of the world, 40% of traffic is carried by Gulf carriers. Generally, foreign carriers dominate the international market out of India, carrying

65% of the traffic. Some of India's airlines use widebodies on thick routes connecting tier one cities, such as Delhi-Mumbai. Dwarakanath suggests that these widebody operations could be extended to international routes from those destinations.

At present, Boeing leads the Indian widebody market with 58 in-service aircraft, against just eight for Airbus, Flight Fleets Analyzer shows. ■

## ROTORCRAFT

# HAL unveils multirole mock-up



Proposed type would replace Russian-built utility helicopters

Hindustan Aeronautics (HAL) has revealed a mock-up of its proposed Indian Multirole Helicopter (IMRH)

The 12t rotorcraft, if developed, would replace India's fleet of Russian-built Mil Mi-8 and Mi-17 utility types.

HAL envisages the helicopter being able to accommodate 24 passengers; total payload would be 3.5t, with a service ceiling of 20,000ft.

Missions for the new type would comprise troop transport, casualty evacuation, combat search and rescue, offshore oil-field support, and VIP transport.

HAL also hopes to find export customers for the proposed type. ■

## MAINTENANCE

# MRO body expects tax changes to lift industry

The MRO Association of India is confident there will be a better tax environment for the maintenance sector in the near term as the country embarks on widespread changes aimed at developing the domestic aviation industry.

Association secretary-general Pulak Sen expects changes in the tax regime affecting MROs to kick in within "two to three years".

"In the last two years, there has been much progress on improving the domestic aviation sector. The old 5/20 rule [for carriers] has been abolished, and now we

hope that they [the civil aviation ministry] can do something about the MRO sector."

Sen's comments reflect his view that MRO was "unfairly overlooked" in the 2017 budget.

Still, he sees three reasons for optimism. First, the local MRO industry is set to become a \$12.2 billion business by 2025, driven by growth in the domestic fleet; second, India's skilled labour costs are still among the cheapest in the world; and more partnerships between OEMs and local MRO providers have helped foster a local support network. ■



Regulators  
command CRJ  
yaw-damper change  
**Air Transport P16**

**MODERNISATION** DAVID KAMINSKI-MORROW LONDON

# Air Mauritius steps up its fleet renewal with further A330s

Carrier insists it is “not cancelling” its order for A350-900s, despite committing to additional examples of smaller type

**A**ir Mauritius intends to acquire additional Airbus A330s as part of its fleet modernisation, but insists it is maintaining its commitment to the A350.

The airline says it is “accelerating” its fleet-renewal programme with an “order” for additional A330s, without specifying the number of aircraft involved.

Air Mauritius has yet to clarify whether the A330s would be the re-engined A330neo version of the aircraft. The airline operates a pair of A330-200s and has four A350-900s on order. Under an

agreement signed in 2014, it is also due to take another pair of A350-900s from lessor AerCap.

Air Mauritius has not indicated whether the A330s would replace any of its A350s but stresses that it is “not cancelling” the A350 orders, adding that it has a “new aircraft delivery schedule”, details of which it intends to disclose shortly.

It plans to carry out a revamp of cabin interiors on its current fleet, which will be completed by June next year. This will include new seats and a new in-flight en-

tertainment programme, providing facilities “comparable” to those on the A350-900.

Meanwhile, Canadian carrier WestJet says its future widebody fleet could include A330neos or Boeing 787s, but has ruled out the A350 and 777.

Chief executive Gregg Saretsky says WestJet is unlikely to place a new widebody type into service until after 2017.

“We are currently analysing all options with respect to the make, model and number of aircraft, and the pace of expansion,”

Saretsky says.

An agreement reached with pilots late last year stipulates pay rates for A330s and 787s, as well as for 767s, which the carrier already operates.

“We have not been talking with Airbus about the A350,” Saretsky says. “We have been focused more on the mid-size widebody, and that’s why this agreement reflects 787 and A330neos.”

The 777 and A350 are in a “different category” and are “not part of our decisions”, he adds. ■



Carrier operates  
two examples  
of -200 variant

AirTeamImages

**INCIDENT** DAVID KAMINSKI-MORROW LONDON

# A320 crew did not comply with ATC

**S**panish investigators have determined that a Vueling Airbus A320 crew substantially exceeded a descent rate restriction before an airprox encounter with a Ryanair Boeing 737, and then failed to follow a collision-avoidance resolution.

The Seville-bound A320 had been descending initially to 25,000ft having been given a maximum descent rate of 2,000ft/min.

Spanish investigation authority CIAIAC says that a Ryanair 737

heading for Malaga had been cleared to descend to 15,000ft at 2,000ft/min or higher, in order to ensure separation between the converging flights.

But the Vueling crew increased the A320’s descent rate to as much as 5,000ft/min in order to reach the optimum altitude for the Seville approach, says the inquiry.

When the flight was cleared further to 17,000ft the controller did not advise that descent restrictions were still in effect.

As the vertical distance between the flights closed, their collision-avoidance systems issued resolution advisories.

CIAIAC says the Vueling A320’s advisory ordered an adjustment of vertical speed, but states that the first officer acted “contrary” to the instruction, disconnecting the autopilot and increasing the rate of descent.

The collision-avoidance system subsequently changed its instruction, ordering the aircraft to climb.

CIAIAC says the captain attempted to take control from the first officer, did not switch control priority. This resulted in a dual-input warning as both pilots sought to arrest the descent.

None of the occupants were injured and neither aircraft was damaged. CIAIAC attributes the airprox to the fact that the Vueling crew “did not comply” with descent instructions originally given by Seville air traffic control. ■



Rex Shutterstock

The advisory ordered the Vueling pilots to adjust their vertical speed

**PROGRAMME**  
AARON CHONG BANGALORE

# Start-up issues with PW1100G engine ‘solved’

**P**ratt & Whitney believes that it has “solved early teething issues” with its Airbus A320neo-powering PW1100G geared turbofan (GTF) engines.

“Early engine start-up times and nuisance messages have been solved,” the manufacturer’s director of marketing for commercial engines, Jim Speich tells FlightGlobal.

He says the GTF’s start-up time “is now similar [to] the International Aero Engines’ V2500 engine”, adding: “Our dispatch reliability on the Airbus A320neos stands at 99.9%... very similar to the Bombardier CSeries. But there are always improvements you can make on an engine.”

A320neo customers can choose between the GTF and CFM International’s Leap-1A engine to power the aircraft. ■





## SAFETY

# Regulators command CRJ yaw-damper change



Bombardier

Issue was traced to failure of voltage regulator in system's actuator

Canadian regulators have ordered Bombardier CRJ operators to modify yaw-damper wiring to prevent uncommanded rudder movement.

Transport Canada mandated a set of emergency procedures in 2013 as a countermeasure to the rudder movement, after several in-flight incidents.

It stated at the time that inquiries pointed to a failure of the voltage regulator in the yaw-damper actuator and warned that the air-

craft could potentially be lost if the situation was not corrected.

Bombardier has developed a wiring modification to prevent uncommanded movement of the rudder and Transport Canada is ordering operators of CRJ200s, CRJ700s and CRJ900s, through an airworthiness directive, to carry out the change.

It has put the compliance time limit at 6,600h or 36 months from 14 February, the effective date of the directive. ■

## FLEET GHIM-LAY YEO WASHINGTON DC

# Widerøe to be first to operate E190-E2

Embraer confirms Norwegian regional carrier will debut re-engined jet after January decision to switch from turboprops

Norwegian regional carrier Widerøe will be launch operator of the Embraer E190-E2, as it makes its move up to jet operations after years of flying Bombardier turboprops.

The airline will place its first E190-E2 into revenue service in the first half of 2018, and the remaining two E190-E2s will be delivered later in the year, Embraer commercial aviation chief executive John Slattery tells FlightGlobal.

He declines to be more specific with the delivery timeline, pending arrangements with the airline.

Widerøe has purchase rights for 12 more E-Jet E2s. The order was announced in January.

Slattery says an Embraer team is in Norway working with Widerøe to prepare for the launch of the E190-E2. "We are hopeful

that after we have a successful entry into service, we will see reasonably quick movement on firming up of the options," he says.

Widerøe is configuring its E190-E2s in a single-class layout of 114 seats.

Despite being a loyal Bombardier customer for years, the airline says it decided on the E2 after concluding that the Bombardier CS100 was too large.

Slattery says the E190-E2 programme is "slightly ahead of schedule". He adds that he is confident Widerøe will not experience the type of issues reported by current-generation E190 launch customer JetBlue Airways, which took the first delivery in 2005. The carrier has lamented high maintenance costs related to its E190 fleet.

"As an OEM we have generated and developed more clean-sheet aircraft designs than any other OEM in the last 20 years," says Slattery. "The technology and development of knowledge have given our programme and engineering teams the confidence on the E2 entering into service on time, and on specifications."

Widerøe currently operates a fleet of 41 Bombardier Dash 8s to destinations within Europe. ■



Type is expected to enter revenue service in 2018

Embraer

## RESTRUCTURING

## US profitability 'won't last', warns Slattery

Suggestions from US airline executives that the industry has entered a golden age where losses are a thing of the past have been dismissed by Embraer's head of commercial aviation.

"Airlines are utilities that are not designed to make \$2 billion in a quarter," says John Slattery, chief executive of Embraer commercial aviation. "Trust me, it won't last."

Slattery, speaking at the Routes Americas event in Las Vegas on 14 February, said he saw numerous challenges ahead for US airlines. Chief among those, he believes, is the infrastructure of both the USA's large hubs and its secondary airports.

"It's sobering to land at JFK if you left Beijing or Shanghai,

because of the quality of the infrastructure," Slattery says.

Smaller airports – including facilities served by Embraer regional jets – must also be kept modern, Slattery adds.

"If you don't develop the secondary and tertiary airports, the game is over," he says. "I think it will really hurt North America."

Slattery's comments came after some in the industry expressed optimism that, after mergers and cost-cutting, carriers had fundamentally changed compared with earlier years.

In April 2016, American Airlines chief executive Doug Parker went so far as to suggest US carriers might never again slip into the red. ■

**"We are hopeful that after a successful entry into service, we will see movement on firming up of options"**

**John Slattery**

Chief executive,  
Embraer commercial aviation



US Navy asks for improvements to F41 engine  
Defence P18

RESULTS DAVID KAMINSKI-MORROW LONDON

# Rolls-Royce to power up production

UK engine maker bullish about Trent output in 2017 despite disappointing profit performance from civil aerospace unit

Rolls-Royce has secured capacity to deliver around 500 large engines this year, having increased output by 15% to hand over 355 in 2016.

It disclosed its readiness as it revealed that underlying revenues for large engine supply, centred on the Trent family, increased by 2% last year to £1.6 billion (\$2 billion), although overall underlying civil aerospace profit more than halved to £367 million.

The production revenue rise resulted from higher volumes of Trent 900s for the Airbus A380 as well as spare Trent XWBs for the A350, partly offset by falling demand for Trent 700s on the A330.

But service revenues for the large-engine sector fell by 4% to £2.3 billion, despite strong growth from in-production engines – growth which had offset the reduction from older powerplants.

R-R says fewer overhauls across the out-of-production fleet meant



Trent 1000-TEN for the Boeing 787 is on track for 2018 service entry

time-and-material revenues reduced, and contract accounting effects in the service revenues were significantly lower, resulting in the overall decline. The manufacturer says large engine service revenues would actually have risen 2% but for the accounting effects.

Transition to the Airbus A320neo meant that original equipment revenue arising from the International Aero Engines V2500 programme slipped by 10%, although service revenues were up 21% on the back of an increase in overhaul activity.

The company, in a full-year fi-

nancial statement, says business aviation engine sales were down 25%, a decline it had forecast as a result of market weakness and a shift to newer aircraft not fitted with its engines.

R-R predicts that its civil aerospace arm will deliver “modest” revenue growth this year, backed by aftermarket business for large engines, but it anticipates that business jet revenues will weaken further.

Near-term uncertainty is affecting production volumes and older engine service activity, the company says, but positive long-term trends “remain unchanged”.

“We continue to expect that strong widebody airframe demand – driven by the need for newer, more fuel-efficient aircraft – should provide resilience to manufacturing schedules over the next few years as the industry undergoes a strong replacement cycle,” it states. ■

INTERIORS EDWARD RUSSELL CHICAGO

## Polaris refit extends life for 66 United stalwarts

United Airlines will begin retrofitting 66 of its Boeing 767s and 777-200s with its new Polaris business-class cabin this year, the first indication of how many of each type it plans to keep in its widebody fleet.

The Chicago-based carrier will begin modifications to the first of 14 767-300ERs in April and the first of 52 777-200s in the fourth quarter, said Maria Walters, managing director of product and brand strategy at United, during a media preview flight for the new premium product.

United operates 35 767-300ERs and 74 777-200s, with 19 of the latter in a high-density configuration for its domestic operations.

