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Gripen grin

How Thailand's air force gained power through its first decade with Swedish fighter fleet **28**

Cabin fever

Industry comes under pressure as passengers and crew call for improved flight conditions **31**



8-14 January 2019

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OPERATIONS

Frosty reception

After three years of service, we assess A320neo's performance



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COVER IMAGE

To illustrate our in-service report on the A320neo, we chose this image of Lufthansa's PW1100G-powered D-AING, taken at Paris Charles de Gaulle by Matthieu Douhaire **P23**



BEHIND THE HEADLINES

Craig Hoyle (pictured) paid a visit to Surat Thani air base – home to Thailand's Gripen-equipped Wing 7 (P28). Dominic Perry was at Bell's site in Fort Worth, for an update on its rotorcraft development plans (P19)



NEXT WEEK SAFETY

Our annual airline safety review looks at accidents listed in 2018 – including this Air Niugini 737 mishap

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Collins Aerospace

Image of the week

Ukraine's interior ministry has taken its first two of 21 "repurposed" H225 twins from Airbus Helicopters, as part of a 55-aircraft project announced in July 2018. Kiev will employ the 11t type for law enforcement and National Guard duties, supported by a new training and maintenance centre

View more great aviation shots online and in our weekly tablet edition:

flightglobal.com/
flight-international



Anthony Pecchi/Airbus Helicopters

The week in numbers

40%

Flight Dashboard

American Airlines shares opened 2018 at \$53, but closed at \$32; gains were rare for majors, but United added 20%, to \$83

\$1.17bn

Flight Dashboard

Gross debt for Jet Airways as of 31 December; the struggling Indian carrier closed 2018 with a bank payments default

91

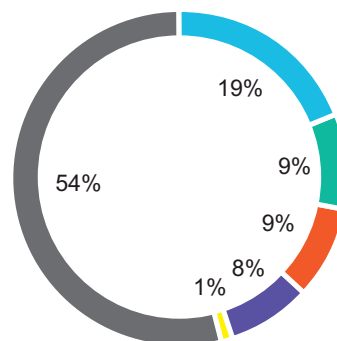
Lockheed Martin

Number of F-35 deliveries made in 2018, meeting the joint delivery target of Lockheed Martin and the US government

Question of the week

Last week, we asked: **2019's biggest anniversary?**
You said:

Total votes: 1,791



Moon landing	955 votes
747 debut	350 votes
Birth of Airbus	170 votes
Concorde's take-off	156 votes
First transatlantic flight	142 votes
Embraer's formation	18 votes

This week, we ask: **A320neo?**

☐ Best in class ☐ Improving situation ☐ Failing to deliver

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Great expectations

The Airbus A320neo is a fine aircraft; that much is clearly evident from early service reports, but aviation faces bigger challenges than discomfort caused by one type's teething troubles

Reading our three-year in-service report on the Airbus A320neo, one could be excused for wondering why the headline does not include the word "disappointing". Big sales and praise for fuel burn aside, an undertone of wariness shows through; only a handful of airlines agreed to be interviewed. Delivery delays with new engines from CFM International and Pratt & Whitney, plus reliability issues with the latter, have taken some lustre off an eagerly anticipated aircraft.

On the plus side are some outcomes so positive as to leave any observer hard-pressed to grumble. The aircraft are quieter and more powerful, and per-seat fuel burn can be one-fifth better than older-generation A320s. One-fifth better, that is, than an aircraft family that has been so good over so many years as to earn the nickname "workhorse" – as in robust, dependable and essentially irreplaceable.

Outside of aviation, the real world has shown signs of economic and geopolitical distress for years now

Airbus, CFM, P&W and their suppliers have of course been scrutinising their performance and may, in hindsight, have done some things differently. But even the best-laid plans cannot be expected to flawlessly foresee every pitfall. Here, an extreme challenge called for taking a hugely successful and highly optimised machine and improving it dramatically while ramping up output to unprecedented rates. By that standard, the programme has been a triumph – even if customers are not, yet, 100% happy.

A320neo service entry is best understood in its



Beware turbulence

broader economic context. Some of the "blame" may well lie at the feet of suppliers who perhaps could have invested more in tooling up. But those with long memories will recall tooling up at Airbus-Boeing insistence, only to see rate rises reversed. Today, it is understandable that reticence might rule.

For much longer than any normal business cycle and despite the interruption of the most savage economic downturn since the Great Depression, aviation has been growing at a rapid and steady rate in both mature and new markets while expanding its headcount and piling on capital assets. But outside of aviation, the real world has shown signs of economic and geopolitical distress for several years.

In the closing weeks of 2018 that became impossible to ignore, with stock markets wobbling, oil prices slumping, the USA slowing down and China cooling rapidly. Aviation is not immune to these pressures. Although further narrowbody rate rises are planned, the industry would do well to exercise caution. ■

See Feature P23

Flying high and feeling fine?

When was the last time you got off a flight feeling really good? Not "good" by the standards of just having got off a flight – but "good" as in sharp-alert-rested-healthy good?

We may walk and stretch a bit on board, and drink plenty of water. We may travel in first or business. But there's no getting around the basic fact that even a short flight is, health-wise, a negative to be minimised.

So consider those who work on the aircraft. Recent research has revealed that flight attendants suffer, compared to the general population, from shocking rates of fatigue, depression, anxiety, sleep disorders and cancers. They are heavily exposed to radiation and ozone, to poor air quality and even to pesticides and

toxins from cabin cleaning – not to mention noise, a gruelling work routine and verbal and sexual harassment from colleagues and customers.

Aircraft and cabin equipment makers are working to reduce some of these factors and, as employers, some airlines are better than others. But there is no escaping the fact that an aircraft cabin is by nature a difficult workplace and airlines are under extreme financial pressure to minimise costs and squeeze every drop of productivity out of their employees.

At the very least, as passengers let us all spare a kind word and a smile for the cabin crew – if only for selfish reasons: our lives may depend on their good health. ■

See Feature P31



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BRIEFING

SWEDEN SAFEGUARDS GRIPEN OPERATIONS

CONTRACT Sweden has dropped a plan to reuse some parts from its air force's in-service fleet of Saab Gripen C/Ds during the production of 60 new-generation Gripen Es. The nation's Defence Materiel Administration has awarded Saab around SKr430 million (\$47.5 million) to produce new components, while some equipment will also be sourced from retired Gripen A/Bs. "This approach secures the availability of the Swedish Gripen C/D fleet in operational service," says Saab.

KOREAN A220 HIT BY ENGINE FAILURE

SAFETY Investigations are under way after an Airbus A220-300 (HL8314) operated by Korean Air suffered an in-flight failure of its left-hand Pratt & Whitney PW1500G engine on 27 December. The jet, which had 64 passengers on board, was en route to Nagoya, Japan when the incident occurred, and subsequently returned to Busan, South Korea.

TH-119 TRAINER MAKES FLIGHT DEBUT

ROTORCRAFT Leonardo Helicopters on 20 December performed the first flight of its TH-119 candidate to replace the US Navy's fleet of Bell TH-57 Sea Ranger trainers. Based on the single-engined AW119, the rotorcraft made its debut from the company's Philadelphia production site. Airbus Helicopters' H135 and the Bell 407GX are also likely to be contenders for the navy's 125-aircraft contract.

QATAR TAKES 5% STAKE IN CHINA SOUTHERN

AIRLINES Middle Eastern carrier Qatar Airways has taken a 5% shareholding in China Southern Airlines. The Chinese operator has disclosed that the 5% stake comprises around 3.5% of "A" shares and 1.5% of "H" shares. The airline already holds stakes in Air Italy, Cathay Pacific, IAG and LATAM.

INITIAL SEARCH FOR LION AIR CVR ENDS

INVESTIGATION Lion Air has ended its search for the cockpit-voice recorder (CVR) of its crashed Boeing 737 Max 8. The search finished on 29 December, Lion Air Group told news agency Reuters. It has not specified the reason for the decision. Reuters says Indonesia's National Transportation Safety Committee is likely to conduct its own search for the CVR, using ships from the country's navy. The 737-8's flight-data recorder was retrieved on 2 November, days after the 29 October crash.

UKRAINE PLEDGES MH17 PROSECUTION SUPPORT

LEGAL Ukraine's government has committed to financial support for the prosecution of perpetrators behind the destruction of Malaysia Airlines flight MH17. The Boeing 777-200ER was brought down by a surface-to-air missile over eastern Ukraine in July 2014. The country's cabinet of ministers has approved a memorandum of understanding with the other four nations participating in the investigation – Australia, Belgium, Malaysia and the Netherlands – covering the financial assistance.

AVATION ADDS EIGHT ATR 72-600S TO BACKLOG

LEASING Singapore-based lessor Avation has exercised options for eight ATR 72-600s, scheduled for delivery between 2020 and 2022. It has also maintained purchase rights and price protection over a further 25 of the turboprops out to December 2025.



New York-based carrier has so far only received A321ceo aircraft

FLEET GHIM-LAY YEO WASHINGTON DC

JetBlue takes long view over A321LR

Airline preparing decision on conversion of existing order for Neos to extended-range Airbus narrowbody variant

JetBlue Airways will make a decision later this year on whether to take the Airbus A321LR, almost 36 months after it took up the option of converting some orders to the long-range variant.

In a New Year's message to JetBlue employees, chief executive Robin Hayes says: "In 2019, we will announce our decision on the long-range version of the A321. This aircraft could open up new and exciting markets for us."

However, the airline stresses that it has not yet committed to the LR variant, or to adding Europe to its network.

JetBlue added the option of conversion to the A321LR in July 2016, when it announced an order for 30 additional A321s, split evenly between the Neo and Ceo variants. The deal includes the option of switching its 85 commitments for the A321neo to the A321LR, beginning in 2019.

JetBlue conducted an extensive fleet review in 2017 and 2018, but made no decision on the long-range model.

The New York-based carrier has repeatedly flirted with the idea of launching transatlantic services from its key cities of Bos-

ton and New York, citing the market's high-fare environment. London is the largest destination from Boston that JetBlue currently does not serve, it says.

JetBlue will take delivery of its first A321neo this year, with a further 12 examples due in 2019, according to its fleet plan. In 2020, it will add another 15 A321neos, as well as its first five A220s.

The arrival of the latter type is now more clear cut, following the carrier's firming of a provisional commitment for 60 A220-300s placed in July 2018.

In addition, the order backlog for the A220 has received a further boost with the move by a US start-up carrier created by JetBlue founder David Neeleman to firm a tentative July deal for 60 -300s.

Airbus says that the A220s for the new airline – "codenamed Moxy" – will be built in the USA, at a planned assembly line in Mobile, Alabama. Construction of that facility will begin later this month, adds the airframer; it will supplement the current A220 line in Mirabel, Canada. ■

Additional reporting by Michael Gubisch in London



Air Tanzania brings A220 into Africa
This Week P8

CAPABILITY CRAIG HOYLE LONDON & GREG WALDRON SINGAPORE

Russian transports gathering pace

A trio of Ilyushin-designed military transport programmes made significant advances as 2018 came to an end, with the types on course to provide a new-generation capability for the Russian air force.

In late December, United Aircraft's (UAC) improved Il-78M-90A tanker commenced factory flight testing with a debut sortie that was conducted from the Aviastar SP production site in Ulyanovsk.

Key changes implemented with the updated model include a new wing providing an increased fuel capacity and Perm PS-90A-76 engines, in common with the -90A version of the Il-76 transport.

In addition to delivering improved fuel efficiency, these also will reduce the tanker's take-off distance, despite an increase in maximum take-off weight.

The aircraft also has new navigation systems that will enable it to be operated in international airspace in accordance with civilian requirements.

Besides its enhanced tanker performance, UAC notes that the new model can be reconfigured for use as a transport, by removing its additional onboard fuel tanks.

Following the completion of the current flight-test phase, the Il-78M-90A will be transferred for state trials from Zhukovsky airfield, near Moscow.

Russia has previously outlined an intention to acquire 31 of the new-generation tankers. Flight Fleets Analyzer shows its air force currently uses 20 Il-78s, aged between 27 and 33 years.

Meanwhile, the Russian air force has taken delivery of an upgraded Beriev A-50U airborne early warning and control system aircraft as part of a broader fleet upgrade.

UAC parent Rostec says system enhancements made by Beriev and Vega Radio Engineering enable the platform to "track more targets and guide more fighters", with its radar able to detect "completely new aircraft".

Modifications include new onboard computers and improved operator displays, plus satellite communications and updated navigation equipment, while endurance has also been increased.

Fleets Analyzer records the Russian air force as having 15 Il-76-based A-50s in service, with an average age of 30 years. UAC declines to reveal how many of these are being upgraded to the new standard.

Finally, an initial prototype of the Il-112V twin-turboprop has commenced taxi trials at the VASO manufacturing plant in Voronezh. Powered by Klimov TV7-117ST engines, the type had previously been scheduled to fly for the first time before the end of 2018. ■



Fleet-wide avionics update will extend use of variable-geometry type

PROGRAMME CRAIG HOYLE LONDON

Upgraded bomber advances to target

UAC says initial example of modernised strategic bomber fulfilled expectations following December maiden sortie

Russia's first modernised Tupolev Tu-22M3M strategic bomber got airborne for the first time on 28 December, completing a 37min sortie from the Kazan Aviation Plant.

United Aircraft (UAC) says the type underwent tests of its updated systems and equipment during the flight, and reached an altitude of 16,400ft. The test asset – which had been rolled out in Kazan last August, after undergoing modification – performed as expected, according to company test pilots.

Extensive updates made to the variable-geometry type included replacing 80% of its avionics

equipment with digital systems, including navigation, communication, targeting and electronic warfare systems, plus new engine and fuel controls. The activity also boosts commonality with Russia's modernised Tu-160M bomber programme, by using some of the same systems.

UAC says the results of joint tests with the lead aircraft will be analysed before work commences on updating a first batch of operational Tu-22Ms for the Russian air force. Flight Fleets Analyzer shows that the service has an active inventory of 67 of the type, the oldest of which entered use 34 years ago. ■



DEVELOPMENT

Third C919 joins flight-test campaign

A third prototype of the Comac C919 performed a debut flight from the company's factory adjacent to Shanghai Pudong International airport on 28 December. The manufacturer says that a total of 31 test points were covered during the sortie, which lasted 1h 38min. Bearing the registration B-001D, the aircraft will now join the programme's two earlier prototypes in Xian province, with its focus to be on testing the narrowbody's flutter, airspeed calibration, loading, stability, and general performance characteristics. Comac has also announced that its first prototype, B-001A, is poised to commence airborne flutter testing, following the completion of ground checks.



SUPPLY CHAIN

GHIM-LAY YEO WASHINGTON DC

Spirit sets prices with Boeing for long-term work

Spirit AeroSystems has reached an agreement with Boeing that includes long-term pricing for additional aircraft programmes, and the release of claims from both sides in relation to the 737 manufacturing delays in 2018.

The pact includes pricing terms for the 737NG, 737 Max, 767, 777 Freighters, 777-9 and 787 programmes “well into the next decade”, says Spirit. These include 737 figures based on production rates above and below current levels, as well as investments for tooling and capital for certain 737 rate increases, it adds.

Both sides have also committed to joint cost-reduction programmes for the 787 and developmental 777X. Previous agreements between the pair concerned cost-cutting efforts for the 737, and pricing for the 747 and 777.

The pact also includes the “release of liability and claims asserted by both companies related to Boeing 737 disruption activity and other matters”, says Spirit.

Boeing struggled to meet a target of 52 aircraft per month for much of 2018 due to supply chain issues, including delays to the delivery of Spirit-built fuselages.

Boeing in 2019 plans to further hike the production rate on the 737 to 57 aircraft monthly.

Spirit has also secured Boeing’s support for its acquisition of SRIF, parent of Belgian aerostructures firm Asco Industries. ■



Airline says adjustments to capacity and an overhauled route portfolio will help improve profitability

OUTLOOK GRAHAM DUNN LONDON

Norwegian outlines progress towards new financial health

Carrier points to cost-reduction initiatives, as it dismisses doubts surrounding its liquidity

Low-cost carrier Norwegian is confident that it will put in a strong 2019 performance, defying the views of a bank analyst who has said the airline could need to raise capital as it risks breaching banking covenants.

Norwegian has dismissed the comments from a Danske Bank analyst as speculation, but in a year-end update to the financial markets, the carrier describes areas of progress in its business overhaul, and highlights a liquidity gain received from the refinancing of one Boeing 787.

The statement includes an update on disruption to long-haul operations from the grounding of its 787s while their Rolls-Royce Trent 1000 engines are inspected.

Norwegian incurred more than Nkr1 billion (\$120 million) in

costs from compensating passengers during the third quarter.

“The company has now reached an agreement with Rolls-Royce which will have a positive effect from the first quarter of 2019,” it says, noting the commercial terms remain confidential.

It adds it has launched an “extensive cost-saving programme”, called Focus2019, which is aiming for savings of at least Nkr2 billion in 2019. “Six weeks into the programme, we have already identified significant savings,” says the airline.

Further cost reductions are being sourced from an overhaul of its route network. “To meet the competitive environment in a period with seasonally lower demand in Europe, the company has made several changes to its route

portfolio and adjusted its capacity. These measures should improve the financial performance from the start of 2019,” it says.

Norwegian states that financing for all aircraft deliveries for the first half of 2019 has been secured. “This also includes refinancing of one of the delivered [787s], resulting in a positive liquidity effect of Nkr275 million in December 2018,” it says.

“The process of divesting aircraft continues, and we experience significant interest in our existing fleet as well as future deliveries,” it adds.

At the nine-month stage Norwegian remained loss-making at an operating level, although sharply improved on the previous year’s levels. The airline had also returned to net profit. ■



DELIVERY

Air Tanzania brings A220 into Africa

Air Tanzania has taken delivery of its first Airbus A220, becoming the initial African operator to receive the twinjet type. The airline received the jet during a handover ceremony at the Mirabel assembly line in Montreal in late December. Air Tanzania becomes the fifth operator of the A220 behind Air Baltic, Delta Air Lines, Korean Air and Swiss. Tanzanian government flight agency acting chief Tito Kasambala says the aircraft has “remarkable performance and economics” and will be an “excellent asset” for the flag carrier.



Birdstrike
highlights startle
effect risk
Air Transport P10

ANALYSIS PAUL HAYES, DAVID KAMINSKI-MORROW & DAVID LEARMOUNT LONDON

Putting 2018's accident rate in context

Although headline figure indicates worse year for commercial air transport safety, data remains within improving trend

Preliminary analysis of the commercial air transport industry's 2018 safety performance reveals that last year was the worst since the middle of the decade, but is nonetheless in line with an overall improvement seen over the past 10 years.

Pinpointing the exact number of passenger and crew fatalities over the past 12 months depends on what operations or aircraft types are included. However, three studies released at the start of 2019 indicate a range of 515-543 deaths over the period, significantly worse than the historic lows recorded in 2017.

At the lower end of the range, analysis by Flight Ascend Consultancy shows 515 fatalities in 10 airline accidents in 2018. However, those figures are for commercially operated jet- or turboprop-powered airliners or commuter aircraft carrying more than 14 passengers or their cargo equivalent.

Data from the European Aviation Safety Agency (EASA), meanwhile, indicates 530 deaths in 11 fatal accidents. EASA's analysis includes the August loss of a Junkers Ju 52 during a tourism flight in which 20 people died, but appears to omit a Let L-410 accident in South Sudan in September, with 20 fatalities.

Finally, *Flight International's* annual safety review, which will be published in our 15-21 January edition, details 14 fatal accidents – six of which involved large passenger jets – in which 543 people were killed. Our figures are slightly higher due to the inclusion of all commercial flights, no matter how small the aircraft involved.

Nonetheless, taking a median average of 530, 2018's figures are still significantly worse than 2017, in which, depending on the analysis, 39-56 passengers and crew died in nine to 12 accidents.

But, as Ascend safety consultant Paul Hayes notes, while 2018's death toll is worse than the current decade's average of



February loss of a Saratov Airlines-operated An-148 near Moscow resulted in the death of 71 people

about 400 per annum, it is well below the previous decade's average of nearly 800.

With so few accidents but the potential for a large number of fatalities in a single one, it does not make sense to try to draw conclusions – positive or negative – from a single year, argues Hayes.

"We should never be complacent with safety and our efforts devoted to protecting passengers"

European Aviation Safety Agency

The long-term trend is still for ever-improving safety. Nowadays, some nine or 10 fatal accidents might be expected each year worldwide, and the number of fatal accidents in 2018 is in line with this trend. Unfortunately, unlike in 2017, some of the accidents in 2018 resulted in a high loss of life, Hayes notes.

Three accidents involving jet-powered aircraft – Lion Air's loss of a Boeing 737 Max 8 in late October (189 fatalities), the take-off crash of a Global Air 737-200 in Cuba (109) and the February loss of a Saratov Airlines-operated

Antonov An-148 (71) – account for a total of 369 of last year's deaths. Two serious turboprop crashes add another 117 fatalities.

WIDER TREND

Putting the number of accidents within the context of total flights undertaken serves to further illustrate the improved safety record of the industry. Preliminary figures show the overall fatal accident rate in 2018 as one per 4.55 million flights, Hayes writes.

On this basis, 2018 was the third-safest year ever – only surpassed in 2015, when there were eight fatal accidents, giving a fatal accident rate that year of one per 4.9 million flights, and in 2017, when the fatal accident rate was one per 4.83 million flights.

However, from a passenger perspective, 2018 was only the fifth-safest year, as there was a lower passenger fatality rate in four of the past five years. Using a figure of 482 revenue passenger fatalities in 2018, the accident rate worsened to one passenger fatality per 9.7 million carried. This was worse than the five-year average passenger fatality rate of one per 15 million passengers carried and the long-term trend, currently one per 18 million passengers carried.

On average, from the point of

view of passengers, these statistics suggest that the airline industry as a whole is now about three times safer than it was as recently as 10 years ago, and 10 times safer than 20 years ago.

EASA says the incidents and accidents during 2018 are a "reminder that safety should not be taken for granted", particularly given the encouraging improvement that was recorded in the previous year.

"We should never be complacent with safety and remain persistent in our efforts devoted to protecting passengers and citizens," says the agency.

EASA states that the number of fatalities last year remains "significantly below" levels recorded even in the 1990s and 2000s, attributing this partly to technological advances and the implementation of safety management systems.

But it adds that runway excursions, in-flight upset, and technical failures involving fire or pressurisation remain "key risk areas".

Among the serious accidents that did not result in fatalities were the destruction of an Aeromexico Embraer 190 at Durango in July and the overrun of a Utair 737-800 at Sochi in September. ■

See Feature next week



INQUIRY DAVID KAMINSKI-MORROW LONDON

Birdstrike highlights startle effect risk

Ryanair captain's reaction to hazard shortly before Rome Ciampino landing underlines danger in instinctive responses

The consequences of the startle effect have been highlighted by Italian investigators in their probe into a Ryanair Boeing 737-800 landing accident at Rome Ciampino airport, after the jet flew through a dense flock of birds on final approach.