Walters says it has yet to be determined whether the airline will retire the 21 767s and three 777s not slated for the Polaris retrofit.

United is in the midst of a fleet review, which includes determining a replacement for its 767-300ERs, that executives hope to complete soon.

“It’s a great airplane [but] it’s getting a little old and if we’re going to keep flying them longer we’re going to need to make some investments in extending the life,” United president Scott Kirby told employees in January.

“But it also serves missions that the other aircraft would be hard-pressed, at least in today’s economics, to find.”

Polaris represents what United



The carrier will start revamping 14 of its Boeing 767-300ERs in April

chief executive Oscar Munoz calls the “new spirit of United”.

The airline is debuting the product aboard its new 777-300ERs, which were due to enter service between Newark and San Francisco on 16 February.

Polaris includes United’s first all-aisle-access business-class configuration. Walters says United will maintain its existing premium seat density on the 767 and 777-200s. The airline has 30 business-class seats on its 767-300ERs

and 50 on its two-class 777-200s.

Daniel Clucas, senior designer at Acumen Design Associates, the company behind the seats, says Polaris will be arranged in a one-one-one configuration on the 767s and the same one-two-one configuration on the 777-200s as on the 777-300ERs.

The first 767 with Polaris is scheduled to enter service in the third quarter, while the first 777-200 will likely enter service in early 2018, says Walters. ■





**TANKER** LEIGH GIANGRECO WRIGHT-PATTERSON AFB

# New schedule puts KC-46 operational tests back to 2018

Domino effect after technical problem delays programme but USAF officials express confidence in Boeing's progress

Initial operational testing and evaluation (IOT&E) of the Boeing KC-46 tanker will begin in January 2018 at the earliest, according to US Air Force officials.

Col John Newberry, KC-46 programme manager, tells Flight-Global that testing will begin pending the results of an IOT&E readiness review in the autumn.

Last year, the Pentagon's top weapons tester estimated a May 2017 start for the IOT&E effort and an April 2016 date for the crucial Milestone C decision, which allows production to proceed.

But after Boeing discovered higher-than-expected axial loads on the refuelling boom last May, the manufacturer was forced to rejig the programme's schedule.

When Milestone C shifted from April 2016 to August that year, it

caused a domino effect that pushed other programme events, such as IOT&E, further out.

The air force has negotiated the updated schedule within the past month, says Brig Gen Duke Richardson, programme executive officer for the service's tanker fleet.

Delivery of the initial 18 aircraft is projected by February 2018, rather than the August 2017 date announced last May.

In his 2016 report, Michael Gilmore, director of operational test and evaluation at the Pentagon, warned that Boeing's past performance did not give confidence that future deadlines would be met.

However, Richardson says he is encouraged by current progress, noting that Boeing has completed 54% of all test points and is reporting on schedule. ■



The first 18 aircraft should now be delivered by next February

US Air Force

**ACQUISITION** GREG WALDRON BENGALURU

## India readies for refuelling requirement

India's pressing need for new aerial refuelling tankers saw a strong presence at the Aero India show from the major contenders for any future requirement.

Airbus's A330-based multirole tanker transport has twice been selected by New Delhi but on both occasions the deal has fallen through, leaving the air force to soldier on with its ageing fleet of Ilyushin Il-78Ms. The last deal, for six aircraft, was cancelled in mid-2016 when the request for proposals was withdrawn.

Despite previous setbacks,

Airbus says it remains committed to the country. "We don't believe that it is the end of the story in regard to the need for an efficient tanker," it says.

Boeing is also keen to pitch its 767-derived KC-46 should the Indian requirement re-emerge. The Pegasus is now flying; during the previous contest in 2013 it was still at the design stage.

Meanwhile, Israel Aerospace Industries argues that its 767-derived multimission tanker transport would be the most cost-effective choice. ■

**PROPULSION** STEPHEN TRIMBLE WASHINGTON DC

# US Navy asks for improvements to F414 engine

The US Navy has revived interest in studying a major upgrade of the engine that powers the Boeing F/A-18E/F, EA-18G and two non-US fighters, which would include the possible addition of new technologies.

In early February, Naval Air Systems Command (NAVAIR) notified industry that it would ask GE Aviation to submit a proposal for a contract for the company's engineers to perform a study on an "F414-GE-400 core enhancement evaluation".

Such notifications are required when the government plans to award a contract without inviting competing bids. No other details were provided about the content

or objectives of the study, which is described only as an assessment of "how upgrades... could improve engine performance, as well as F/A-18E/F and EA-18G performance".

GE adds: "NAVAIR has ex-

pressed interest in GE evaluating how our latest engine technologies could be applied to the F414 Enhanced Engine."

The company's design surfaced as a proposal several years ago as part of Boeing's bid with the



US Navy

Service wants higher performance from its Boeing EA-18G Growlers

Super Hornet for India's medium multirole combat aircraft contest.

GE has already tested the durability of thrust upgrades in laboratory rigs. NAVAIR also paid GE in late 2013 to evaluate the F414 Enhanced Engine, with the possibility of funding a development programme two years later, although that follow-on contract never materialised.

"We believe this study would be an update of the previous work to include new technologies," GE says, without offering further details.

As well as the two US types, the F414 will also power the Hindustan Aeronautics Tejas MkII and the Saab Gripen E. ■



Defence is best  
form of attack  
for IAI  
News Focus P21

ENHANCEMENT LEIGH GIANGRECO WASHINGTON DC

## UH-60V takes flight as upgrade gains velocity

Prime contractor Northrop Grumman has performed the first flight of the Sikorsky UH-60V, which modernises the legacy L-model Black Hawk with a new digital cockpit.

Under a 2014 contract from the US Army, Northrop will remove existing analogue gauges from UH-60Ls and replace them with digital instrument displays.

The initial engineering and development aircraft flew late last month, with the army performing a series of trials to evaluate the performance of the displays during several flight modes.

Following the V-model's initial sortie, the army is expected to transition the helicopter to its aviation flight-test directorate in February. During that time, the service will perform additional system-level developmental tests on the aircraft and its software.

The integrated avionics suite on the UH-60V maintains an interface that is almost identical to that of the M-model.

Northrop has also designed the digital cockpit in accordance with the future airborne capability environment standards, an open architecture initiative led



US Army

Up to 760 L-model helicopters will be modified under the programme

by the US Navy which supports the integration of off-the-shelf hardware and common software across aviation platforms.

Modification work on the first

of an eventual 760 helicopters will begin next year and run until 2033. The enhancements add another 10 years to the life of the legacy Black Hawks. ■

STRATEGY JIM WINCHESTER LONDON

## Italian army outlines rationalisation plan

ICH-47Fs and NH90s will replace mix of older rotorcraft and will be joined by successor to Mangusta attack helicopter

The Italian army's aviation branch is to rationalise its fleet of helicopter and fixed-wing aircraft types from nine today to just four, including a new attack platform to be developed by Leonardo Helicopters.

Operations with the service's Boeing CH-47C transports will be fully transferred to its 16 new F-model Chinooks this year, says Col Roberto Minini, chief of flight safety for Italian Army Aviation. Its growing fleet of NH Industries NH90s will replace an ageing inventory of Bell 205s and Bell 212/412s by 2021, he adds.

A new 8t-class attack helicopter, to be developed by Leonardo Helicopters, will replace the army's AgustaWestland AW129D



Leonardo

Transition to the service's new Chinooks will be completed this year

Mangusta fleet from 2033 to 2035, Minini says, and the incoming model will feature a much-reduced crew workload.

The army's current Mangusta

has undergone weapons, sensor and communications upgrades and is now qualified to fly from the Italian navy's aircraft carrier *Giuseppe Garibaldi*. The type will

soon also be qualified to operate at night from all the service's ships, Minini told the Defence IQ International Military Helicopter conference in London.

Four of the army's AW129s remain based in Afghanistan – down from a peak of 10 in 2010-13. These are supported by four NH90s to provide a personnel recovery capability.

Meanwhile, the army is to realign its different-standard NH90s by deploying examples in a full operational capability configuration – including a helmet-mounted sight display-compatible obstacle warning system – to Iraq, while also retaining earlier advanced initial operational capability airframes in Afghanistan. ■

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AW609 set for icing trials to recover from frozen progress  
**Business Aviation P22**

STRATEGY ARIE EGOZI TEL AVIV

# Defence is best form of attack for IAI

Israeli manufacturer seeks additional export opportunities for high-tech systems and eyes potential for fighter upgrades

Today, about 75% of Israel Aerospace Industries' (IAI) income is generated by defence systems. With this responsibility, the company's military aircraft group is under heavy pressure to maintain this number – or even increase it.

This is not a simple task, however. While Israel is a leading manufacturer of military systems – with IAI at the forefront – current market conditions are making it harder to do business.

Among the list of obstacles to growth are: the fact that many of IAI's highly classified systems cannot be exported; increasing competition is now being seen in many sectors; and not every nation has an operational need to acquire such highly sophisticated equipment. Last, but not least, in many cases politics dictate the outcome of competitions, rather than the performance or price of the systems on offer.

## COMPLEX REALITY

Shaul Shahar, IAI's executive vice-president and general manager of its military aircraft group, is dealing with this complex reality on a daily basis.

The trauma that was an outcome of IAI's effort to develop an Israeli fighter during the 1980s – and its axing by Washington – may seem like a fading memory, but it has resulted in a situation where the company no longer harbours ambitions to develop a manned combat aircraft.

"The political atmosphere that killed the Lavi has not changed, and in addition we cannot invest the funds that resulted in developing the Lavi," Shahar tells FlightGlobal.

The group is, however, "manufacturing" combat aircraft, albeit made from ex-Israeli air force Kfirs. IAI offers to adapt the jets with new avionics and other systems for countries with limited budgets.



German air force recently extended its lease of IAI's Heron 1 unmanned air system until February 2018

IAI has previously supplied the updated Kfir Block 60 model to Colombia, and Shahar says negotiations with Argentina are under way.

But this business has a finite potential for IAI, because the number of stored Kfirs is limited.

"The effort now is to do the same upgrade on the Lockheed Martin F-16A/Bs that were phased out from the service by the Israeli air force," Shahar says.

"We have a complete upgrade programme, and are sure that the potential for such an upgrade of a fourth-generation aircraft is big."

Shahar adds that when the Israeli air force eventually phases out its F-16C/Ds they will also offer potential for modernisation and sale. The advantages of such an upgrade are obvious due to the list of systems that can be integrated, but again the success of the programme depends on the goodwill of Washington. A US-made fighter bought with dollars via the US Foreign Military Sales mechanism leaves no flexibility for IAI.

Beyond fighters, the company is also a major developer and manufacturer of unmanned air vehicles, and sees major potential

in the realm of unmanned combat air vehicles (UCAV).

"When you think about such an unmanned system, the two main features are speed and carrying capability," says Shahar, the first time that a senior IAI official has pointed in the direction of UCAVs. "We are seriously looking at this," he confirms, but refuses to elaborate.

However, Shahar points to IAI's long experience of developing manned aircraft and UAVs, noting that the required capabilities are "at hand".

## GROWING PORTFOLIO

Also with an eye on exports, IAI has recently stepped up its efforts to win business ahead of US rival General Atomics Aeronautical Systems. Teamed with Airbus Defence & Space, the company has won a contest to equip the German air force with its Heron TP, and is waiting on the outcome of a legal challenge by the defeated MQ-9 Reaper manufacturer.

To strengthen its portfolio and comply with restrictions imposed on the sale of such high-end systems, in early February IAI revealed the export-optimised Heron TP-XP. Making its

debut at the Aero India show in Bengaluru from 14-18 February, this is compliant with the international Missile Technology Control Regime 2 agreement.

"We designed a version [of the TP] that can fly at 41,000ft for 30h, but which has a maximum payload of 450kg [990lb]: less than half of what the original version can take," Shahar says.

The Indian market has a huge potential for IAI's military aircraft group, and Shahar confirms that negotiations are under way to establish joint ventures with local companies to pursue major tenders for small UAVs.

The group is also one of the key suppliers to Bell Helicopter during the development phase of the V-280 Valor; it has manufactured the engine nacelles for the advanced tiltrotor.

With such broad efforts and others that remain highly classified, Shahar is confident that his division will continue to support IAI's high volume of defence sales.

"We are manufacturing wings for the [Lockheed] F-35 and fuselage assemblies for other military aircraft, and we can say that the client list will grow," he says. ■





## PERSONAL JET

KATE SARSFIELD LONDON

## Flaris first flight close as ground tests near end

Polish engineering company Metal Master is in the final stages of ground testing its Flaris LAR-1 personal jet, and plans to fly the five-seat single early in the second quarter.

"We are still performing tests of the on-board systems under the supervision of the Polish civil aviation authority," says company founder and LAR-1 project manager Rafal Ladzinski. "But all ground testing should be complete by the end of [March]."

Metal Master, based in Podgorzyn, southwest Poland, recently completed the final strength tests of the LAR-1's detachable wing – described by Ladzinski as "one of the aircraft's key features" – and cabin pressurisation tests are almost finished.

Unveiled in 2013, the Williams International FJ33-5A-powered aircraft is believed to be the only Part 23 single-engined personal jet being developed outside the USA. Its sole rivals in this space are the in-development Stratos 714 and the Cirrus Vision SF50. The latter has already opened up a significant lead, having entered service in December with a backlog of more than 600 aircraft.

Privately owned Metal Master says it plans to open the orderbook for the €1.6 million (\$1.7 million) LAR-1 following its maiden sortie. The all-composite aircraft – which is planned to be first of a family of small aircraft developed by the company – will initially be validated under the Polish regulator's S-1 experimental aircraft designation, with deliveries scheduled to begin in 2018. A certificated version – approved to European CS-23 standards – is expected to follow about two years later.

Ladzinski says the project was born out of a desire to create a low-cost aircraft that could be used for short-haul point-to-point transport for commercial, corporate and private owners. ■

## DEVELOPMENT STEPHEN TRIMBLE WASHINGTON DC

## AW609 set for icing trials to recover from frozen progress

Manufacturer hopes to maintain 2018 certification goal for developmental civil tiltrotor

Icing trials will soon begin on the Leonardo Helicopters AgustaWestland AW609 tiltrotor as the programme recovers from a nearly year-long flight-test hiatus caused by a fatal crash of the second prototype in October 2015.

The third flight-test article will soon move from Philadelphia to Marquette in Michigan's Upper Peninsula to validate the AW609's flight performance in known icing conditions, Leonardo says.

The round of winter testing will keep the tiltrotor programme on track to receive airworthiness certification from the US Federal Aviation Administration in 2018. The AW609 is the first fly-by-wire rotorcraft to apply for a commercial airworthiness certificate.

An interim investigation report released last June by Italy's ANSV blamed the 2015 crash on flawed control logic that reacted improv-



Third prototype will be utilised for winter testing in Michigan, USA

erly to an unusual manoeuvre at the extreme limit of the AW609's speed envelope.

The crash left Leonardo with the first prototype in Philadelphia and the third prototype in Italy. After flight testing resumed last year, the two aircraft traded places. The third prototype has since resumed flight trails to check out avionics and systems, performing basic hovering, land-

ing and manoeuvres around Northeast Philadelphia airport. The prototype will "shortly" perform short take-offs and climb to 4,000ft, Leonardo says.

The company is working on the fourth AW609 prototype, which has been moved to the main production area in the Philadelphia factory to "ensure a smooth transition to the first production build aircraft" in 2018. ■

## CERTIFICATION KATE SARSFIELD LONDON

## MT-Propeller lifted by US approval

Germany's MT-Propeller has received US supplemental type certification for its MTV-27 five-blade, constant-speed pro-

peller on the Texas Turbines Cessna 208/B Supercub.

Introduced in 2008, the aircraft is a re-engined version of the Car-

avan turboprop single, featuring a Honeywell TPE331-12JR engine in place of the standard Pratt & Whitney Canada PT6. There are about 60 of the type in service today.

The MTV-27 – dubbed the "quiet fan-jet propeller" by MT – is more than 30% lighter than the Supercub's original Hartzell four-blade unit, the company says, while the damping characteristics of the composite structure cut fuselage vibration by up to 60%.

"Certification flight tests have also revealed improvements in the overall performance [of the Supercub]," MT says, including better ground-roll figures and an 8% increase in the aircraft's rate of climb. ■



System will be fitted to Cessna aircraft modified by Texas Turbines



New era's top flyer  
Cover Story P24

RESALE MURDO MORRISON LONDON

# End in sight for years of falling values

Hopes for "Trump bump" to stimulate US sales after secondhand market suffers steep decline across most segments

Business jet values have continued their three-year decline, with the fall steepening in the past 12 months, according to a study by Flight Ascend Consultancy. However, despite most major types suffering a bigger loss of value in the year to the end of the first quarter of 2017 than in 2015-16 or 2014-15, resale prices may begin slowly to stabilise, Ascend suggests.

Any recovery will be from a perilously low base, with Ascend appraised market values across some 100 business aircraft variants falling an average 11.6% between early 2016 and 2017. That followed a 9.4% decrease in the previous 12 months.

The weakness is down to lacklustre secondhand demand, and heavy discounting of new aircraft as manufacturers battle to retain market share, Ascend says.

Areas affected include the



Prices for the Falcon 7X and its rivals fell an average of 18% in 2016

highest-value portion of the market – large-cabin – as well as the ultra-competitive midsize segment, and even the once-stable airliner-derived business jets.

The three families of long-range, large-cabin jets – Bombar-

dier's Global 5000 and 6000, Dassault's Falcon 7X and 8X, and Gulfstream's G450, G550 and G650 – saw an 18% average decline, compared with 13% one year earlier.

Several shorter-haul types suf-

fered falls in value of more than a fifth over the past 12 months. They include the Challenger 605 and Learjet 75, Falcon 2000/2000EX, Embraer Legacy 650 and the G200.

Even the formerly robust airliner-based business jet segment has seen an average 11.6% decline in market values.

There were some brighter spots. The superlight Cessna Citation Excel/XLS, large-cabin GV, and midsize Hawker 850XP, all held on to their value during 2016. The Learjet 60, which has endured many years of value cuts, kept the decrease in its market value to under 5%.

With the USA still the biggest market for business aircraft, some hope for a "Trump bump" – the new president is famously a user of business jets and insists his policies will stimulate the domestic economy. ■

SHIPMENTS KATE SANSFIELD LONDON

# Pacific seeks to double P-750 deliveries in 2017

New Zealand's Pacific Aerospace has delivered the first P-750 XSTOL to the Thai market and hopes to double annual shipments of the single-engined turboprop in 2017.

The aircraft was handed over in early February to skydiving company Freefall Thailand. The skydiving market accounts for about a third of P-750 sales, although the type has also found success in a host of other arenas, including medical evacuation and passenger transport.

"We have sold 112 P-750s to date," says Mark Crouch, Pacific's general manager, global markets. Papua New Guinea, with its remote communities, rough terrain and poor transport infrastructure, has become the largest market for the nine-seat type with 18 aircraft in service. "XSTOL stands for ex-

treme take-off and landing, and this capability is essential for aircraft operating within this country," says Crouch.

The Pratt & Whitney Canada PT6A-34-powered P-750 can take off and land in less than 244m (800ft). It has a maximum speed of 170kt (315km/h) and a range of 1,180nm (2,190km).

Crouch believes the P-750's short-field performance will also be a major draw for operators across South America.

Pacific delivered 12 P-750s in 2016 – double the output for the previous year – and intends to ship 25 units in 2017. "We plan to double the number again by 2019," says Crouch.

China's growing appetite for the P-750 should also help it to reach its 2019 delivery goal. "This market is very strong," he says.



Freefall Thailand will use its single-engined turboprop for skydiving

Pacific set up a joint venture last year with Beijing General Aviation Company to assemble P-750s for the Chinese market. The facility in Changzhou has the capacity to build up to 100 units a year. "We supply aircraft kits to the factory, which are then as-

sembled and delivered to Chinese customers," Crouch says.

The first aircraft was completed late last year and the second kit is packed and awaiting delivery. "We are also about to ferry-fly two finished aircraft from our Hamilton base to China," he says. ■



# NEW ERA'S TOP FLYER

Thirty years ago this week, Airbus opened the flight-test campaign for its all-new A320 narrowbody airliner. Using digital fly-by-wire control technologies adapted from fighter jets, the aircraft was more than an ambitious bid to bring civil aviation into the 21st century – it was a bold stretch for technological leadership that ensured its place in the booming market for big jets

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As the A320 enters its fourth decade, the Neo version offers new engines for greater fuel efficiency (top: CFM International Leap-1A; right: Pratt & Whitney PW1100G), but the classic profile (above) remains a powerful force in operators' fleets – and in Airbus's orderbook







Clockwise from main: Airbus, AirTeamImages, Airbus





AirTeamImages

Popularity of the A320 has been the payoff of an existential choice: be first with new technology or, likely, be out of the market

## TECHNOLOGY

# How Airbus got it right

The A320's introduction of fly-by-wire controls made it a milestone airliner as well as the foundation of a bold corporate product strategy

DAVID LEARMOUNT LONDON

As the world's first digital fly-by-wire (FBW) airliner, Airbus Industrie's A320 was positioned to bring commercial flying and flight management into the 21st century when it was rolled out in 1987.

The question at the time was: how was 21st century flying going to differ from the way it had been? The question now is: did Airbus get it right?

For Airbus, the A320 was more than just a FBW airliner. It was the still-young compa-

ny's debut in the narrowbody marketplace. But above all – from the airframer's strategic perspective – it was the first product in a planned family of FBW airliner types that would, as a result of their control technology, share very similar flying and control-system characteristics.

Nearly 10 years after the A320's entry into service, by which time the type's market acceptance was obvious, former Airbus president Roger Béteille admitted the decision to use FBW flight controls was one of the most difficult he had ever made. He explained: "Perhaps we were too bold, but we had no choice. Either we were going to be first with new technologies or we could not expect to be in the market."

From the pilot's point of view, the fundamental change in the A320 was the addition of flight envelope protection (FEP), which all aviators hope – and most would like to believe – they will never need.

The most visible difference was the replacement of a control yoke with a sidestick. The stick has a relaxed central position such that, when released during manual flying, no

roll or pitch input is demanded of the pilot. Control inputs to the sidestick and to the power levers in manual flight are intuitive, even to pilots trained on a mechanically controlled aircraft, but initially it feels strange not to have to follow up a manually commanded pitch change with trim inputs. There are no trim switches, and the conventionally positioned pitch trim wheels on the centre console are not used in flight except as an emergency back-up pitch control system. Pitch change demanded manually via the sidestick is delivered by the elevators, and the act of centring the sidestick commands the stabilisers to trim to the selected flight profile.

## RIGHT RESPONSE

In 1997, one of *Flight International's* test pilots, Peter Henley, benefiting psychologically from the knowledge that the A320 series had been in successful service for nearly a decade, flight-tested the new A319. He had this to say about flying the aircraft manually: "The sidestick works in the conventional sense and produces a rate of aircraft response which feels right to a pilot accustomed to a conven-

tional aircraft. A comforting feature of the system is that the apparent response to the control and the feel remain constant throughout the flight envelope.”

FEP as a concept was difficult, at first, for flightcrew to get their heads around. In the A320 (and all subsequent FBW Airbuses) it works like this: with its flight control computers selected to normal law, the pilot's manual inputs, when the aircraft is flying within the flight envelope, are transmitted direct to the control surface actuators unaltered by the computers, so pilots get what they are asking for.

If, however, the pilot allows the aircraft to get close to the edges of the flight envelope, warnings are triggered. If it continues right to the edges, the aircraft will be prevented from stalling, overbanking, overspeeding or overstressing, no matter what the pilot input – or the lack of pilot input, if that happens to be the problem. The FEP also provides an automatic reaction to the effects of windshear.

### **“A comforting feature is that the apparent response and the feel remain constant”**

Peter Henley

A319 flight test, *Flight International* 1997

Meanwhile Airbus's long-term plan – completely visible in the fleet today – is that all FBW Airbuses (all types except the A300 and A310 series) would have so much commonality in terms of human/machine interface and systems control philosophy that for a pilot trained on one, cross-type qualification on the others would be achievable with minimal training time and cost, even across the widebody/narrowbody divide.

FBW as a technology was not a new idea in the early 1980s when the A320 was in gestation. The military had used it extensively, and Airbus's Toulouse forebear Sud Aviation (later Aérospatiale) had installed analogue computer-driven FBW in Concorde, its supersonic joint venture with British Aircraft Corporation.

To put the Airbus FBW venture into the context of its era, only one other airliner manufacturer was actively considering FBW control. In



Airbus named its A350 assembly line after A320 champion Roger Béteille, speaking

the mid-1980s, Boeing had proposed a FBW-controlled narrowbody designated the 7J7. It was to be fitted with twin aft-fuselage-mounted unducted fan engines (“propfans”), and intended for service entry in 1992. However, problems with the propulsion technology ultimately defeated the manufacturers, and a propfan has still not been successfully developed.

Boeing introduced FBW seven years after the A320's service entry in its hugely successful 777 widebody, but the company's direct narrowbody competitor for the A320, the perennially successful 737 series, is still selling well despite having conventional mechanical controls. The 737's flightdeck is just as highly automated as the A320's in terms of its autopilot/autothrust and flight management system capabilities, but it does not have active flight envelope protection, just warnings and a stickshaker.