It states that the aircraft's captain saw the flock moments before touchdown, as the jet descended below 140ft at a distance of just 300m (984ft) from Ciampino's runway 15.

Italian investigation authority ANSV says that go-around thrust was commanded, but the crew retracted the flaps to their 10° setting rather than the 15° required for a go-around.

The aircraft flew through the flock, suffering a serious birdstrike that involved nearly 90 impacts, resulting in a loss of power in both engines just 100m from the runway threshold.

It briefly climbed from 112ft to 173ft but failed to gain altitude and started to descend. The jet's nose-up attitude and loss of airspeed generated a stick-shaker warning at 21ft, and the aircraft struck the ground in a stall condition.



737-800 sustained nearly 90 impacts from flock during 2008 event

The flaps were still retracting and had reached 12.1° at the time of impact, registered at 2.66g.

ANSV says the aircraft stopped 50m from the threshold of the opposite-direction runway 33, having sustained serious damage to its left-hand main landing-gear, and there was evidence of damage to the aft fuselage and left engine, caused by ground contact.

While the inquiry's findings have been newly published, the accident occurred more than a decade ago, on 10 November 2008.

At the time, says ANSV, there were no guidelines for managing and mitigating the startle effect – the instinctive reaction to sudden and unexpected events.

This effect influenced the Ryanair crew's actions, notably the decision to try a go-around when – given that the jet was 7s from touchdown – proceeding with the landing was likely to have been the safer option.

ANSV points out that, during approach at low thrust settings, the engine core is less susceptible

to birdstrike damage, while commanding full thrust could increase the risk of damage and loss of power at a critical stage.

The inquiry also believes the startle effect explains the instinctive decision to retract the flaps to 10°, an action that overcame the detent in the 15° position intended to prevent retraction beyond the go-around setting.

"From the statement made by the captain, the selection was not voluntary nor was there any awareness of the flaps selection error," says ANSV. "This action is indicative of a reaction to an unexpected situation."

The inquiry says the crew had not been given sufficient instruction concerning the most suitable procedures to adopt in the event of a birdstrike during the landing phase, and there was an absence of specific training to cope with the startle effect.

But ANSV notes that Boeing then introduced recommended birdstrike techniques into the 737 crew training manual, while Ryanair developed specific training for bird encounters and strikes during take-off and landing. ■

INCIDENT DAVID KAMINSKI-MORROW LONDON

C-check fault behind Qeshm Air gear-up landing

Iranian investigators have determined that poor maintenance procedures, allowing contamination of hydraulic lines, led to a gear-up landing by a Qeshm Air Fokker 100 (EP-FQF) in early 2018.

The aircraft had departed Tehran Mehrabad for Mashhad on 16 February but some 10nm (18km) from touchdown, its crew discovered problems with the left-hand main landing-gear.

They executed a missed approach, says Iran's Civil Aviation Organization, and entered a holding pattern while attempting to resolve the problem.

Several attempts to recycle the undercarriage were not successful, says the inquiry, and neither was an effort to use the alternate landing-gear deployment procedure.

A low pass over the airport allowed ground personnel to observe that the left-hand gear was only partly extended, and high-load manoeuvring failed to free it.

The crew declared an emergency and, having remained in the hold to burn fuel, conducted an approach to Mashhad's runway 31R.

As it landed, the aircraft veered off the left side of 31R, coming to rest between the paral-

lel runways, suffering left wing structure and flap damage from ground contact. The landing-gear was also damaged.

Occupants were evacuated from the aircraft. None of the 97 passengers or seven crew members was injured, the inquiry says.

Examination of the hydraulic system has concluded that "foreign pollution" entered while C-check maintenance was being carried out on a restrictor valve and hose from the left-hand landing-gear actuator.

A filter near the valve was damaged, it says, and enabled

contaminants to block a downstream nozzle, affecting the landing-gear mechanism.

Investigators say that "insufficient surveillance" of the maintenance operation and a "lack" of experience from Qeshm Air maintenance personnel contributed to the situation.

Qeshm Air had "recently" been authorised by the Iranian authorities to perform C-check work, which had previously been conducted by Iran Aseman Airlines at Mashhad. Qeshm carried out the C-check at the facility of maintenance firm Farsco. ■



Low-cost
FlyArystan to be
mane event
Air Transport P12

PROPULSION MICHAEL GUBISCH LONDON

A319neo achieves certification with Leap engine, as PW1100G follows

Airbus has received type certification for the CFM International Leap-1A-powered version of the A319neo.

The airframer says that the European Aviation Safety Agency and US Federal Aviation Administration issued the joint approval after more than 500h of flight testing since the twinjet's first sortie in March 2017.

While both the A320neo and A321neo received their initial type certifications with the alternative Pratt & Whitney PW1100G geared turbofan – with subsequent approvals for the Leap-powered versions – Airbus opted to first concentrate on the Leap for the A319neo.

Flight Fleets Analyzer shows that Airbus has orders for 53 A319neos.



Three operators have selected CFM powerplant for new narrowbody

A total of 17 aircraft have been selected with Leap engines – 12 for Avianca, four for an unconfirmed Chinese operator, and a single ACJ319neo VIP jet – while no engine selection has been announced for the other 36, which include eight for Avianca.

Airbus is targeting certification for the PW1100G-powered variant by the end of 2019. The manufacturer says the test campaign will be conducted with the same aircraft, MSN6464, that was used to gain approval for the A319neo with the Leap-1A engines. ■

DEVELOPMENT
MAVIS TOH SINGAPORE

Comac builds all-composite fuselage first

China has produced the first forward fuselage prototype section for the in-development CRAIC CR929 widebody, marking the first time an all-composite construction has been employed by the nation's aerospace industry.

The 15m (49ft)-long structure, with a 6m diameter, will provide important technical support for the preliminary design of the composite structure of the CR929, says Comac, a partner with United Aircraft in the CRAIC joint venture.

China is responsible for fuselage production on the Sino-Russian widebody, as well as final assembly. The aircraft's composite wing, empennage and tail section will be built in Russia.

The target is to deliver the 280-seat aircraft in 2025. ■

MILESTONE ELLIS TAYLOR PERTH

Mitsubishi accelerates efforts on MRJ

Japan Civil Aviation Bureau authorisation clears path for regional jet programme towards type approval test phase

Mitsubishi Aircraft has passed a major milestone that should allow it to commence certification flight testing for the MRJ90 regional jet in 2019, while work on the design of the smaller MRJ70 is progressing.

The manufacturer has received type inspection authorisation from the Japan Civil Aviation Bureau (JCAB), which will allow it to kick off certification flight testing in early 2019.

"Throughout our programme we have worked closely with the JCAB to develop a set of processes, procedures and expectations that will take us to the type certification of our MRJ90," says Mitsubishi Aircraft president Hisakazu Mizutani. "It has been a long, but necessary journey for the development of our MRJ programme and the commercial aviation industry in Japan."

Most of the certification testing will be conducted from Mitsubishi Aircraft's base at Moses Lake in the USA, where it has based four MRJ90s for flight testing.

Andrew Telesca, head of Mitsubishi's certification management office, adds that the manufacturer is undergoing a safety review with the US Federal Aviation Administration to support the granting of a letter of authorisation ahead of flight testing.

The MRJ programme has experienced several delays, with the latest, revealed in 2017, to accommodate a redesign of parts of the avionics bay and the rerouting of some electrical wiring harnesses. That pushed projected entry-into-service to 2020, almost six years later than originally planned.

Mizutani has also signalled that progress is being made on the development of the smaller



Launch customer ANA is now expecting entry into service in 2020

MRJ70, with a concept study under way.

"In view of the fact that 10 years have passed since the MRJ90 development started, we are considering how we can incorporate the new technologies and the changes of customers' needs but keeping the basis with MRJ90, in order to enhance the productivity of MRJ," he says.

While there are no firm commitments for the MRJ70, the smaller variant could make inroads into the US market, as it is expected to comply with pilot scope-clause requirements.

Mitsubishi Aircraft has previously indicated that it plans to achieve type certification for the MRJ70 around 12-18 months after the larger variant. ■



STRATEGY OLIVER CLARK ASTANA

Low-cost FlyArystan to be mane event

Air Astana spin-off will help flag carrier to confront growing challenge from budget domestic and international rivals

The formation of Air Astana 16 years ago – via an alliance of Kazakhstan's government and BAE Systems – was aided by what now looks like fortunate timing, particularly the collapse of rival Air Kazakhstan under a mountain of debt.

Air Astana seized the opportunity to be designated as national airline – and was thus able not only to pick up Air Kazakhstan's traffic rights but also to take over its dominant positions at the key cities of Almaty and capital Astana.

Since then, Air Astana has become recognised as one of the region's principal carriers, with a network stretching to Europe and across Asia. But now the airline's dominance is being challenged by new domestic and international rivals.

In response, it is launching a new low-cost arm, FlyArystan, named after the Kazakh word for lion. FlyArystan is scheduled to begin operations in May 2019 with a fleet of four Airbus A320s provided by the parent airline.

"A lot of the reason we went for the low-cost [carrier] is that we realised that Kazakhstan had been a bit of low-cost-free zone, really, for the last 16 years that we have been operating – but that was never going to remain so," Air Astana chief executive Peter Foster said during a media briefing in Astana last month.

Foster says that since the deregulation of fares in 2014, three new domestic carriers have emerged in Kazakhstan: Bek Air, Qazaq Air and SCAT Airlines.

JOINING IN

Elsewhere, Foster says new entrants from abroad have begun to make their presence felt, including Wizz Air, with its new service from Budapest, and Air Arabia, which operates to Astana from Sharjah. Other budget carriers based in the Gulf states also pose competitive threats to Kazakhstan's flag carrier.



Initial fleet will comprise four 180-seat A320s drawn from parent operator's narrowbody inventory

Full-service carriers that try to fight off budget operators by starting their own are often accused of failing to embed a true low-cost carrier ethos.

Foster acknowledges "many examples" of full-service operators that have undermined their low-cost arms when they "interfered" in their management.

To avoid this, Air Astana has taken the "strategic and management decision" to allow FlyArystan to develop "in isolation", he says.

He indicates that allowing FlyArystan its independent mindset implies an acceptance that there will be a certain level of "cannibalisation" of Air Astana's own traffic.

The new unit is being developed by an outsider: Tim Jordan, a veteran of the low-cost business model, having worked previously at Cebu Pacific Air and Virgin Australia's predecessor, Virgin Blue.

While he says he cannot talk too much about the plans for the new carrier, citing confidentiality, Foster does disclose that within two years FlyArystan will have four bases in Kazakhstan, one of which will be in the south, one in the west, and the other

two "in and around where we live and where we sit" – in reference to Astana and Almaty.

From these bases the airline will operate a "very extensive" domestic network, he says.

Foster says FlyArystan will thereby be able to employ a "classic" low-cost model of operating from multiple bases, from which flights are conducted early, at high frequency, and with quick turnarounds.

INVESTOR SUPPORT

Foster says that all of the major institutional stakeholders involved in Air Astana – including the government, which owns a 51% stake – are "completely on side" with the launch.

But the "big challenge" Foster identifies is the willingness of the country's airports to support the new venture, particularly on turnaround times.

For FlyArystan to be successful, Foster says it must be able to achieve aircraft preparation times of 30-40min; otherwise, the venture will be a "failure".

Foster says initial discussions are now taking place with the country's airports towards driving closer co-operation.

The philosophy behind the FlyArystan product offering will be to provide "very basic things for free" but charge for everything else. Thus, water and overhead cabin bag allowances will be free, while fees will apply to food and check-in luggage.