The question almost 30 years after the A320 entered service is: did Airbus get it right? The market says yes, and so do the accident statistics (or lack of them). But have the original flight laws/software that defined the A320's flying characteristics at service entry in 1988 had to be changed in the light of experience? Soon after entry into service the manufacturer added a low-energy warning to the system, but otherwise the simple answer seems to be no.

Certainly no fundamental changes have been needed, but there have been a few adjustments to take account of higher gross weight or aerodynamically modified versions – such as engine nacelle changes. Airbus also admits blandly: “A rotation law has been implemented for better take-off performances. The crosswind landing is made easier thanks to a new decrab law.”

### **LOOKS FAMILIAR**

The cockpit in the latest versions looks remarkably similar to the original, but its capabilities have been updated like those of other airliner types over the past 30 years. These updates take account of the drift away from navigating by radio beacons toward global satellite navigation systems. For example, they include precision area navigation, required navigation performance, vertical navigation, autopilot-flown traffic alert and collision-avoidance manoeuvres, runway overrun warning and prevention systems, and electronic flightbags. The company says there have been no changes to its A320neo cockpit.

So, despite all the initial apprehension about the A320's FBW and FEP systems, they have proved themselves to be remarkably durable. ■



Livery styles may have changed since 1987, but much of the original aircraft christened by UK royalty lives on



### FLIGHT TEST

# You can try to stall it...

*Flight International's* former air transport editor recalls a flight in the A320 testbed that demonstrated the power of computerised control

DAVID LEARMOUNT LONDON

In 1984, when Airbus Industrie was flight-testing its fly-by-wire (FBW) system – some three years before the first A320 was rolled out – the manufacturer's then senior vice-president for engineering, Bernard Ziegler, invited me, as *Flight International's* air transport editor, to take the controls of the FBW testbed A300B2. The aircraft carried the FBW flight computers linked to a single sidestick control mounted at the left-hand seat. The right-hand seat had a conventional yoke with mechanical control runs.

In a short pre-flight briefing, Ziegler explained that, although the aircraft might feel

as if it was acting in response to a direct connection between the sidestick and the elevators and ailerons, the relationship was more subtle. The spring-loaded sidestick, when relaxed to its central position, commanded – via the flight control computers – a 1g flight profile and a zero roll rate. When displaced in pitch the stick commanded a proportionate change in the vertical acceleration by operating the elevators, but the computers would limit the positive or negative acceleration to the maximum allowable g load if the stick was pushed or pulled on to its stops.

Ziegler explained that sideways stick dis- »

ORIGIN DAVID LEARMOUNT LONDON

## 'Pilots to remain essential – but will need more back-up'

An ambition to design a flight control system that would help pilots do their job better and more safely than purely mechanically connected controls drove Airbus, in the early 1980s, to conduct a fresh examination of how pilots' roles were changing in the modern commercial aviation environment. The company concluded that pilots would definitely remain essential and that cockpit design would reflect their primacy as decision-makers, but also that they would need more back-up in the age of highly automated cockpits, busier skies and an expectation of zero accident risk.

The new cockpit automation philosophy first launched in the A320 series anticipated an imminent era when pilots would hardly ever trip the autopilot out, and aircraft could rely largely on flight management systems for navigation, because their computational capabilities, speed and accuracy far exceeded the mental capacity of pilots. These things are taken for granted now, but then they were unfamiliar.

Autopilots combined with auto-throttle had long been a useful pilot tool, but they work equally well with the old mechanical control systems as with fly-by-wire

(FBW). The latest variant of the venerable 737 series is a good case in point, and it still competes commercially with the A320 family.

There are times, however, when the autopilot – capable of operating only when the aircraft is within its flight envelope – is designed to trip out if it approaches the limits of its operating capability for whatever reason. This is the point where the pilots are expected to take over, using their flexibility, ingenuity and training to take charge of a situation that might be surprising, complex and confusing.

### COMBAT PROVEN

At this point, a glance at military control technology in the 1970s and 1980s can aid understanding of the philosophy behind the extension of FBW capability to encompass flight envelope protection (FEP). In the 1980s there was direct cross-fertilisation of ideas between the computer-controlled dynamic (CCD) system of the Dassault Mirage 2000 and the Airbus team, some of whom had flown the fighter or similar types.

CCD, which would nowadays be called FBW with FEP embedded in the software, enabled a combat pilot bent on obtaining maximum performance from the aircraft to be able to demand it at any speed by moving the joystick and throttle on to the stops with no fear of overstress or damage. This liberated the pilot to concentrate on mission tactics, and enabled the airframe to be designed with "relaxed stability" without

fear of loss of control, making the aircraft much more manoeuvrable.

FEP keeps the aircraft operating within safe parameters even if the pilot mishandles or neglects to control it, and the full-authority digital engine control system does the same for the powerplants.

Airbus's ultimate reason for moving into digital FBW was that it was now a sufficiently mature technology for use in the commercial arena, and the safety benefits of FEP were so obvious that it simply did not make sense not to use it. ■



Some Airbus designers had flown the Dassault Mirage 2000

**CCD enabled a combat pilot to demand maximum performance with no fear of overstress**

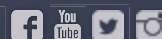
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David Learmount gets a feel for the new sidestick on the fly-by-wire A300 testbed

» placement commanded a proportionate roll rate up to a maximum of 15°/s. And, he added, the system would not let the pilot stall the aircraft. He told his ingénue co-pilot he could try it when airborne.

In the testbed A300, the sidestick's signals were sent to the computers which, in turn, sent signals that activated control-surface servos according to the stick displacement and the flight laws embedded in the software.

The purpose of this flight was to demonstrate the system's flight envelope protection (FEP) in action. I took over the sidestick seat when the aircraft was at a safe altitude; Ziegler gave me control and invited me to try to stall the aircraft in clean configuration. The throttles were set to idle, and I chose to let the aircraft slow down in level flight. When the indicated airspeed was approaching the stall at about 100kt (185km/h) the nose began to dip to maintain an angle of attack just above the stall. I pulled the stick back to raise the

### Pilots do not complain that yaw dampers or turn co-ordination systems take control away from them

nose and induce a stall, but the nose continued to dip and the airspeed continued – marginally – to reduce until it reached what Ziegler later explained was “alpha-floor”. This is the stalling angle of attack. At that point, with the stick still fully back on the stops, the engines wound up automatically to take-off/go-around power. As the airspeed increased and

the angle of attack was just clear of the stall, the nose began to rise steadily and the aircraft powered upwards out of its brief descent.

The FEP limits the angle of bank more simply: a pilot roll input on the stick simply stops being effective at a maximum of 67° bank. Overspeed protection is provided by raising the nose to keep the speed within flight envelope limits, even if there is nose-down pilot input.

A pilot's mental appreciation of how the FBW laws work in practice seems to be just a matter of familiarity. Manual flying in the A320 series feels perfectly intuitive, so it should not matter whether the pilot thinks of a pitch-up displacement of the sidestick as a demand for a proportionate elevator deflection, or as a demand for a proportionate increase in vertical *g* (which is how the FBW system delivers it), because the effect is identical: the nose-up attitude increases as demanded by the pilot. Likewise, it should not matter whether a pilot displacing the sidestick to the left is demanding a proportionate aileron deflection or a proportionate rate of roll, as the effect is identical.

### MAKING THE TRANSITION

Having experience not only of developing Airbus's cockpit automation philosophy but of introducing conventionally trained line pilots to it in the early days, experimental test pilot Etienne Tarnowski remembers how it felt persuading them that the A320 was not taking control away from the pilots and giving it to a computer.

Tarnowski says it was useful to provide them with analogies they were familiar with. Pilots do not complain that yaw dampers or turn co-ordination systems take control away from them, he suggests, but rather see them as assistants. FEP in pitch loading does not take control away from pilots hit by a storm down-burst on final approach, but liberates them to pull fully back on the stick knowing it will provide absolute maximum aircraft climb performance without fear of stalling.

Most questions from trainees, says Tarnowski, were not about manual flying or the flight controls, but about getting the most from the flight management guidance computer via the autopilot, autothrust and flight management system: managing the automated systems and choosing the best autopilot modes for any particular phase of flight. This happens to be the same in highly automated cockpits that do not work with FBW/FEP.

Tarnowski believes there would have been an early days benefit for new A320 crews if Airbus had merged its design and training teams earlier in the design process, but says: “I am not convinced that an earlier merging of the test and training communities would have changed the design of the A320.” It would probably have helped the instructors, however. ■

### PRODUCTION

## Not quite out with old

Orders booked point to the appeal of re-engined A320s, but the classic versions remain in demand so Airbus has to manage a gradual transition

DAVID KAMINSKI-MORROW LONDON

Airbus has not quite reached the point of declaring: “The A320 is dead – long live the A320neo,” but the transition to the re-engined version is accelerating and the backlog for the original model of its first single-aisle aircraft is rapidly diminishing.

Although the baseline A320 family ended last year with a net surplus of 46 orders, the basic model – the A320 itself – finished with a net deficit of 49. The airframer's dominant jet, having accounted for some 4,700 sales, is approaching the end of its reign.

The A320 did not completely surrender its position in the rush for the A320neo, launched in 2010. Airbus was careful to ensure it had a sufficient backlog to support a smooth transition of production, initially during introduction of the reinforced sharklet-capable wing and then to the aircraft itself.



Airbus commercial aircraft president Fabrice Brégier, speaking in Toulouse in mid-January, said the market for the original A320 family “remains extremely solid and extremely robust”.

“The transition is less sharp than we expected three or four years ago,” Brégier says, adding that the airframer expects to deliver “quite a substantial number” of baseline aircraft beyond 2017.

But since the A320neo’s maiden flight in September 2014, the A320 backlog has been evaporating, falling by two-thirds from 911 in January 2015 to 315 in January 2017. While this equates to about 15 months of production, based on the 251 A320s delivered last year, this does not account for the slowing of output resulting from the A320neo ramp-up, or the adjustments arising from Airbus’s higher overall monthly single-aisle production rate. The airframer has lifted this rate to about 50, in contrast with its initial plan to keep the rate at 42 per month to avoid the risk of instability during transition.

### PROGRESS REPORT

Brégier says the airframer is “on track” for a progressive increase in this rate to 60 in mid-2019, as it works to hack away at the backlog of A320neos – more than 5,000 aircraft – accumulated over the past six years.

“Our issue is to make sure we can deliver,” says Brégier, pointing out that Airbus is re-organising its “industrial footprint” with a fourth single-aisle assembly line in Hamburg



A321: Neo and classic versions pulling order conversions from smaller family members



PW1100G hitches dented 2016 deliveries



Variants of the family’s largest model will account for the bulk of 2017 output

– set to start producing jets this summer – and optimising its production by providing cabin-fitting capability at Toulouse. He acknowledges that Airbus still needs to “catch up” on A320neo deliveries, but expects the airframer to hand over “about triple” the number this year, compared with 68 in 2016.

Hitches with the Pratt & Whitney PW1100G engine meant only 39 of those 68 Neos were delivered with this powerplant, and Airbus ultimately reinforced its output last year with original A320-family models, delivering only 14 fewer than in 2015.

But Brégier is confident that A320neo manufacture is under control, stressing that the re-engined aircraft is meeting, or exceeding, performance commitments and achieving a dispatch reliability in the region of 99.7%.

Airbus took orders for 69 original A320s in 2015, but changes to its backlog involved 68 aircraft. Most of those changes – 31 in total – were conversions to the A320neo family as airlines opted to upgrade. But another 26 were converted to the larger A321. This was repeated last year, when 27 A320s were converted to A321s, leaving the backlogs for the original A320 and A321 virtually level.

Brégier highlights the increasing importance of the A321 and its re-engined counterpart, the A321neo, stating that the former accounted for 40% of all Airbus single-aisle deliveries last year.

Airbus chief operating officer for customers John Leahy says variants of the A321 will account for “over 50%” of all A320-family production this year. He claims its planned 240-seat capability places it as the “ideal middle-of-the-market airplane” – a shot at rival Boeing, which has been considering its options for the sector – and says he does not envision “any real need” for a further stretch beyond the A321. ■





All output so far has been of A321s, and buyers have demanded non-standard cabins

### AMERICAS

## In tune with the times

A 2012 decision to expand A320 output with a US assembly plant always made industrial sense, but politics have also gone Airbus's way

STEPHEN TRIMBLE WASHINGTON DC

Four years and four months before Donald Trump rode a wave of industrial nationalism to the White House, Airbus decided to plant a factory in Mobile, Alabama to deliver A320-family aircraft to US customers. In retrospect that looks, well, prescient.

"Prescient is a good descriptor. Brilliant is another one," laughs Allan McArtor, chairman and chief executive of Airbus Americas and the architect of the strategy that brought the largely European manufacturer to the US Gulf Coast.

He has got a point. US companies managing global supply chains now dread the unexpected presidential tweet demanding the return of outsourced, skilled factory jobs to American soil. As a foreign company, Airbus can point to its operations in Mobile as a prime example of foreign direct investment in the American economy, supporting American customers with an American-assembled product.

"It's okay to be a tourist, but to be a resident means even more," McArtor says.

To drive the point home, Airbus staged a dramatic event in late November 2016, flying a newly assembled A321 for Atlanta-based

Delta Air Lines over the Iron Bowl; an American football game pitting Alabama's two largest college football teams against each other in front of nearly 102,000 supporters.

Airbus's growth in southern Alabama has unfolded almost exactly as chief executive Fabrice Brégier described in July 2012. Mobile's Hangar 9, a replica of the A320 family final assembly halls in Hamburg, delivered the first A321 to JFK-based JetBlue Airways last April. In total, Airbus delivered 17 A321s to four customers – also including American and Spirit – in 2016, plus two more in January this year, says Daryl Taylor, vice-president and general manager of its US manufacturing facility.

The Mobile site is on track to deliver three A320-family aircraft by mid-year and four per month by the end of the year, Taylor says. Airbus has kept to the schedule, despite encountering a few surprises. In 2012, for example, the company's planners assumed the site would be devoted to delivering a steady flow of A320s

with standard cabins. Since opening two years ago, however, the final assembly line has delivered only A321s. The American clientele also have demanded more complex cabins, including first-class products introduced on JetBlue and Delta A321s, Taylor says.

Mobile's staff have had a lot of help. Not least, the fact that over 30 years Airbus has delivered more than 7,500 A320-family aircraft. The opening of a final assembly line in Tianjin, China, also provided a blueprint. But Airbus was careful not to insert risk into the equation. The assembly process implemented in Mobile is nearly an exact replica of the manufacturer's proven A320 assembly sites. The one exception, Taylor explains, is a different automated drilling machine used at the wing-to-body join station in Mobile, but even that technology was proved first on the A350 line.

In America, Airbus executives are already plotting the next steps for the Mobile site. There is still discussion about expanding the monthly production rate beyond four, which the US market could support, McArtor says. In the near term, discussions are focused on how to expand the statement of work within the planned production rates in Mobile. Some US-built components are currently shipped to major component assembly sites in Europe before being moved back across the Atlantic for final assembly in Mobile. In some cases, it may be simpler to ship American-made parts direct to Mobile.

Unlike Boeing, which has distributed component assembly but kept a firm grip on final assembly, Airbus has been willing to do the opposite, allowing final assembly to disperse globally but keeping assembly of the major sections in Europe. But that may change.

"We've taken a look at how do we diversify our component assembly," McArtor says. "It naturally has grown up around a UK, Germany, France, Spain-based manufacturing capability, but there's no reason we can't look at other areas." ■



The assembly process in Mobile is essentially identical to proven methods at other sites



CHINA

# Tianjin sets an example

The joint-venture assembly plant in the port city has emerged as a major commitment, with widebodies set to follow as demand keeps growing

MAVIS TOH SINGAPORE

**A**irbus's 2004 decision to establish an A320 final assembly line in Tianjin was a milestone in its growth in China.

Today, the European manufacturer views Tianjin as a paragon of its industrial co-operation with the nation. While some industry observers discount the importance of the line in either winning orders or boosting China's aerospace sector, Airbus believes it has "undoubtedly" helped to increase its market share in the

country. The facility, inaugurated in 2008, has now delivered more than 300 A320-family jets.

Airbus entered the Chinese market in 1985 with the delivery of an A310 to China Eastern Airlines. In that year it had 6% market share, but this grew rapidly through the 1990s and 2000s, eventually making it an equal to Boeing. Today, China absorbs about 20% of Airbus's global production.

In March 2016, Airbus took things to the next level, breaking ground on an A330 completion and delivery centre. This is an extension of its collaboration with AVIC and the Tianjin Free Trade Zone. The widebody facility is adjacent to the A320 family line, and will perform cabin installation, aircraft painting, flight tests and aircraft delivery. Assembled aircraft will be flown from Toulouse to Tianjin, with the majority of the completed jets going to Chinese customers.

"I am personally committed to this partnership in China," Airbus commercial aircraft president Fabrice Brégier pledges.

The A330 completions project elevates Tianjin, and China, to a different league.

Once operational this year, Tianjin will become only the third city in the world to deliver both narrowbody and widebody jets, after Toulouse and Seattle.

Airbus says construction of the new facility is proceeding "smoothly", and that the first wave of Chinese employees has been sent to the A330 final assembly line in Europe for training. If all goes to plan, Tianjin will deliver its first A330 in September. The A330neo and A350 will also be added at some point.

Flight Fleets Analyzer shows Airbus delivered 147 aircraft, the majority of which were A320-family jets, to China in 2016. Boeing, meanwhile, handed over 165 aircraft, mostly 737s. In less than a decade, China is expected to overtake the USA as the world's largest aviation market. Both manufacturers will no doubt strive to keep relations warm, to ensure that aircraft deals continue to come through.

For years, Boeing stuck to the rhetoric that it did not need to set up a local completions or manufacturing facility to do business in China. Instead, it would grow its presence by deepening partnerships across the country. »



Production of the A320neo family will start in Tianjin this year, and output could be raised from the current four to six aircraft a month



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» Meanwhile Airbus, coming from behind, continued to gain market share, now accounting for about half of China's fleet.

In September 2015, Boeing finally announced that it would open a 737 completion and delivery centre in China: its first such foreign facility. Curiously, it will collaborate with Chinese manufacturer Comac, which is building the C919 to compete directly with the 737 and A320. The facility will install interiors, paint and deliver 737s to Chinese customers.

Progress on the Boeing project has been slow. It took a year before the location was confirmed to be the coastal city of Zhoushan, and until now neither Comac nor Boeing has given an indication as to when the factory will open.

### Airbus already leads Boeing in terms of in-service widebodies in China, accounting for 194 units compared with Boeing's 166

Under US President Donald Trump's administration, Boeing could also be a target for retaliation in any trade war with China. Trump has criticised Beijing and even threatened to impose tariffs on imports from China, and keeping jobs in America is high on his agenda.

Airbus, meanwhile, has derided Boeing's late arrival, saying that to gain market share from China, one needs to be "looked at as bringing value to the country". This, Brégier says, means partnering long-term and in areas which are not "industry offsets" – merely producing what the manufacturer no longer wants to build elsewhere.

Should Boeing continue to take a back seat, it could leave more opportunities for Airbus, which has so far demonstrated more agility in China.

The European manufacturer has said it is looking at potentially raising production rates on its Tianjin A320 assembly line, as it gears up to raise the narrowbody's global production rate to 60 units a month by mid-2019. The line currently produces four aircraft a month, and delivered 51 jets in 2016. It has the capacity to assemble six aircraft a month, simply by reducing the time spent at each station, without the need for new infrastructure such as hangars and jigs. This year, Tianjin will also start producing A320neos.

Airbus, however, maintains that the Tianjin facility is a joint venture and that any decision to raise production must first be agreed with its Chinese partners.

Airbus already leads Boeing in terms of in-service widebodies in China – accounting for

194 units, compared with Boeing's 166, Fleets Analyzer shows.

Chinese airlines have been aggressively launching long-haul international services in recent years, to match the population's growing affluence and desire to travel. Both manufacturers will seek to push their new-generation widebodies, but the A330 appears to be the immediate beneficiary of the airlines' long-haul push.

While Airbus does not rule out setting up a

widebody production line in China, Brégier points out that it does not currently have a business case to do so. This is especially so since widebody assembly is "more complex and costly".

He says: "China has focused, rightly so, on single-aisle a lot and will continue to procure lots of single-aisles, but I'm sure the next step will be getting more widebodies. So perhaps one day there will be enough market to look at such an investment." ■

#### COMPETITION MAVIS TOH SINGAPORE

### Western duo have set the bar high for Comac C919

All eyes are on Comac, as the Chinese manufacturer's C919 narrowbody edges towards a first flight some time this year.

Analysts struggle to define how long it will take for Comac to become an influential aircraft manufacturer. What they do not doubt, however, is that the nine-year-old Chinese state-owned company has what it takes to break Airbus and Boeing's long-held duopoly.

"Comac has a golden opportunity with the huge [China] market and government backing. It has all the keys to be successful," one Western supplier involved in the C919 tells FlightGlobal.

The C919 may not yet be flying, but Comac already has commitments for 570 aircraft

from 23 customers, most of which are Chinese airlines and leasing companies. China Eastern Airlines, one of the largest carriers in the world, will be the launch customer for the jet.

Airbus commercial aircraft president Fabrice Brégier says that while Comac will "clearly not" catch up with Airbus and Boeing in the next five to 10 years, he considers the manufacturer "a very real competitor".

Analysts say Comac must, however, go beyond the delivery of the first aircraft and ensure a successful production ramp-up. Thereafter, customers need to operate the C919 efficiently, with the manufacturer also required to demonstrate a clear ability to

support the type. While Chinese airlines and lessors may be nudged to support the indigenous programme, they are used to the reliability and performance of Western-built aircraft, and will be unwilling to let an inferior product affect their operations.

Suppliers who worked on the earlier ARJ21 say Comac learned valuable lessons from its long and tortuous journey on the regional jet programme, and it will only improve going forward. Beyond the C919, it has already started work on a widebody joint venture with Russia.

For now, China has voiced its ambitions in aerospace, and Comac bears the weight of those dreams on its young shoulders. ■

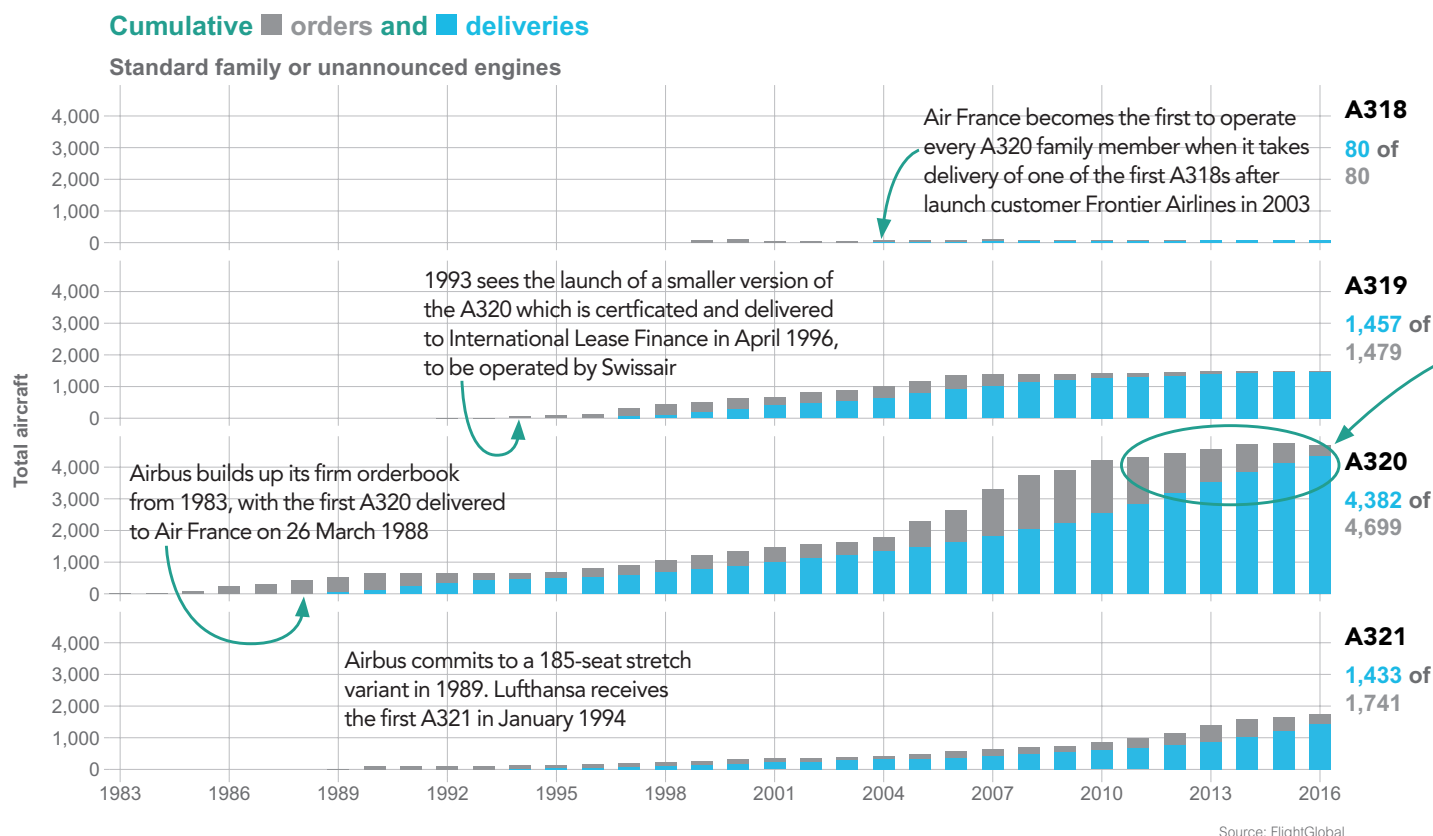


Beyond first flight and production, the airframer will need to prove its reliability