A key issue for Air Astana is that under Kazakh law, airlines are not able to charge for baggage up to 20kg (44lb) in weight. Foster expects this law to be amended imminently to allow the airline to charge for bags. Richard Ledger, vice-president marketing and sales, foresees the change will come in January 2019.

Ledger says FlyArystan's four A320s will be equipped with 180 seats in an all-economy configuration.

He says the airline has not yet decided whether to retain the current in-flight entertainment system – which is delivered via tablet and app – when the aircraft are redeployed to the low-cost unit. If they are retained, it would be "very hard" to charge for their use, Foster says.

"It's going to be complicated enough, frankly, selling coffee and sandwiches; trying to sell TV series is going to be hard," he says. ■



Civil focus
powering
General Atomics
Defence P14

LEGAL JON HEMMERDINGER BOSTON

AeroTEC counters Bombardier's MRJ confidentiality suit

US technical specialist denies allegations of theft relating to flight-test and approval process on competing regional jets

AeroTEC, the US company supporting the flight-test campaign of the Mitsubishi Aircraft MRJ, has fired back at Bombardier in a US federal court, denying accusations it acquired and took advantage of confidential documents related to certification of the CSeries, now known as the Airbus A220.

The Seattle-based company has asked a federal judge to throw out a request by Bombardier that would prohibit several AeroTEC staff members from working on the MRJ certification effort.

"There is no threat of irreparable harm to Bombardier and it has little chance of prevailing" with its lawsuit, AeroTEC said in a late December court filing.

Bombardier "attempts to portray the handful of documents as centrally critical to the certification of the MRJ by mis-casting innocent events in a sinister light", AeroTEC adds. "The documents have not been, and will not be, used by the AeroTEC defendants."

AeroTEC's filing is a response to the Canadian manufacturer's 19 October lawsuit against Mitsubishi Aircraft, Mitsubishi Aircraft Corporation America, AeroTEC and several former Bombardier employees now working at those companies.

Bombardier alleges that, prior to leaving for jobs at AeroTEC and Mitsubishi Aircraft, its former employees stole confidential CSeries flight-test and certification documents by emailing them to personal addresses.

Those documents allegedly included CSeries certification reports related to air speed, static pressure and air temperature systems – information "invaluable to anyone involved in an effort to certify aircraft for entry into service", Bombardier claims.

Bombardier is requesting unspecified damages and the wrongful profits from the named companies. But AeroTEC insists the staffers emailed the CSeries documents to themselves for the purpose of working at home for the

benefit of Bombardier during their last few days with the airframer.

"They never intended to take or misuse any confidential information, and merely had the unfortunate timing to be working on things from home in their last months and days at Bombardier," says AeroTEC.

POACHED WORKERS

Bombardier's lawsuit also alleges that AeroTEC's director of test and evaluation Michel Korwin-Szymanowski, who formerly headed the CSeries flight-test team, poached the workers from Bombardier and knew of the stolen documents.

Korwin-Szymanowski denies this. "I have never seen or been given access to any of the documents Bombardier has identified as trade secrets," he says in a separate 27 December filing. "Bombardier's suggestion that AeroTEC or I solicited any employee with the intent they would disclose or use their former employer's confidential... information is absurd."

Mitsubishi Aircraft Corporation America had earlier filed a motion to dismiss the lawsuit, arguing that Bombardier has failed to substantiate a number of the claims.

It categorically denies that it ever sought or misappropriated trade secrets from the former and current employees of the Canadian manufacturer.

"Regardless, these materials would not be useful or applicable to our programme, which relies on a unique certification process distinct from that employed for any Bombardier aircraft programme," it adds.

Mitsubishi's filing also states that for two years Bombardier had tried to pressure it and AeroTEC into signing "what would have amounted to illegal non-poaching agreements."

It also states that it was only after the two defendants refused to sign such an agreement that it "filed this 'trade secret' lawsuit."

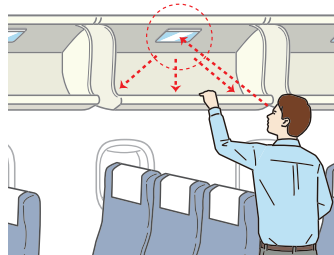
The motion to dismiss the suit is set to be heard in the US District Court in Seattle on 11 January. ■



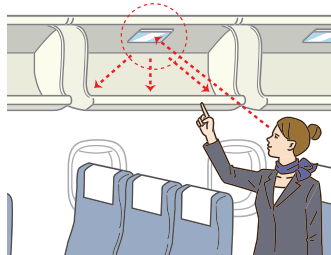
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UNMANNED SYSTEMS GARRETT REIM YUMA

Civil focus powering General Atomics

Manufacturer sees airspace integration as key to competitive edge following successful transatlantic demonstration

General Atomics Aeronautical Systems' Predator/Reaper series is best known as a counter-terrorism asset, so it might raise a few eyebrows when the manufacturer describes its current highest priority as certifying the unmanned air vehicle (UAV) with the US Federal Aviation Administration to fly in civilian airspace.

In fact, a civil-certifiable version of the Predator B – called the MQ-9B SkyGuardian – is the practical next step in the evolution of UAVs, according to General Atomics. Because UAVs currently have to be flown in segregated airspace, away from commercial and private air traffic, their utility is mostly restricted to combat zones, such as Afghanistan, Iraq and Syria. Securing FAA certification would allow militaries to more easily fly their unmanned aircraft on missions within national airspace, and could eventually lead to increased civilian uses for the technology, the firm believes.

"The future of unmanned aircraft is to be able some day to file [a flightplan] and fly," says Dave Alexander, General Atomics' president of aircraft systems. "If we don't do this, somebody else will, and we'll just fade away and be just a counter-terrorism, combat-zone machine."

FIRST MOVER

General Atomics is aiming to become the first company to secure civil certification for a medium-altitude, long-endurance UAV. To that end, it is investing heavily in the programme, having spent \$300 million since 2013, and is expecting to invest \$400-450 million in total.

The strategy is already bearing fruit, with the UK Royal Air Force having ordered 14 examples, to be named Protector RG1s. Potential missions include joint operations with its incoming Boeing P-8A Poseidons and other



Company is testing its SkyGuardian evolution from Arizona facility

anti-submarine warfare aircraft, as well as flying homeland security, coastal patrol and police support missions.

"We would not have the Protector programme for the UK without this airplane, because they cannot bring the standard MQ-9 or any other [unmanned] airplane into their airspace," says Alexander.

"The future of unmanned aircraft is to be able some day to file [a flightplan] and fly"

Dave Alexander

President of aircraft systems, General Atomics Aeronautical Systems

The other advantage of certification is that it will allow militaries to fly their UAVs across other countries' airspace, making it easier for aircraft to take the shortest route to a battle zone. Such a capability was at the core of Belgium's decision to begin negotiations in October 2018 to acquire the SkyGuardian, says Chris Dusseault, General Atomics' Protector programme senior director, who notes that the nation does not have the airlift ca-

pability to quickly move a UAV and ground control system thousands of miles at short notice.

General Atomics demonstrated such a "self-deploy" concept in July 2018, when a SkyGuardian prototype was flown nonstop from Grand Forks, North Dakota, to RAF Fairford in Gloucestershire, the UK. The flight covered 3,760nm (6,960km), taking a little over 24h.

To facilitate self-deploy missions, General Atomics is also working to automate pre- and post-flight procedures, as well as take-off and landing. The company aims to be able to land the UAV at an airstrip supported by three deployed personnel and a single pallet of equipment. Previously, a shipping container-sized ground control station and crew of six was needed.

VALUABLE ASSET

Such a capability could allow militaries to position ground support equipment at multiple airfields with GPS-surveyed files, providing more options for diversion flights and locations for refuelling and rearming. The SkyGuardian's automatic launch and landing function – scheduled to be ready by "the fall" of 2019 – also increases the MQ-9B's performance envelope

under crosswind conditions.

General Atomics is aiming to secure type certification for the Protector in 2022 from the UK Military Airworthiness Authority, which in November 2018 sent over a book of more than 1,700 requirements for the MQ-9B to match.

"We believe we can meet them all without a redesign, which is our primary objective at this point," says Dusseault. This milestone should be followed by civil approval from the FAA.

As part of the certification effort, the company has segmented the wing and fuselage assembly area at its Poway, California headquarters into two sections: one for certifiable aircraft, and another for legacy US Air Force and US Army UAVs. It has also invested heavily in machinery, including a large riveting robot from Electroimpact. The FAA requires the composite MQ-9B to be fastened together with an "order of magnitude more rivets" than the standard Predator because of a lack of safety data about aircraft held together using adhesives, says General Atomics.

Other features being added in pursuit of civil certification include a wing de-icing system, lightning protection and upgraded avionics.

A military head-up display in the ground control station has also been swapped for Collins Aerospace's Pro Line Fusion avionics system, already used by manned types such as the Beechcraft King Air.

"Pilots are familiar with this," notes Dusseault. "It is proven and it comes with a [FAA] technical standard order. This is the key part that makes this ground station certifiable."

General Atomics has two company-owned SkyGuardian prototypes undergoing flight testing at Laguna Army Airfield in the Yuma Proving Grounds, Arizona. It expects to deliver its first example to the UK in the early 2020s. ■



SB-1 Defiant breaks cover as ground tests near Defence P16

PROGRAMME DOMINIC PERRY LONDON

M-345 prospects receive boost as production standard gets airborne

Leonardo has flown the first production model of its M-345 jet trainer, as it works towards service entry with the Italian air force in 2020.

Performed from the company's site in Venogono Superiore in the north of Italy, the sortie was conducted by test pilots Quirino Bucci and Giacomo Iannelli.

Bucci says the aircraft "performed excellently", with its Williams International FJ44-4M-34 engine showing "exceptional response to power changes".

Launch customer Rome has so far ordered five M-345s from an eventual requirement for 45 examples, as it looks to progressively replace its air force's fleet of 137 Aermacchi MB-339s, including those flown by its Frecce Tricolori aerobatic display team.

Leonardo Aircraft managing director Lucio Valerio Cioffi says the company's M-345 integrated



FJ44-powered trainer will enter Italian air force service during 2020

training system also "has already generated interest among many air forces worldwide".

The Italian air force in July 2018 outlined its plans to establish an international flight train-

ing school at Lecce-Galatina air base by 2021, supported by CAE and Leonardo. This is expected to eventually use a fleet of up to 22 M-346s, and potentially also M-345s. ■

WEAPONS GARRETT REIM LOS ANGELES

LRASM makes delivery splash with B-1B fleet

A first batch of Lockheed Martin long-range anti-ship missiles (LRASM) has been delivered to the US Air Force, with the weapon reaching early operational capability with its Boeing B-1B bomber fleet.

Derived from the extended-range version of Lockheed's AGM-158 Joint Air-to-Surface Standoff Missile, LRASM is designed to detect and destroy specific targets within groups of ships using its sensors, encrypted communications and digital anti-jamming GPS, the company says.

With a range performance of greater than 500nm (925km), the stealthy missile can be armed with a 454kg (1,000lb) penetrating blast/fragmentation warhead. It is also scheduled to achieve early operational capability with the US Navy's Boeing F/A-18E/F Super Hornet fleet during 2019. ■

ROTORCRAFT GREG WALDRON SINGAPORE

Crash probe gives Surions the all-clear

Medium-twin resumes service after South Korean inquiry implicates rotor mast defect in fatal loss of marine variant

The South Korean army has lifted a grounding of the Korea Aerospace Industries (KAI) KUH-1 Surion helicopter which had been imposed following the fatal crash of a variant operated by the nation's marines in July 2018. Seoul's official Yonhap news agency indicates that the type resumed operations on 24 December.