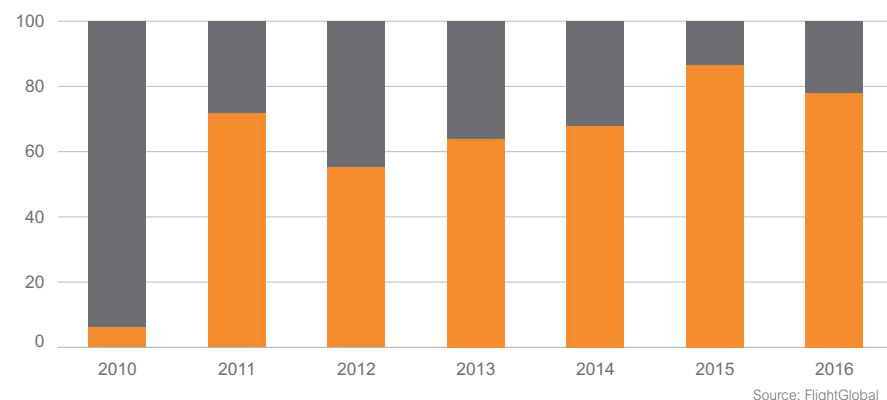
# 30 years – the data

By the end of 2016, Airbus had received 13,066 orders and delivered 7,422 A320-family aircraft. With the announcement of a re-engined version in 2010, the airframer refreshed the programme in response to customer demands for lower fuel-burn and competition from Boeing and Bombardier as it aims to stay at the front of the narrowbody market



## How orders for the A320neo overtook the standard model

Gross orders % share



## TYPE ENHANCEMENTS

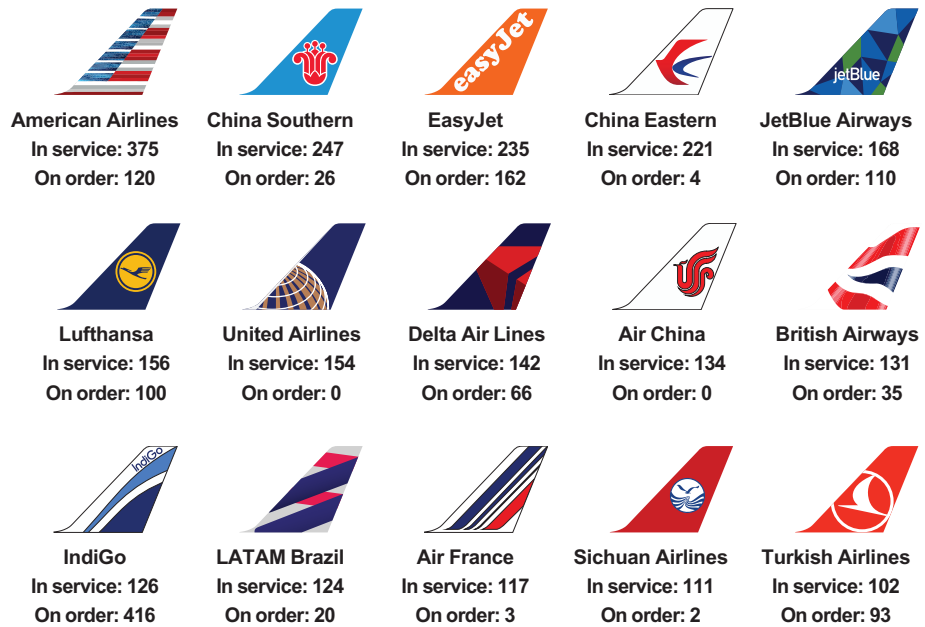
In order to maintain commonality with the standard A320s, reducing costs for customers and its own engineers' "requirement creep", Airbus kept enhancements to the addition of blended winglets dubbed "Sharklets" – claiming to reduce fuel burn by 3% – and the choice of new engines from Pratt & Whitney and CFM International. P&W's PW1100G is a derivative of the geared turbofan used on Bombardier's CSeries and the Leap-1A from CFM shares enhanced technological characteristics with the Leap-1B engines installed on Boeing's 737 Max.

Airbus continues to offer A320s powered by CFM56-5B and International Aero Engines V2500s alongside its Neos but deals have tended to swing in favour of the latter since Airbus started taking orders for the new model.

### TOP CUSTOMERS

Airbus launched the A320 project at the 1981 Paris air show with orders from French airlines Air France and Air Inter. For the aircraft to have a long-term future it needed support from a non-state, non-French airline – this was British Caledonian, from which it received an order in 1983. BCal later merged with British Airways and, after evaluation, the A320 was retained by the airline which went on to order more of the type and has become one of the largest A320 fleet operators.

As well as being popular with mainline operators like American Airlines and China Southern, the A320 has become one of the primary choices for low-cost carriers. EasyJet, JetBlue and IndiGo have operations based around minimising fleet diversity and have made up the bulk of their fleets with A320s. The versatility of the type has also proved a hit in the ever-growing Asia-Pacific market, with five of the current top 15 operators from that region.



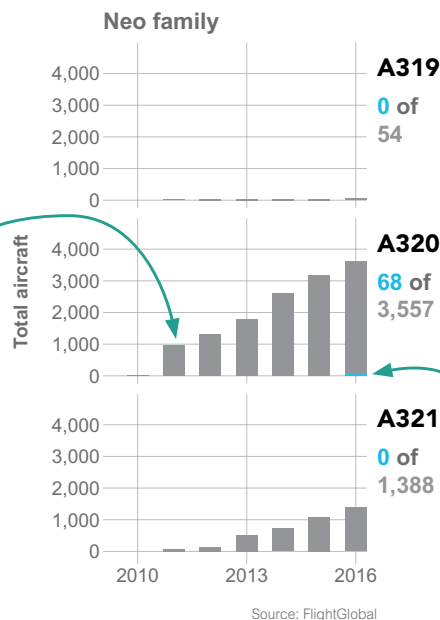
Standard A320 orders begin flattening off after the launch of the Neo programme in December 2010; new engine options are announced for the A319, A320 and A321. In January 2011, Indian low-cost carrier IndiGo commits to a memorandum of understanding that covers 150 A320neos and 30 standard A320s

AirAsia places an order for 200 A320neos at 2011's Paris air show, bringing total bookings for the Neo family to 1,029.

**"We said we saw a good market and [at launch] saw a demand for 4,000 aircraft over the next 15 years"**

**John Leahy**

Speaking during a briefing in January 2016, chief operating officer for customers said demand had vastly exceeded Airbus's expectations



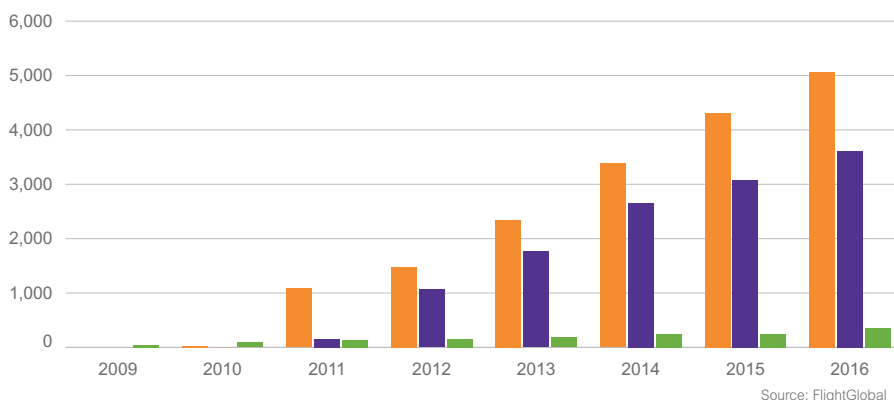
# 342

**Operators with in-service A320-family aircraft, located in 115 countries around the world**

Lufthansa takes delivery of the first A320neo in January 2016. Airbus delivered 68 Neos in 2016: 60 A320neos were delivered in the second half, including 25 in December, as Airbus and Pratt & Whitney resolved the snags with the PW1100G powerplant which had restricted first-half deliveries to just eight jets.

### A320neo sits on top of the new narrowbody orderbook

Cumulative net orders



### FACING THE COMPETITION

In 2008 Bombardier firmed up its geared turbofan-equipped CSeries, promising a 20% fuel burn advantage over Airbus and Boeing's existing single-aisle types. In response Airbus began considering a new engine for its A320 family, with COO John Leahy stating in 2010: "If we don't re-engine, they will have a niche."

When Airbus launched the Neo, Boeing was still deliberating side-stepping an interim development in favour of an all-new design. Both manufacturers made decisions to take on Bombardier's clean-sheet narrowbody with formal launches of their re-engined designs by mid-2011. Since then orders have stacked up for each, with Neo outnumbering Max by 5,059 to 3,605 at the end of 2016. This should keep production lines busy until the mid-2020s.



# Candid Canberra

Australia's air force is in a period of rapid modernisation as it takes delivery of increasingly sophisticated aircraft types. But the change is not causing the service's chief to lose any sleep

GREG WALDRON SINGAPORE

Air Marshal Leo Davies, chief of the Royal Australian Air Force (RAAF), leads one of the most modern – and capable – services in the Asia-Pacific region. His CV includes stints in the 1980s as a navigator and pilot on Lockheed Martin P-3 Orion maritime patrol aircraft, and amassing 2,000h as a General Dynamics F-111 pilot. He later went on to be Canberra's air attaché in Washington DC, before assuming his current role in 2015.

Speaking to FlightGlobal, Davies says while he does not lose sleep over the task of overseeing the RAAF as it adopts several new types and increases force connectivity, these are the first things he thinks about on waking up in the morning.

"Our air force role is emerging," he says. "We are quite a sophisticated air force now, and becoming more sophisticated. The option set we bring to a land-centric fight, a control-of-the-air fight or a maritime fight is like a Swiss Army knife. We have many options. It's

key that we educate our counterparts and regional neighbours of what we can do, and why they would seek that contribution."

One major area where the RAAF has recently ventured is the secrecy-shrouded world of electronic warfare (EW), a capability that will feature prominently at the upcoming Australian International Airshow at Avalon airport. At the show, Davies and Australia's defence minister Marise Payne will welcome the arrival of the RAAF's brand-new Boeing EA-18G EW. The service has now taken all 12 of its ordered examples of the Growler, and has worked closely with the US Navy at Whidbey Island, Washington state, to train its personnel and develop the Super Hornet derivative's capability.

The EW mission is among the crown jewels of US air power, and Washington's willingness to share this capability with Canberra testifies to the close ties between them. With some pride, Davies says RAAF Growlers recently flew their first all-Australian training sortie. The effort took place over a US range, with the mission planned, flown and debriefed by Australian personnel.



"All the Growlers are ready to come over [to Australia]," he says. "One thing that has proliferated is the number of electronic devices in the bad guy's game." He adds that the RAAF regards the Growler as a "kinetic" asset. "You select the weapon for the effect you want in a frequency band and get results – it's not a broad-spectrum effect," he notes.

## JOINT ROLE

Davies stresses the joint nature of the Growler platform. He estimates that for 75% of the aircraft's missions it will not operate alongside the RAAF's F/A-18A/B and F/A-18F Super Hornets. Rather, it will spend most of its time supporting ground and maritime forces. "It's truly a joint platform," he says.

Another major Australian acquisition is of Lockheed's F-35A Lightning II. So far, the air force has taken two examples, which are part of the global F-35 training pool at Luke AFB, Arizona. These came from the programme's sixth lot of low-rate initial production (LRIP). It will take eight more of the conventional take-off and landing aircraft each in LRIP 10 and 11. Canberra's overall commitment is for 72 aircraft, although this could eventually rise to 100.

So far the RAAF has four qualified F-35A pilots, and is beefing up maintenance capabilities for the type. Australia has been a long-term partner on the programme, and the Avalon show has featured prominently in the



EA-18G Growler forms key part of Royal Australian Air Force's electronic warfare capability

Commonwealth of Australia



Australia's Super Hornets have flown 418 sorties and dropped 278 munitions in Iraq and Syria

**"The option set we bring to a land, air or maritime fight is like a Swiss Army knife"**

**Air Marshal Leo Davies**  
Chief of the Royal Australian Air Force

with the remainder to follow shortly thereafter. Personnel will transfer to the F-35A.

Although on their way out, the Classic Hornets are leaving with a dramatic flourish. The venerable type has formed the bulk of the RAAF Air Task Group's supporting operations against Islamic State militants in Iraq and Syria. Service data shows that single-seat F/A-18As have flown more than 1,500 sorties, releasing 1,250 weapons. Its younger and larger stablemate, the F/A-18F, had logged 418 sorties and dropped 278 munitions by late January.