"The resumption came days after a team of civilian, government and military experts cited defects in the rotor mast of the Marine helicopter as the cause of the crash," a Yonhap report states. "Before the resumption, the army conducted detailed inspection of the [Surion's] rotor mast and conducted test flights to ensure it has no operational problems."

Video footage of the 17 July crash showed the rotor mast and rotors completely detaching as the rotorcraft took off. Five marines were killed in the accident and another was injured.

Yonhap states that 30% of the army's 90-strong Surion fleet had undergone inspection prior to the return to service being approved. Flight Fleets Analyzer shows the Republic of Korea Marine Corps as having one operational example, with a further 28 of the medium-twins on order.

Besides the aircraft flown by South Korea's military, Fleets Analyzer shows three as being operated by its National Police Agency, with another employed by its Forestry Aviation Office.



Army has 90 examples, with 30% having already cleared inspection

Separately, KAI recently unveiled its new light armed helicopter, which is being developed as a replacement for South Korean army Bell AH-1 and MD Helicopters MD500 rotorcraft. The

4.9t type – derived from the Airbus Helicopters H155 – is expected to make its flight debut from the company's Sacheon site around mid-2019 and enter service in 2023. ■



PROGRAMME MAX KINGSLEY-JONES LONDON

Improved L-39NG makes flight debut

First pre-production example of Aero Vodochody's next-generation trainer completes maiden sortie in Czech Republic

Aero Vodochody's first pre-production example of the L-39NG jet trainer completed a 22 December maiden flight from the company's Vodochody airport site in the Czech Republic.

Flown by Aero Vodochody test pilots David Jahoda and Vladimír Tovarek, the aircraft underwent several development tests during its 26min debut, and reached an altitude of 5,000ft.

"The L-39NG performed extremely well and fully met our expectations in terms of stability and controllability," says Jahoda. "We could even perform some tests like configuration changes, acceleration up to 200kt [370km/h], turns to 30, 45 and 60° and slow down to approach speed."

The manufacturer says the two-seat trainer was flown in a configuration representative of serial production aircraft, including an upgraded "wet wing" and new engine intakes. The first flight was performed just over two months after a roll-out ceremony conducted on 12 October, with Aero Vodochody expecting to achieve type certification by the end of 2019.

"This pre-series first flight represents a significant milestone, sending an important message to our customers," says Aero Vodochody Aerospace chief executive Giuseppe Giordo. "We can fulfil our commitments and we will be ready to deliver the first aircraft in the first quarter of 2020," he adds.



Aircraft performed 26min debut and reached an altitude of 5,000ft

The L-39NG is powered by a Williams International FJ44-4M turbofan engine, which replaces the Ukrainian-supplied AI-25 used on previous models of the type. Other updates include the use of glass-cockpit avionics, hel-

met-mounted displays and an on-board virtual training system.

Aero Vodochody in April 2018 announced its receipt of a first contract for the L-39NG, with Senegal to acquire four examples in an armed configuration. ■

DEMONSTRATOR GARRETT REIM LOS ANGELES

SB-1 Defiant breaks cover as ground tests near

The Sikorsky-Boeing team working on the SB-1 Defiant helicopter has released its first images of a completed aircraft, shortly after confirming that an

already delayed first flight scheduled had slipped further.

Bearing the registration N100FV, the high-speed rotorcraft is shown on the runway at Sikor-

sky's West Palm Beach factory in Florida, potentially indicating that the team is nearing the start of ground tests.

"The SB-1 Defiant is designed to fly at twice the speed and range of today's conventional helicopters and offers advanced agility and manoeuvrability. It will help inform the next generation of military helicopters as part of the US Army's Future Vertical Lift [FVL] programme," the partners say.

Key design elements include a coaxial main rotor system to provide lift and lateral stability, and a push propeller in the tail to generate forward thrust.

The Sikorsky-Boeing team had intended to fly the SB-1 for the first time before the end of 2018, but in mid-December opted to push this into the first or second quarters of this year. The partners need to accumulate at least 15h of ground testing on an unspecified update made to a powertrain system testbed prior to achieving the milestone.

Also produced as a technology demonstrator in support of the US Army's FVL programme, Bell's rival V-280 Valor tiltrotor last month passed the first anniversary of its flight debut, with the design having already passed 250kt (463km/h) in level flight. ■



High-speed type supports US Army's Future Vertical Lift programme

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MILESTONE KATE SARSFIELD LONDON

First Global 7500 begins 'bright future'

After an eight-year development effort, Bombardier has handed over the initial example of its ultra-long-range flagship

Bombardier's flagship Global 7500 jet has entered service, eight years after launch.

The milestone was marked at a ceremony on 20 December at the airframer's Montreal completion centre, where Bombardier Business Aircraft president David Coleal described the ultra-long-range twin "the gateway to a transformed business aviation landscape and a very bright future".

The Global 7500 – registration C-FXAI, serial number 70006 – is owned by aircraft trading compa-

ny Jetcraft and Stonebriar Commercial Finance. Bombardier says it will operate the aircraft as a demonstrator under a lease-back arrangement with the owners, before it moves on "to another end-user".

Launched in 2010 as the Global 7000, the GE Passport-powered twinjet was rebranded in May 2018 to reflect a 300nm (560km) increase, to 7,700nm, in maximum operating range achieved during flight testing.

The Global 7500 has the longest cabin in the traditional

business jet market, at 16.5m (54ft) and is described by Bombardier as the only aircraft in its segment with "four customisable living areas".

"The world-class, highly skilled team continues the tradition of delivering game-changing large-cabin aircraft in Montreal, much like the original Global Express 20 years ago," says Michel Ouellette, Bombardier senior vice-president, programme management and engineering.

Bombardier has secured more

than 100 orders for the Global 7500 and says production is sold out until 2021. The company forecasts deliveries of between 15 and 20 aircraft in 2019 and 35-40 in 2020.

Customers include former Formula 1 racing driver and Bombardier brand ambassador Niki Lauda, Hong Kong charter and management company HK Bellawings Jet, fractional ownership giant NetJets, and Thomas Flohr, founder of luxury charter provider and long-time Bombardier customer VistaJet. ■

DELIVERY KATE SARSFIELD LONDON

G500 to make overseas arrival in Qatar colours

Qatar Executive has become the international launch customer for the Gulfstream G500, following delivery of two of the super-large-cabin business jets to the VIP charter company on 17 December.

The aircraft (A7-CGP/A7-CGQ) are from a 2014 order from Qatar for 30 Gulfstream business jets, including the larger, longer-range G600 – for which Qatar will also be the international launch customer – and the flagship G650ER.

Qatar increased its order for the G650ER in 2015 and has received five to date. The Doha-based operator plans to add another G650ER and five G500s in 2019.

Akbar Al Baker, chief executive of Qatar Airways Group, says the G500 is "a state-of-the-art aircraft"

that sets "a new industry benchmark and will offer our passengers an unrivalled flying experience".

The G500 secured type certification from the Qatar Civil Aviation Authority in October, three months after the US Federal Aviation Administration granted approval for the 5,200nm (9,620km)-range jet.

The first Pratt & Whitney Canada PW800-powered aircraft was handed over to an unnamed customer on 27 September, and Flight Fleets Analyzer records deliveries of nine G500s to date.

Qatar operates a 15-strong business jet fleet, Fleets Analyzer shows, with the line-up also consisting of three Bombardier Challenger 605s, four Global 5000s, and a Global XRS. ■



Launch operator Cape Air plans to eventually field 100-strong fleet

CERTIFICATION KATE SARSFIELD LONDON

European approval for Traveller

Italian airframer Tecnam has received European type certification for the P2012 Traveller, three years after launching development of its top-end piston-twin.

US approval is imminent, and Tecnam is currently preparing the first examples for delivery to co-developer and launch customer Cape Air in the first quarter.

The US regional airline has signed with Tecnam for 100 of the Lycoming TEO-540-C1A-powered type, comprising 20 orders and 80 options. These will replace its fleet of 88 Cessna 402C piston-twins and four Britten-Norman BN-2 Islanders.

Tecnam believes that – as the first piston-engined aircraft to be certificated in the FAR-23/CS-23 category for decades – the Traveller can replace many of the hun-

dreds of ageing legacy types serving the short-haul transport sector. The aircraft's "superb versatility" will also open up "new, unexplored opportunities" in the cargo, commuter, air ambulance and VIP charter markets, it adds.

Tecnam has orders and options for around 130 Travellers and will launch a demonstration tour in the coming weeks to promote the 950nm (1,750km)-range model.

The €2.35 million (\$2.7 million) Traveller is Tecnam's first dedicated commercial aviation platform. The initial test aircraft made its maiden sortie in July 2016, and a second joined the certification campaign in December 2017. The pair flew a total of 600h before flight testing was wrapped up last October. ■



VIP charter operation placed order for 30 Gulfstream jets in 2014



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Boeing earns its November reign

Seattle's order successes for the month included 40 aircraft to South Korean carrier Jeju Air, while deliveries across commercial sector increased significantly from the previous year

GRAHAM DUNN & ANTOINE FAFARD
LONDON

Boeing was the biggest winner in what was a generally sluggish month for order activity during November 2018, sealing a 40-aircraft commitment from South Korea's Jeju Air for the 737 Max 8. This is the largest ever order from a low-cost carrier based in the country.

In total, Flight Fleets Analyzer records orders for 128 new commercial aircraft in November, along with two cancellations.

Other notable commitments included EasyJet's firming of options on 17 more A320neos, with India's Vistara and SaudiGulf ordering 13 and 10 Neos, respectively.

In the regional space, meanwhile, American Airlines regional unit Envoy Air placed an order for 15 Embraer 175s, and Comac landed a firm commitment from Shanghai Pudong Development Bank Financial Leasing for 15 ARJ21s.

Widebody orders were again thin on the ground: Dubai-based lessor Novus Aviation added three 777-300s, while Turkish Airlines signed for a trio of 777 Freighters.

Commitments for a total of three turbo-props were placed: two Bombardier Q400s for

New orders, November 2018

Jeju Air	737 Max 8	40
EasyJet	A320neo	17
Envoy Air	Embraer 175	15
SPDB Financial Leasing	ARJ21	15
Vistara	A320neo	13
SaudiGulf	A320neo	10
Urumqi Air	ARJ21	5
Novus Aviation	777-300	3
Turkish Airlines	777F	3
Chorus Aviation Capital	Q400	2
Royal Air Maroc Express	ATR 72-600	1
SkyUp	737 Max	1

Source: Flight Fleets Analyzer

Note: Information for known customers only



Cayman Airways received its first 737-8

Chorus Aviation Capital and an additional ATR 72-600 for Royal Air Maroc Express.

At the end of November, the overall order backlog stood at 14,758, down 58 on the previous month.

In all, 184 commercial aircraft were delivered to 91 operators in November, 14% more than during the same month in 2017.

A total of 88 units were shipped to Asian operators, while European and North American carriers took 36 and 31 airliners, respectively. Just over 50% of deliveries, 98 aircraft, went to mainline operators.

The 184 new aircraft shipped in November comprised 129 narrowbodies and 35 widebodies, 11 regional jets and nine turboprops.

In the narrowbody sector, China Southern Airlines took 10 units, including six 737-8s and four A320neo-family aircraft, bringing the carrier close to operating a fleet of 600 jets.