"This is a substantial amount for a small force," says Davies. He declines to discuss where, exactly, in the Middle East the RAAF's contribution is based, but says its current composition is six Hornets, one Airbus Defence & Space A330/KC-30A multirole tanker transport and one Boeing E-7 Wedgetail airborne early warning and control (AEW&C) system aircraft. Australia's contribution to the campaign is entirely self-deployed, with its own intelligence capability and air tasking.

Davies says the KC-30A has been very effective during the campaign, delivering nearly 70 million pounds of fuel, and that the 737-based E-7 has also performed extremely well in the AEW&C role.

**GULFSTREAM ACQUISITION**

To complement its Growler and Wedgetail capabilities, the RAAF is in the process of obtaining two Gulfstream G550 business jets that will be modified for electronic intelligence missions.

"In the 2016 defence white paper, we found there was an electronic warfare co-ordination role that was not being filled," Davies says. "The G550 will serve as the conductor of the orchestra." The service is still looking at how exactly these assets will work together, he adds.

"Our air warfare centre is looking at a maritime environment, in which case the Growler will support vessels like the future frigate and the air warfare destroyer, providing the navy with an electronic option at distance. The bit we want to understand regarding [the] G550, Wedgetail and Growler is what part of that EW mission do we apportion to each. We don't want to have a Wedgetail that should be doing airborne control in a congested environment, also having to send packets of ones and zeros to the F-35 or the air warfare destroyer. This becomes the role of the G550."

Davies says the RAAF has approval for two ➤

past. At the 2013 show, the head of the US Joint Programme Office, Lt Gen Christopher Bogdan, used a briefing to blast the relationship with Lockheed and F135 engine manufacturer Pratt & Whitney, which he accused of taking a short-term view of the programme. One topic bound to come up at this year's show is a January report from the outgoing top Pentagon weapons tester, Michael Gilmore, citing hundreds of deficiencies with the programme, which he said would push back full combat tests to late 2018 or early 2019.

Davies says the RAAF welcomed the independent perspective the report brought, but points out that there was a lag between the identification of several of the issues and its publication. He says the programme continues to make steady progress dealing with issues discovered, and that it is reasonable to expect deviations from the schedule.

"While the test plan hasn't followed the squiggly red line, it hasn't been too far away," he says.

Davies lists several specifics to support his confidence in the F-35 programme. "There are now more than 200 aircraft delivered, operating in 12 locations, with over 75,000 flight hours. More than 380 pilots and 3,700 maintainers have been trained, or are under training. This can't happen with a troubled programme."

The first of Australia's F-35As will be ferried to the country in 2018, with an eye to

achieving initial operational capability (IOC) in 2020.

Meanwhile, the RAAF's 71 F/A-18A/B "Classic" Hornets, which the F-35 will eventually replace, continue to be its combat workhorses. Davies says the average rate of activity for each airframe has risen by 1,000h annually as a result of its combat detachment to the Middle East. Examples with the highest airframe hours will start to be retired in 2018,



AM Davies: forging close ties with the USAF



» G550s, but has yet to decide how many more will be sought and in what configuration. Last year's white paper suggested that Canberra's G550 special-mission aircraft fleet could eventually grow to five.

Another major intelligence, surveillance and reconnaissance (ISR) asset the RAAF plans to obtain in the near future is an armed medium-altitude, long-endurance (MALE) unmanned air system. A decision could be made this year between a type from General Atomics Aeronautical Systems' MQ-9 Reaper or Israel Aerospace Industries' Heron families. "We're still looking at the options," says Davies, adding that "a decision is not that far away".

In addition to the MALE system, Canberra is committed to an eventual acquisition of the Northrop Grumman MQ-4C Triton. A mock-up of this aircraft has been a staple at previous Avalon shows, and for its 2015 iteration the US Air Force sent a related Block 30 Global Hawk to appear in the static display after flying from Beale AFB in California via Guam.

An RAAF officer at the show said the aircraft's 24h endurance would allow it to cover patrols along Australia's northern borders. The Tritons will work intimately with the RAAF's incoming fleet of Boeing P-8A Poseidon maritime patrol aircraft. Canberra has firm orders for eight of the 737-based type, and its 2016 white paper suggested that seven more could be obtained.

"We are looking at [initial operational capability] for the P-8s in 2019," says Davies. The RAAF has taken delivery of a single example so far, which is at RAAF Edinburgh in South Australia. Davies estimates that subsequent P-8s will arrive at 20-month intervals. A crew will head to Seattle "very shortly" to take delivery of its second aircraft, he notes. A third crew is halfway through its training, and a fourth is about to begin its instruction.



Air force has previously conducted refuelling trials of the Lightning II using its KC-30A tanker

The capability offered by the P-8A/Triton combination will replace the RAAF's aged fleet of Lockheed AP-3C Orions. The first three of these have already been retired, and others will be gradually retired as the replacement manned capability is stood up.

In terms of airlift, Davies is very satisfied with the RAAF's capabilities. The service has a range of fixed-wing transport options comprising eight Boeing C-17s, 12 Lockheed C-130Js and four Leonardo Alenia C-27Js. Flight Fleets Analyzer shows that the C-27J force will grow to 10 aircraft by the end of 2018.

Davies says this array of strategic and tactical transports is complemented by the RAAF's five KC-30As. In addition to their tanker role, the aircraft can carry 270 passen-

gers and have capacity for 34t of military and civilian cargo.

"The KC-30A has proven to be such a great aircraft for carrying people that we also use it as an element of our air bridge for carrying people to the Middle East," he says. "But we can also use it very efficiently in deploying, say, four Hornets to RMAF Butterworth in Malaysia. We can take the tanker, all the troops, and all the maintenance gear for one week of operations in one aircraft."

The RAAF has ordered two additional KC-30As, which will be converted from former Qantas A330-200 airliners. One of these will have VVIP accommodation, which will allow Australia's prime minister, for example, to fly long-haul routes on government business along with accompanying staff and journalists.

## AMALGAMATION

Davies says that the real challenge for the RAAF is knitting these assets together into a capable whole. This represents a continuation of the Plan Jericho effort launched by his predecessor, AM Geoff Brown, in 2015. One successful example Davies offers is a Heron UAS transmitting imagery of a landing area to soldiers aboard an inbound C-17.

"They could plan their arrival to best fit the scenario they saw," he says. "The information they received was 3h newer than their last brief."

Another Jericho initiative, conducted with help from Northrop, related to connecting three assets with disparate datalink systems. This saw a Eurogrid-equipped Airbus Helicopters Tiger attack rotorcraft operated by the army, a Link 16-equipped Super Hornet and the army's battle management system all linked up for a shared, common perspective. ■



Initial operational capability for its Boeing P-8A maritime patrol aircraft is anticipated in 2019

Cobham has fitted several BAe 146s with "gravel kits" to support its operations from unpaved runways



Cobham Aviation Services

# Blue sky mining

Australia's unique requirement for "fly-in, fly-out" services to transport workers in the mineral extraction industry has created a thriving sector using rugged, niche airframes

ELLIS TAYLOR PERTH

**O**n any given week, the mornings between Monday and Wednesday at Perth airport are a hive of activity, as thousands of passengers board flights to destinations for which it is impossible to buy a ticket.

These are the fly-in, fly-out (FIFO) workers that are the mainstay of Australia's mining industry. Kitted out in high-visibility workwear, they board charter flights to places such as Boolgeeda, Granny Smith, Nifty and Yandigoona. In most cases, they work for two weeks straight, then fly home for a well-deserved week off before doing it all again.

Similar scenes takes place elsewhere across Australia. In Queensland, a number of FIFO flights operate from Brisbane, Cairns and Townsville to mining and gas projects out to

the west of the state. There are even flights from Melbourne, on Australia's south-east coast, to remote mines in the north-west of the country – some taking 3h to complete.

Carrying those remote workers is the role of a number of specialist charter operators, such as Alliance Airlines, Cobham Aviation Services Australia and Skippers Aviation. In recent years, Qantas and Virgin Australia have entered the fold through their respective acquisitions of Network Aviation and Skywest, since renamed Virgin Australia Regional Airlines (VARA).

Elsewhere, Darwin-based AirNorth operates Embraer 170 jets and EMB-120 turboprops on a mix of FIFO and scheduled services. In 2015 the carrier received a boost after being majority acquired by global helicopter giant Bristow Group.

There are a number of turboprop operators,

such as SkyTrans and Regional Express, that also play a significant role in the industry, especially in northern Queensland.

FIFO operations grew strongly from 2008 as the prices of major commodities such as iron, gold, zinc and crude oil raced upwards on the back of voracious demand from China. Those higher prices unleashed a major investment programme from a number of mining and petroleum companies, which necessitated moving more workers in and out of remote locations on a regular basis.

That benefited several operators, and saw a number of the charter flights up-gauged from 30- and 50-seat turboprops to 100-seat jets, especially as a number of mining companies started to build jet-capable airstrips at their remote sites.

At one point, Qantas and Virgin were meeting the demand by flying their Boeing 737s to certain sites that were equipped to handle the larger jets.

A collapse in commodity prices in 2014, and the end of construction at some of those projects, have changed the landscape significantly now.

"The FIFO market has been, and remains, challenging, with the downward cycle caused by the drop in commodity prices and the end of many major construction projects," says Peter Nottage, sector president of Cobham Aviation Services.

Alliance Airlines managing director Scott McMillan says the impact on his business has not been that severe, as it had less focus on servicing projects that were in construction, and more on mature production mines.

## LEGACY FLEETS

Most of the operators serving the FIFO market are focused on reliability and maintaining low aircraft capital costs, so their focus has been on types that have been forgotten in other parts of the world.

Fokker 100s and 70s have played a major role over the past decade in the FIFO market. Flight Fleets Analyzer shows that Australian carriers account for 42% of the remaining F100 fleet, led by Alliance with 16 aircraft.

Qantas's Network Aviation, Skippers Aviation and VARA are also major operators of the type.

McMillan says the F100 has proven to be very effective in FIFO operations.

"By its nature, FIFO operates to isolated areas that are generally hot with 30m by 1,800m [5,900ft] runways, and the Fokker jets are the best aeroplanes for the job," he says.

Alliance is also the only such operator of the smaller F70, with eight in service. It has upgraded six of these to the LR variant with additional fuel tanks, which give them the ability to fly non-stop virtually anywhere around Australia. In most cases, however, they are used to fly out to a site and back on one »



» tank of fuel, providing major cost savings compared with fuelling up in a remote location.

Alliance scored a coup in 2015 when it entered into a deal with Austrian Airlines to buy the Star Alliance carrier's entire fleet of Fokker jets. While originally viewed as a long-term source of spare parts, three of those jets have been moved to Australia to fly with Alliance, while two more were sold to Network and one leased to VARA.

Since it started operations in 1991, Cobham has relied on BAe 146s and Avro RJs as the backbone of its fleet. Nowadays, it operates nine passenger-configured 146s and RJs, including a number that have been modified with "gravel kits" to operate from unpaved airstrips.

Nottage says the rough-field capability of the quad-jets has given Cobham a unique capability. "Our fleet decisions will be based around what's best for our clients, and the BAe 146/RJ will always hold a special place in Cobham's fleet because of its unique capability to land on unpaved runways throughout Australia," he says.

**"We've got a very good mix of high quality customers. We think it will be fairly stable"**

Scott McMillan

Managing director, Alliance Airlines

Two years ago, Cobham added its first Embraer 190, leasing an ex-Air Berlin aircraft from Falko, which is used on its Perth-Barrow Island services.

"We have received extremely positive feedback from our clients about the E190, and its performance, payload and reliability have exceeded even our expectations," Nottage says.

For Virgin and Qantas, the ability to access the wider fleets of their commercial airlines has been an advantage. Qantas, for instance, at one stage was using Jetstar Airbus A320s to

fly charters to Fortescue Metals Group's Christmas Creek mine in the Pilbara region, alongside Network's F100s.

VARA also operates two A320s, which were initially acquired for its FIFO operations but nowadays split their time between charter and scheduled services.

At the smaller end of the scale, turboprops continue to play a strong role, led largely by Bombardier Dash 8s, Fairchild Metroliners and Saab 340s. Fokker 50s are also flown by Alliance, while Virgin retired that type in 2015.

## HIGHLY COMPETITIVE

Although there has been some concentration towards Alliance, Cobham, Qantas and Virgin, there remains strong competitive tension among the players.

While that has put some pressure on pricing, McMillan and Nottage say that clients are mainly focused on safety and on-time performance, which have been key in securing ongoing business from the major resource customers.

"There is a significant choice of very good operators in Australia and you've got to stay on your toes to stay there," says McMillan.