Another Chinese carrier, Capital Airlines, received four A320neos and one A321 during

14%

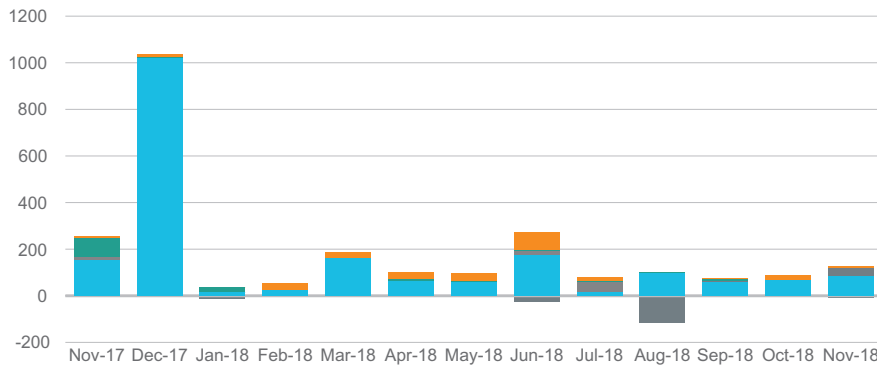
184 commercial aircraft were delivered to 91 operators in November, 14% up from the corresponding month in 2017

the month. Cayman Airways also received its first 737-8, on lease from Air Lease Corp.

Of the 24 widebodies shipped in November, Singapore Airlines took a trio of A350s, while Etihad Airways and United Airlines each took a pair of 787s and a single 777-200, and Emirates accepted two A380s and a 777-300.

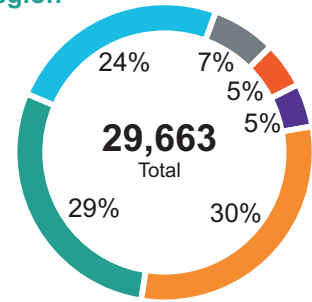
Horizon Air, meanwhile, received four E175s, and SkyWest Airlines took delivery of a pair of Bombardier CRJ900s, along with a single E175. ■

Commercial monthly net orders, November 2017-2018



Source: Flight Fleets Analyzer

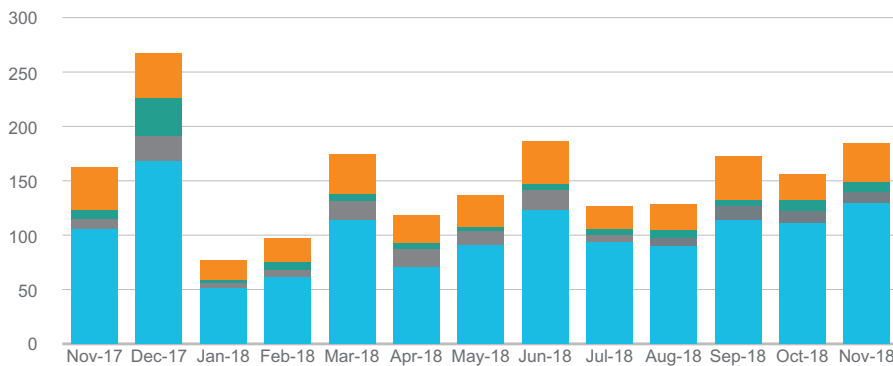
Commercial in-service fleet by region



Source: Flight Fleets Analyzer

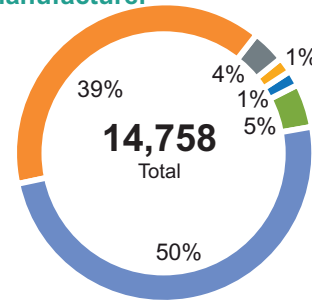
Asia-Pacific 9,010	North America 8,614	Europe 7,149
Latin America 2,048	Middle East 1,499	Africa 1,343

Commercial monthly deliveries, November 2017-2018



Source: Flight Fleets Analyzer

Commercial aircraft order backlog by manufacturer

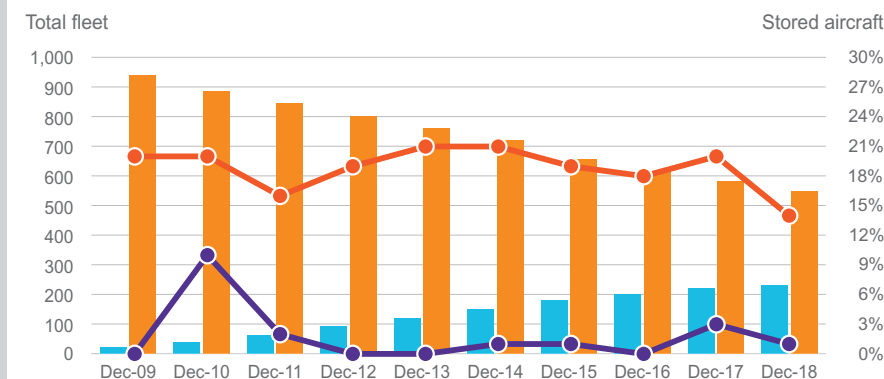


Source: Flight Fleets Analyzer

Airbus 7,306	Boeing 5,748	Comac 544
Embraer 248	ATR 244	Other 668

In focus: fleet development for Airbus A380 compared with Boeing 747

Fleet development for Airbus A380 vs Boeing 747



Source: Flight Fleets Analyzer

The Airbus A380 and Boeing 747 currently compete as ultra-high-capacity airliners. The classic Boeing type has seen its popularity as a passenger jet wane and just 20 orders remain on backlog: all for the -8F cargo model. In the 2009-2018 period, the fleet fell from 940 aircraft to just under 550 units.

Although the A380 has seen more recent sales success, large orders have been few and far between. Introduced in 2007, the superjumbo fleet has risen from 21 units in 2009 to 231 at the end of 2018. There are 180 A380s on order, of which 55 are for the type's biggest customer, Emirates.

The older 747 has seen a higher storage rate over the period, having reached 21% in 2013 and 2014, falling to 14% at present. Storage rates for the A380 topped out at 10% in 2010, but have since averaged 1%.

And the winner is...



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German flag carrier Lufthansa was launch user for the type in 2016 and has 14 in service



First with the Neos

Operators of the re-engined Airbus narrowbody are effusive over its fuel efficiency but, as our in-service report reveals, reliability, delivery and spares have disappointed

AARON CHONG SINGAPORE
MICHAEL GUBISCH LONDON &
JON HEMMERDINGER BOSTON

For all of the undoubted sales success of the Airbus A320neo family – now approaching three years in service – what was telling when compiling this report on initial operations was that so few of the type's more than 60 operators agreed to be interviewed about the aircraft. Airlines that declined to contribute to this article included Azul, EasyJet, Frontier Airlines, IndiGo, GoAir, Pegasus, SAS and Volaris.

While the re-engined narrowbody itself appears to deliver on its fuel-burn promises, a substantial number of operators have suffered from either engine-related performance issues or late delivery of promised aircraft. We can only assume that it is the inconvenience caused – and consequent strain on relationships with the manufacturer and engine suppliers – that have prevented carriers from speaking out or more openly.

The A320neo's in-service performance can be split into two topics – fuel burn on one side and engine reliability and delivery de-

lays on the other – each with markedly different results. It is in the former category that the aircraft appears to excel.

When Klaus Froese, chief executive of Lufthansa's Frankfurt hub and active line captain, scans the cockpit instruments at cruising altitude on one of the carrier's A320neos, his eyes often stop at the fuel flow indications because, he says, the figures are "noticeably different" to what he is used to seeing on the airline's older A320s. They are, he says, "really fantastic".

Fuel flow on each engine is usually measured in thousands of kilograms per hour on the German carrier's fleet, but the figure for the re-engined narrowbodies frequently drops to just three digits. "You notice [the fuel-savings] when you fly the aeroplane – not just in terms of book-keeping at the office desk," he says.

Lufthansa selected Pratt & Whitney's PW1100G geared turbofan (GTF) for an initial A320neo fleet and became the type's launch operator in 2016 after Qatar Airways declined the role. The decision by the Middle Eastern carrier was based on technical issues with the GTF powerplant.

However, Lufthansa also opted to equip

about half of its on-order A320neo fleet with the alternative CFM International Leap-1A engine. Deliveries of these aircraft are scheduled to begin in 2021.

MORE POWER, LESS FUEL

From a pilot's perspective, the new engines have led to a quieter, more comfortable flight-deck. In addition, there are minor updates to the cockpit information and menu navigation within the flight management system. But perhaps more significantly, in Froese's view, pilots enjoy flying the re-engined variant. As it has more thrust and a better climb performance than the A320ceo, the new twinjet is "fun" to fly, he says.

That view is echoed by AirAsia, which introduced its first Leap-powered A320neo in 2016.

The aircraft "feels more powerful and has a distinctive engine sound", is how the carrier sums up its pilots' experience with the type – noting that operations are "very similar to the A320ceo, with only minor variations to standard operating procedures".

Lufthansa says its A320neos are achieving the 16% fuel savings promised by P&W over previous-generation aircraft. »

» On a per-seat basis, the airline has calculated that its 180-seat Neos deliver a fuel saving of 21% versus its oldest A320s, which can accommodate 168 passengers. Flight Fleets Analyzer shows that the oldest aircraft in Lufthansa's roughly 180-strong A320-family fleet are 29 years old and are powered by CFM56-5As.

Avianca tells FlightGlobal that its Leap-powered A320neos offer 15-20% lower fuel consumption in cruise than first-generation Ceos – a saving the Colombian carrier's engineering director, Adolfo Carvajal, describes as “huge” on flights longer than 4h.

However, the introduction of Airbus's updated “bread-and-butter” aircraft has been marred by multiple engine issues – largely centred on, but not limited to, the GTF – and delivery delays due to production and supply chain hold-ups.

All new aircraft are affected – to varying degrees – by teething issues. But what has made the situation on the A320neo much more painful for operators, Airbus and its suppliers, is the high production rate at which the switch-over from the A320ceo is taking place.

When the previous generation of engines was introduced during the 1990s for the A320 and Boeing 737, problems that might have surfaced during the initial production run and in-service period affected a much smaller number of aircraft and operators.

Not only was the exposure of potential problems much smaller – it was arguably also easier for manufacturers to incorporate changes in the production process without creating substantial bottlenecks and consequent delivery delays.

START-UP ISSUES

Lufthansa and other airlines' initial operations with the GTF were severely affected by a rotor-bow problem that led to increased start-up times.

A320neo-family aircraft in service and on order

	In service	On order	Total
A319neo		53	53
A320neo	459	3,528	3,987
A321neo	99	2,107	2,206
Leap-powered A320neo-family aircraft	310	2,115	2,425
PW1100G-powered A320neo-family aircraft	248	1,621	1,869
Orders without announced engine selection		1,952	1,952
A320neo-family overall	558	5,688	6,246
Number of A320neo-family operators	65		

Source: Flight Fleets Analyzer, 7 December 2018

While A320ceos require about 2min to start up both engines, the procedure initially took 6-7min on the Neo as the GTFs were spun up for several minutes – without injecting fuel – to reduce any rotor temperature differential between the cold and hot sections.

The extended start-up time created a headache for Lufthansa, especially at its Frankfurt base. As Germany's largest hub has cul-de-sac bays with multiple aircraft stands, departing Neos were holding up other flights and disrupting the airport's traffic flow.

P&W responded with a number of modifications in 2016, including software changes, strengthened shaft bearings, and introduction of a dual-cooling button in the cockpit, which enables pilots to save some time by beginning to spool up the second engine while the first is still in the start-up process.

Froese says, however, that Lufthansa struggled with the start-up issue for “a long time” and that it was not resolved until late 2017. “It is really inconvenient for an airline battling for productivity improvements to be wasting time on something like that,” he says.

Start-up times have been reduced to what he calls a “just about acceptable” level of 2-3min, depending on weather conditions. But Froese notes that the Neo still takes longer to start than the A320ceo.

P&W acknowledges that the GTF's initial start-up times were “longer than expected”, but

says that the modifications have brought start-up times to “within industry standards”. The manufacturer notes: “Because the [GTF] operates at higher temperatures than earlier-generation engines, it can take longer to dissipate the heat gradient within the engine prior to start.”

Avianca, meanwhile, gives a glowing – but not perfect – review of its A320neo-family jets.

“Our entry into service was fantastic,” says Carvajal, citing the aircraft's fuel efficiency, the quietness of its Leap engines and a positive reception from passengers. “All [these] variables gave it an excellent entry into service with our company.”

Having received its first Neo in 2017, the carrier and corporate affiliates under Avianca Holdings had nine aircraft (seven A320neos and two A321neos) in service by December 2018, with about 120 more aircraft to follow up to 2025. Carvajal acknowledges that a number of early Neo deliveries were delayed by Leap production bottlenecks. But he describes the hold-ups as largely insignificant.

AirAsia adds that a “few” of its A320neo deliveries were delayed – mainly for the same reason – while a majority of aircraft arrived on schedule. According to Fleets Analyzer, AirAsia's Malaysian operation in December had 23 A320neos, with another 372 A320neos and A321neos on order. Part-owned group affiliate Thai AirAsia had another 11 Neos in service in December. The delivered aircraft have per-



Pratt & Whitney insists less than 2% of PW1100G engines have been affected by “transitory vibration” in early phases after take-off

formed well in service, AirAsia says.

In addition to lower fuel burn, oil consumption has been halved compared with the CFM56-5B, and routine maintenance requirements have been reduced too, the airline says.

The only major in-service issue experienced on the Leap so far has been the premature degradation of a thermal barrier coating on high-pressure turbine shrouds. To resolve the issue, CFM changed the application process for the coating in 2018.

AirAsia has also experienced reliability issues with starter air valves, fuel nozzles and pressure sensors, anti-ice valves, and variable bleed valve actuators. But the problems have been or are in the process of being addressed, the airline says. It adds that the Neo's technical dispatch reliability (TDR) is "comparable" to that of its Ceos.

VIBRATIONS

Lufthansa's in-service experience with the Neo has been one of a series of technical issues – mainly with the engines – separated by periods of relative stability. The latest issue centres on vibrations of the high-pressure rotor (N2) shaft, which have been observed on several PW1100G engines. Froese says the vibrations are not noticeable by occupants on board, but have been picked up by engine instrumentation.

P&W describes this as "transitory engine vibration" and asserts that less than 2% of in-service powerplants have been "impacted" by the issue. The manufacturer has not disclosed the vibration source and told FlightGlobal in December that engine tests were still being conducted to understand the issue. No in-flight engine shutdown incidents have been associated with the vibrations, P&W says.

Lufthansa says the vibrations – which were registered over time as engines matured – are typically encountered during early flight phases, after take-off.

As P&W mandates that operators replace engines once a certain vibration strength or event frequency has been reached, Lufthansa has had to take several powerplants off wing. "This is something that has kept us busy indeed over the past months, because we repeatedly reached a [vibration] range where we had to replace engines," Froese says.

He notes that the operational challenges with the GTF would be much easier to cope with if the supply of spare engines was more plentiful. Lufthansa has frequently operated for long periods with no spare GTF available at its base, Froese says. While it has spare engines in storage for other aircraft in its fleet, the carrier tends to receive spare GTFs from P&W only in an aircraft-on-ground scenario.

P&W is caught between two opposing requirements for engine output: on the one hand it has to meet Airbus's ramp-up plan (and recover from earlier delays) and on the



Airlines have recorded reductions in fuel consumption of 15-20% compared with the Ceo

Top 30 A320neo-family operators by in-service fleet size

Operator	Engine	Aircraft in service	On order	Orders with no engine selection
IndiGo	PW1100G	62	369	146
Frontier Airlines	Leap	31	185	134
China Southern Airlines	Leap + PW1100G	25	14	
AirAsia (Malaysia)	Leap	23	372	
GoAir	PW1100G	23	118	71
SAS	Leap	23	49	35
Air India	Leap	22	5	
Pegasus	Leap	22	78	
EasyJet	Leap	21	126	
Azul	Leap	18	50	
All Nippon Airways	PW1100G	16	16	
Volaris	PW1100G	16	113	79
Lufthansa	PW1100G	14	110	6
Sichuan Airlines	PW1100G	13	6	
Avianca Brazil	Leap	12	63	59
China Eastern Airlines	Leap	12		
Hawaiian Airlines	PW1100G	11	7	
Thai AirAsia	Leap	11		
Interjet	Leap	10	41	
S7 Airlines	PW1100G	9	19	
Vistara	Leap	9	28	
VivaAerobus	PW1100G	9	56	
Alaska Airlines	Leap	8	32	
British Airways	Leap	8	27	
Citilink Indonesia	Leap	8	27	25
Loong Air	Leap	8	4	
Air China	PW1100G	7	3	
Royal Brunei Airlines	Leap	7		
SriLankan Airlines	Leap	6	1	
Vueling Airlines	PW1100G	6	41	

Source: Flight Fleets Analyzer, 7 December 2018

other, it needs to supply spare engines to increasingly frustrated end-users.

Airbus says that after GTF deliveries were suspended for eight weeks until April 2018 because of a flawed seal in the high-pressure compressor, the airframer decided with P&W to prioritise engine deliveries to airlines – for the support of in-service aircraft – rather than to the assembly lines for new aircraft.

For airlines, performing daily fleet opera-

tions without spare engines at hand poses a particular challenge.

Froese describes spare engine supply as a "very dynamic business", to which Lufthansa has dedicated staff to "protect our interests". And while engine replacements in regard to the vibration issue are – to a certain extent – predictable, he says the spare engine situation has remained "very difficult", despite "intensive talks" with P&W. »

» The manufacturer says that it is in the process of ramping up spare engine supply to operators and to P&W's pool and of increasing maintenance, repair and overhaul (MRO) activity in order to "meet our customers' expectations for on-site spares. Spare engines are allocated to the best of our ability to minimise operational disruption." P&W adds: "This effort will continue into 2019."

The engine maker describes 2018 as "the year of catch-up", as both GTF production and MRO output were nearly doubled compared with the previous year. "We are maturing the production and MRO facilities faster than any other programme in our history and, clearly, demand continues to rise," says P&W.

"ABSOLUTELY UNSATISFACTORY"

Lufthansa declines to specify a TDR figure for its A320neo operation – citing its limited fleet size – but says it is clearly below the airline's fleet-wide goal of 99.8%. And Froese claims that the Neo's technical reliability has not substantially improved since service entry.

Fleets Analyzer shows that the carrier had 14 A320neos in December, and orders for another 110 aircraft, including 40 A321neos. At the end of last September, Lufthansa's then 13 Neos completed around 20% less operating time per day than the carrier's A320ceos, the airline says. On average, the carrier's Neos generated 73% of the daily operating hours of same-age Ceos and only 92% of Lufthansa's oldest Ceos.

At the same time, the Neos encountered unscheduled ground times that were five and a half times as long as same-age Ceos, while maintenance costs were approximately 60% higher, the airline says.

Noting that the re-engined aircraft are meant to become the central pillar of Lufthansa's European operation, Froese describes the airline's in-service experience with the A320neo so far as "absolutely unsatisfactory", despite "intensive maintenance". He acknowledges that both Airbus and P&W have been available to discuss the operator's concerns, but says: "In terms of [operational] results for the engines, we would have wished for something else."

P&W asserts that the in-service fleet of GTF-powered Neos has an engine dispatch reliability of 99.91%, which, it adds, "compares favourably to other early-phase engine programmes".

Responding to the comparatively low Neo utilisation and high maintenance effort observed by Lufthansa, P&W says: "There are no operational restrictions on the PW1100G-JM that would result in such a reduced level of performance." Instead, the manufacturer suggests that the low utilisation might be a result of the airline's individual circumstances as "operators make their own decisions on air-

craft route structure and utilisation".

P&W insists that the GTF is "capable" of meeting operational levels of the previous-generation International Aero Engines V2500 – the US manufacturer is the largest shareholder of that programme – and that "we are seeing increasing levels of utilisation" for the GTF.

Airbus acknowledges that P&W still has to deliver upgrades and efforts to modify in-service engines will continue into 2019, but says that the GTF's technical issues have "largely been addressed". The entire in-service Neo fleet's operational dispatch reliability is "very close to target" at 99.6%, says Airbus – adding that there is now "less dis-

Top 30 A320neo-family customers by on-order fleet size

Customer	Engine	On order	Orders with no engine announcement
AirAsia	Leap	372	
IndiGo	PW1100G	369	146
Wizz Air	PW1100G	256	146
Frontier Airlines	Leap	185	134
Lion Air	Leap	178	
GECAS	Leap	172	
Unconfirmed Chinese Airline	Leap + PW1100G	145	
China Aircraft Leasing Company	Leap + PW1100G	130	77
Avianca	Leap	127	104
EasyJet	Leap	126	
GoAir	PW1100G	118	71
VietJet Air	PW1100G	118	50
Volaris	PW1100G	113	79
Lufthansa	Leap + PW1100G	110	6
American Airlines	Leap	100	
Delta Air Lines	PW1100G	100	
Jetstar	Leap	99	
AerCap	Leap + PW1100G	95	81
Turkish Airlines	PW1100G	91	
SMBC Aviation Capital	Leap + PW1100G	90	50
Norwegian	PW1100G	88	50
JetBlue Airways	PW1100G	85	
Avolon	Leap + PW1100G	82	62
CDB Aviation Lease Finance	unannounced	82	82
Air Lease Corporation	Leap + PW1100G	81	15
Flynas	Leap	79	
Pegasus	Leap	78	
JetSmart	PW1100G	75	70
Avianca Brazil	Leap	63	59
Spring Airlines	Leap	60	

Source: Flight Fleets Analyzer, 7 December 2018

Hiatus in GTF output disrupted A321neo deliveries for Hawaiian and forced the carrier to make schedule changes



parity” between Ceos and Neos.

On maintenance costs, P&W argues that while V2500 operators have “benefited from 30 years of continuous improvement”, the GTF is still “early in its life cycle”.

Costs for maintenance efforts on the GTF will almost certainly be borne by P&W, as engines are still under warranty and a majority of the in-service fleet is covered by hour-based service agreements with the manufacturer. But airlines face additional, disruption-related expenses when aircraft are not serviceable – or are not available in the first place because of delivery delays, which have affected multiple operators of both Leap- and PW1100G-powered Neos.

DELIVERY DELAYS

The hiatus in GTF deliveries in 2018 and a separate, parallel Leap production delay – due to supply-chain bottlenecks to CFM – led to an accumulation of engine-less Neos at Airbus’s assembly lines, which peaked at more than 100 aircraft in June 2018.

While that number has since been reduced, Airbus said in December that the backlog “will not be fully cleared by year-end”; the airframer foresaw that less than 10 aircraft would be taken across to 2019.

Having revised its output targets after the delivery pause in 2018, P&W is now handing over engines in line with the new plan, Airbus says. Meanwhile, CFM had “not fully” caught up in December with its plan of overcoming the production delay by the end of 2018, the airframer admits.

Airbus acknowledges that more effort is required to stabilise and ramp up Neo production, but says it is on track to reach a target rate of 60 deliveries per month by mid-2019.