There have been some major shifts among clients over the past year. Alliance secured a contract for gas producer Santos to fly from Adelaide that was previously held by Cobham. Not to be outdone, in July Cobham secured a 12-month contract from Doray Minerals, and has secured extensions for most of its major clients.

The competition brought Virgin and Alliance together last year, with a proposal to jointly bid for future contracts and offer preferential engineering services and spare parts to one another. That process has not gone smoothly: the Australian Competition and Consumer Commission (ACCC) issued a draft ruling proposing to block the tie-up on concerns that it would reduce competition.

"Alliance and Virgin responded to the ACCC as requested on 27 January and we'll

have further consultations going forward," McMillan says.

Although FIFO is a major part of their operations, a number of the charter carriers have other business areas, including some scheduled services, aircraft trading and wet-leasing.

Alliance has turned to the tourist sector to provide additional revenues. Having acquired Austrian's former Fokker fleet, it is expanding its aircraft, parts and engine trading operations. McMillan is also looking to build its wet-leasing business, which primarily provides capacity for Virgin in Queensland.

Network and VARA both operate a mix of charters and scheduled services for their parent airlines. That has become more important, as the lower demand on regional services has seen Virgin and Qantas redeploy their larger 737s to other routes. The smaller Fokker 100s have allowed them to maintain frequency on some routes while lowering capacity.

Cobham has also long been involved in other operations. It is a major operator of aircraft for Qantas, flying 717s for QantasLink and BAe 146 freighters for Qantas Freight.

## HIRING AGAIN

There are signs of improvement ahead in the FIFO market. Prices for most commodities bottomed out in 2015, and even started to rise last year. Some mining companies are hiring again, which should increase the volume of FIFO flights.

"From an Alliance perspective, we've got a very good mix of high quality customers. We think it will be fairly stable with a little bit of growth in it," says McMillan. This year he expects the company to operate more FIFO flights than in 2016.

Nottage still sees pressure this year for Cobham, but remains upbeat.

"We foresee the market remaining challenging in the short- to mid-term, but there are some signs of stability and small shoots of new activity that are encouraging," he says. ■



Alliance has upgraded six of its Fokker F70s to the LR variant, so they can make return trips to remote mining sites without refuelling

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"Steady on lads, I'm not quite as fast as I used to be"

## Alpha Foxtrot's final Filton waltz

The last Concorde built, and last to fly – British Airways' Alpha Foxtrot, also known as 216 – has made her journey to the new Aerospace Bristol museum due to open near her Filton birthplace this summer.

It was a short trip across the Filton runway, but a delicate operation for the team from BA and Airbus – not only was it her first outing in more than 13 years, but the old girl tucks into her new home with just a metre to spare between each wingtip and the walls.

Alpha Foxtrot made her maiden flight on 20 April 1979 and touched down at Filton for the final time on 26 November 2003. Since then, she has stood alongside the runway and

remains in "remarkable condition", according to those who look after her.

## Fixin' the Vixen

A fund-raising push has been launched to return the last airworthy de Havilland Sea Vixen to full flying condition in time to greet HMS *Queen Elizabeth* when she docks at Portsmouth later this year.

The plan is for the twinjet to join two fellow vets – a Hawker Sea Fury and Fairey Swordfish – in a flyover to welcome the supercarrier to her new home.

RNAS Yeovilton-based G-CVIX XP924 needs a repair to her flap system and wing to keep her airworthy. You can make a donation and become a supporter at the Fly Navy Heritage Trust website.



Quick, before it's illegal again

## Teasing Trump

We love Royal Jordanian's retort to one of President Trump's most contentious moves. This advert from the airline appeared just after a judge overturned The Donald's travel ban on citizens of seven Muslim countries.

## Brush hour

That tedious wait between landing at a busy airport and reaching the gate can feel like watching paint dry. For the crew of one LOT E-Jet, that's literally what they had to do.

After leaving the runway by the wrong exit at Warsaw's main airport, the crew encountered a group of airport workers installing ground markings. Although the maintenance gang made a speedy exit, the aircraft could not proceed until, you've guessed it, the paint dried.



Sea Vixen in race to get ready for a royal appointment

## Lighting the sky

Night flying is being taken in hand now in earnest in the United States. To this end searchlights, each of more than 1,000,000 candle-power, have been installed at the United States Army Aviation Field at Hempstead, New York.

**100 YEARS AGO**

## USAAF build-up

Last autumn there were 210,000 officers and men in the U.S. Army Air Force, says *Life*. By June this number will be increased to 385,000, and the total is now to be expanded to a million men.

**75 YEARS AGO**

## Speedy suitcases

American Airlines is sponsoring the development of an ultra-fast baggage-handling system which could

**50 YEARS AGO**

deliver a suitcase from any point on an airfield, such as Chicago O'Hare, to any one of hundreds of other points on the same airfield in a maximum of 180sec.

## BAe job cuts

British Aerospace has cut a further 2,350 jobs in its

**25 YEARS AGO**

aircraft manufacturing operations. The losses were

expected... although the worldwide slump in defence and aviation markets has sharpened the need for further cut-backs. Since 1990 BAe has announced 12,700 job cuts including 5,000 in defence in 1990 and another 5,000 in 1991.

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## EVENTS

### 4-11 March

IEEE Aerospace Conference  
Big Sky, Montana, USA  
aeroconf.org

### 6-9 March

HAI Heli-Expo  
Dallas, Texas, USA  
heliexpo.rotor.org

### 14-16 March

IATA World Cargo Symposium  
Abu Dhabi, UAE  
iata.org/events

### 19-21 March

Routes Asia  
Okinawa, Japan  
routesonline.com

### 21-25 March

Langkawi International Maritime  
& Aerospace Exhibition  
Langkawi, Malaysia  
limaexhibition.com

### 4-6 April

Aircraft Interiors Expo  
Hamburg, Germany  
aircraftinteriorsexpo.com

### 4-7 April

LAAD Defence & Security  
Rio de Janeiro, Brazil  
laadexpo.com.br/2017/en.html

### 8-11 May

Xponential unmanned systems  
and robotics  
Dallas, Texas, USA  
xponential.org

### 22-24 May

European Business Aviation  
Convention & Exhibition  
(EBACE)  
Geneva, Switzerland  
ebace.aero

### 4-6 June

IATA Annual General Meeting  
Cancun, Mexico  
iata.org

### 19-25 June

Paris air show  
Le Bourget, Paris, France  
siae.fr

### 14-16 July

Royal International Air Tattoo  
RAF Fairford, Gloucestershire, UK  
airtattoo.com

### 18-23 July

MAKS  
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aviasalon.com/en

### 24-30 July

EAA AirVenture Oshkosh  
Oshkosh, Wisconsin, USA  
eaa.org/en/airventure

### 12-15 September

DSEI  
London, UK  
dsei.co.uk

### 23-26 September

World Routes  
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routesonline.com/events/189/  
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The Head of Air Finance is a senior role in the Markets group in FlightGlobal, reporting to the Vice-President of Markets. The Markets team is responsible for leading the strategic direction of the Air Finance and Aerospace sectors in FlightGlobal.

The Head of Air Finance role requires a subject matter expert in the dynamic global air finance world, with particular knowledge of aircraft leasing and banking.

They will be able to connect and work intimately with customers within that sector to identify and articulate the market drivers of the sector, and understand and articulate the high-level and most critical customer problems in the sector.

From this deep-customer insight and understanding, the Head of Air Finance will identify the future large product and service opportunities in the sector. Their customer insight will also help the business shape and prioritize opportunities to drive revenue growth in the nearer term.

This Markets head role is a key interface between FlightGlobal's overall strategic goals and delivering actionable customer insights and understanding from which the Product team can design, define and deliver great products and services.

The role will require an experienced and skilful leader who is comfortable and confident working with multiple stakeholders across FlightGlobal and in the wider RBI business. These stakeholders will include colleagues in product, technology, sales, marketing, content and consultancy.

The Head of Air Finance:

- Provides leadership of the Air Finance sector
- Acquires and maintains a deep understanding of the sector market drivers and trends
- Voice of the customer in the organisation – being able to articulate the most pressing customer problems and answer 'what is the value to them?'
- Develops and articulates customer use cases
- Produces sector-based strategic and opportunity roadmaps
- Undertakes strategic customer discovery to link their emerging business problems with top-level strategy to understand the direction they are moving in.
- Demonstrate the capability to solve those problems and provide a compelling value-proposition to the customer (lead the process of delivering a proposed solution / presentation of the data analysis)

- Articulate the commercial opportunity to the internal sales team, and in partnership with the commercial team present the opportunity (Markets lead knowledge required to understand how the solution is deployed in the client organisation)
- Help sales to formulate and implement value-based sales strategy
- Conducts sector and business case opportunity analysis
- Works with other sector heads to identify and harmonise requirements across sectors
- Prioritises requirements in close collaboration with the product team for Horizon 1 and Horizon 2 activities

The Head of Air Finance must be able to demonstrate a deep understanding of the key personas within their sector. They will have sound commercial acumen that allows them to define the value proposition for our services in the eyes of our customers, helping to drive go-to-market activities that will deliver profitable revenue growth.

As a global business, with offices across every continent, the role will require a considerable degree of overseas travel.

In the Head of Air Finance role, the individual will be expected to demonstrate excellent presentation and influencing skills, specifically being able to input into directing the thought-leadership and opinion-forming work of the air finance community within FlightGlobal and be comfortable presenting to industry conferences, workshops or similar face-to-face events.

### About Reed Business Information

Reed Business Information (RBI) provides information, analytics and data to business professionals worldwide. Our strong global products and services hold market-leading positions across a wide range of industry sectors including banking, petrochemicals and aviation where we help customers make key strategic decisions every day. RBI is part of RELX Group plc, a world-leading provider of information solutions for professional customers across industries.  
<http://www.reedbusiness.com>

RBI is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, colour, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

### RBI General Benefits Package:

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- Life Insurance (4x salary)
- Save As You Earn Share Scheme (SAYE)
- Competitive Salaries

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WORK EXPERIENCE GREG PRINCIPATO

# Keeping an eye on the big picture

As head of the US National Aeronautic Association, Greg Principato deals daily with the passion and achievements of aviation: something that is not always easy to explain to hard-nosed business people

## How did your career in aviation begin?

My aviation career has been entirely on the policy/promotion front. I worked for two United States senators and always had aviation in my portfolio of issues. When I worked for then-Virginia Governor Gerald Baliles in the late 1980s aviation became a much bigger issue for me as we reformed the way airports are funded and worked on the creation of the Metropolitan Washington Airports Authority. In 1993, President Bill Clinton appointed Baliles to chair a presidential commission looking into the financial troubles facing aviation. He brought me along as executive director and thus began my full-time immersion in aviation.

**What is your role with the National Aeronautic Association?** The NAA is the oldest aviation organisation in the United States, formed in 1905 because people did not fully appreciate the magnitude of this new invention. Some 111 years later, as its president, I would argue we still need to educate people on the importance of aviation, as well as celebrate aviation and its impact. That's what we are here for! For example, we recently awarded the Wright Brothers Memorial Trophy to Colleen Barrett, a truly legendary figure and President Emeritus of Southwest Airlines. The Wright Trophy was founded after the passing of Orville Wright in 1948 and is administered through a trust established



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by the Wrights. As you can imagine, we must have a very rigorous process to ensure the award meets very high standards. Other awards, such as the Collier Trophy, given for the greatest achievement in aerospace and aeronautics the previous year, require the same care. This is a responsibility I take seriously and personally.

## What do you enjoy about your job?

That I am constantly around people who are passionate about aviation and want to spread that passion to others. This includes sectors of aviation with which I had very little previous exposure. Modellers are one example. I also enjoy connecting with air

sports such as parachuting and hang gliding. It's astounding to learn about the unique programmes aircraft manufacturers and other aviation innovators such as Blue Origin and SpaceX are working on. In my role, I have the chance to be more exposed to all of these sectors.

## What's your biggest challenge?

We are a small organisation and made it through some difficult fiscal times in the past. That is an ongoing challenge. Because we do not take positions on legislative or regulatory issues, it is sometimes difficult to explain the value proposition to people. In my previous work, I could go to an airport director and tell him or her that I could help deal with

US Federal Aviation Administration regulatory issues if they joined. That's easy to explain. We don't do any of that, so we have to appeal to peoples' passion, or their interest in our awards and records.

## What has been the highlight of your career to date?

The best job I ever had was working for the Governor of Virginia. He was committed to some important goals, and we achieved them. The best thing is that those achievements had lasting impacts on people, and that includes a commitment to transportation and aviation.

## What do the next 12 months hold for the NAA?

My predecessor did a great job of turning this organisation around during a time of fiscal peril. I want to solidify those gains, and maintain the intensity of our current focus while further broadening our outreach to other aviation sectors including general aviation, airports, airlines, and others. We administer some of the greatest awards in aviation, and there are many people in those other aviation sectors who should be recognised. I want us to be able to do that. ■



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