Among affected operators is Hawaiian Airlines, which had to postpone new route plans



Lufthansa says experience will show whether maintenance costs outweigh savings on fuel

and return a retired 767 to service to cope with months-long A321neo delivery hiccups.

“The biggest challenge we faced is the delivery delays,” Hawaiian chief executive Peter Ingram tells FlightGlobal, expressing particular frustration with the GTF delivery freeze. “That was a major disruption to our plans for [2018], and we had to make some significant schedule changes.” Delays aside, however, Ingram has repeatedly praised the A321neo’s operational capabilities and efficiencies.

Lufthansa had by September received 13 out of around 20 A320neos that had been scheduled to operate for the carrier at that point. As new aircraft did not arrive, old equipment could not exit the fleet as planned.

But as previous maintenance efforts had been tuned to keep the old aircraft in service until their planned departure, the airline had to catch up on maintenance which, Froese says, “often pumps fresh life into the aircraft, which you are not going to use”.

He says that Lufthansa has so far been able to avoid having to wet-lease external capacity to operate its schedule, despite late arrivals of new aircraft. But he asserts that the carrier is “scraping by, from month to month” with the available fleet, and that the situation is “to our economic disadvantage”.

In order to cushion the effect of the Neo delivery delays, Lufthansa has ordered nine additional A320ceos – scheduled to arrive between December 2018 and summer 2019 – which were not part of the airline’s original fleet plan.

If the price of jet kerosene rises again as seen during much of 2018 – before oil prices eased in the autumn – the Neo’s fuel economy benefits will become more pronounced than over the type’s first three years of operation.

Froese says, however, that the A320neo’s overall economic advantages must be assessed against the aircraft’s acquisition cost – Airbus lists a \$9.6 million difference between the two generations of A320 – and operational performance over a long period.

He suggests that any fuel savings could be wiped out by additional costs generated by maintenance or reliability issues. “The engines are highly expensive [and require] a lot of maintenance, I would say, but [have] much lower fuel consumption. I am curious how the [overall] bill looks like in 10 years’ time.”

With a nod to the fuel price, he quips: “God forbid it falls.”

In Froese’s view, Lufthansa’s main lesson from the A320neo introduction has been to generally allocate more reserve capacity and to expect more disruption during major operational changes.

He thinks that while airlines have increased utilisation of their assets, risks associated with introduction of new technology or processes are not sufficiently recognised in operators’ economic analyses for such projects.

Noting capacity limitations across the air transport sector – at carriers, manufacturers, airports and air traffic control providers – Froese says: “We notice it everywhere... buffers within aviation’s production system have become so thin that minimal disturbances are enough to substantially disrupt the system.

“If we want to have more stable operations, we need more buffers and reserves,” he adds.

For Airbus, the main learning is, unsurprisingly, short and sweet – and clearly directed at the engine manufacturers. The airframer says it is necessary to have “more extensive engine tests in the engine OEM test cell and also on [Airbus’s] flying testbed”. ■



Pratt & Whitney



Commonwealth of Australia

Despite its 701 Sqn having only 11 examples, Thailand was able to deploy six jets to Australia's Pitch Black-series exercise during 2018

Thai fighter

With 10,000 flying hours already logged with a small Gripen fleet fielded via an ambitious air-defence deal with Sweden, Bangkok could be poised to further boost its capabilities

CRAIG HOYLE BANGKOK & SURAT THANI AIR BASE

Last year brought twin milestones for the Royal Thai Air Force's fleet of Saab Gripen C/Ds, with the service having marked a decade since ordering the Swedish-built fighter, and completed its first 10,000 flying hours with the single-engined type.

In late November, FlightGlobal was among a select group of media invited to make a first-of-its-kind visit to Thailand's Surat Thani air base since the nation introduced its latest combat additions over seven years earlier.

Located a flying distance of approximately 530km (980nm) south of Bangkok, the city of Surat Thani is usually a stopping point on the tourist trail heading for popular Thai island destinations such as Ko Samui. Occupying the western side of its international airport,

the air force's 7 Wing includes its Gripen-equipped 701 Sqn, nicknamed "Shark", and its 702 "Orca" squadron, which operates six Saab 340s. Acquired from Sweden and also independently, these are used in the airborne early warning, electronic intelligence and transport roles.

BOLD ACQUISITION

Following a selection decision made in 2007 and an initial production award placed the next year, a first batch of six Gripens – two single-seat Cs and four D-model trainers – were delivered to Thailand in February 2011.

Bangkok had also considered replacing its oldest Northrop F-5s by buying more Lockheed Martin F-16s or acquiring Sukhoi Su-30MKIs, before signing a government-to-government deal via Sweden's Defence Materiel Administration (FMV).

A follow-on contract was signed in 2010,

leading to a further six Gripen Cs arriving at Surat Thani in two batches during 2013.

Under the framework of its Peace Suvarnabhumi programme, Thailand also received a trio of Saab 340s, enhanced command and control equipment, a national datalink capability, plus personnel training and an initial package of in-service support.

Sweden has also supplied Thailand with a new national command and control centre, to support its adoption of a network-centric operating model. Its provision of the Thai-owned and -controlled Link T datalink is a critical element of its integrated air-defence network. This enables Gripen pilots to receive secure information uplinked from a ground station, while its two Erieye airborne early warning radar-equipped Saab 340s relay surveillance data via downlink.

The fighters are armed with Raytheon AIM-9 Sidewinder and AIM-120 Amraam air-to-air missiles, while the service has also recently received its first Diehl Defence IRIS-T short-range weapons. As part of its Peace Suvarnabhumi II acquisition, Bangkok became the lone Asia-Pacific-region customer for Saab's RBS15 anti-ship missile. Its aircraft also are capable of using unguided and laser-guided bombs.

In common with its fellow Gripen export customers the Czech Republic, Hungary and South Africa, Thailand's instructor pilots and other early adopters of the type received training in Sweden. Thirteen of its pilots and 60

air force technicians gained such instruction through the initial programme phases. Martin Mann, the FMV's programme director, Gripen for Thailand, notes that Stockholm has provided more than 100,000h of training to its customer to date.

TECHNOLOGY TRANSFER

While neither of its contracts contained industrial offset packages, Thailand has also received technology transfer in areas including electronic warfare, datalinks, avionics and logistics, and 63 Thai personnel have been funded through scholarship programmes in Sweden.

Despite its small fleet size, the Royal Thai Air Force passed the combined 10,000 flight hours milestone after a little over seven years of operational use, during which time its Gripens have provided a permanent quick reaction alert (QRA) capability for the south of the nation. Roughly once per month, several of 701 Sqn's aircraft are deployed to other bases around Thailand for joint training with other units flying F-5s or F-16s, and it has also participated in several multinational exercises.

701 Sqn commanding officer Wing Commander Kritsana Sukdee describes the unit as "small, but powerful", as represented by its Tiger Shark emblem. He also points to the importance of regular joint training with other Thai air force squadrons, noting: "there is everything you need to win the war."

Flight Fleets Analyzer shows the service's combat inventory also includes 53 F-16A/Bs, aged between 22 and 36 years, and 35 F-5B/E/Fs, ranging between 30 and 40 years old.

Pointing to the high operational demands that are placed on the Gripen unit, Wing 7 deputy commander Group Captain Prachya Tippayarat proudly says: "Everything is on our shoulders."

"For us as operators, the aircraft is very good, and we would love to have more," says Tippayarat. Referring to Bangkok's uncertain budget plans, he adds: "It's just a matter of when." Such an acquisition would be likely to include a replacement for one Gripen C, which was lost with its pilot during a crash in January 2017.

DEMOCRATIC RETURN

Thailand's procurement plans are unknown, with the nation having been under military rule since a coup d'état staged in May 2014 following a period of political instability and public protests.

The outcome of free elections currently expected to be conducted in the first or second quarters of this year is likely to influence potential future business opportunities for Saab and other Western suppliers. Faced with restrictions on sales due to its period of military

rule, the nation has since 2014 ordered equipment including submarines, tanks and air-defence missile systems from China and Russia.

Mann indicates that the nation is interested in potentially boosting the size of its Gripen inventory, noting that Bangkok's early discussions around a purchase more than a decade ago explored multiple fleet-size options, ranging from the 12 aircraft ultimately acquired to twice this number.

However, a more immediate priority for the nation is likely to be pursuing a programme to update its current aircraft from their MS19 operating standard to Sweden's improved MS20 configuration. Thai personnel were briefed about the update's capabilities in 2017, while attending a multinational Gripen User Group meeting in Hungary. "Headquarters is working hard on that at the moment," says Tippayarat of the potential development.

Saab believes an MS20 upgrade could be on the cards, with Robert Bjorklund, its head of Thailand and Vietnam, describing a positive decision as "a matter of when".

While declining to comment on the status of any discussions with the nation, Mann notes: "They are quite well aware of the advantages of MS20. It is a substantial upgrade of the capability." Benefits include the option to introduce new weapons, potentially including MBDA's Meteor beyond-visual-range air-to-air missile, plus a digital close air support function which would increase interoperability with army units.

Sweden's support contracts with Bangkok for the Peace Suvarnabhumi programmes spanned operating periods running from

"They haven't missed a single day [of quick reaction alert duty] since going live in 2011"

Martin Mann

Programme director, Gripen for Thailand, Swedish Defence Materiel Administration

2008-2012 and 2011-2015, with these now continuing under multi-year rolling extensions. Mann describes the arrangement as a "firm, fixed-price for a fixed number of flight hours" per year, with the FMV responsible for spares provision, and in-service support delivered by local maintenance, repair and overhaul firm Thai Aircraft Industries (TAI).

Mann adds that there are now only three Swedish personnel supporting logistics and planning at Surat Thani; down from a one-time commitment of 12-13, including pilots, who supported the air force's introduction of the type.

Spare parts held at Surat Thani are stored in an FMV-controlled facility, while others are flown in as required on commercial flights. The only exceptions have been when what Mann describes as "difficult or sensitive items" – such as air-launched weapons – have been transferred from Sweden. On two occasions, this has involved the nation drawing on its involvement in the NATO Heavy Airlift Wing to deliver equipment using Boeing C-17 strategic transports.

Maintenance is performed at the base, with the aircraft kept inside a hangar overnight due to the humid environment. "We have had very high availability of the aircraft – some >>



Single-engined type's potent weapons fit includes RBS15 anti-ship missile and newly-fielded IRIS-T

» days they have 100% available,” says Mann. Referring to the delivery of QRA cover, he adds: “They haven’t missed a single day since going live in 2011.”

In a notable demonstration of its high fleet availability, Thailand had all 11 of its Gripen operationally available throughout the duration of the Royal Australian Air Force-led Pitch Black exercise, staged from late July through mid-August 2018. Bangkok sent almost 200 personnel and six jets to Australia for four weeks, while simultaneously ensuring the continuous provision of air-defence cover from Surat Thani.

STRONG PERFORMANCE

“We were there not only to train, but to test our air force,” says Sukdee of the service’s second Gripen deployment to a Pitch Black-series event, following a debut appearance in 2014. Its deployed aircraft were employed primarily for air-to-air operations during the exercise, although around 20% of their use was in support of air-to-surface scenarios, involving simulated use of the type’s Rafael Litening targeting pod.

In all, more than 140 aircraft from 15 nations were involved in the exercise.

For 701 Sqn, other similar activities have included taking part in the Cobra Warrior, Cope Tiger and Thai Boomerang exercises, and the unit also has trained alongside Chengdu J-10 and Shenyang J-11 fighters

from China’s People’s Liberation Army Air Force on three occasions.

Tippayarat notes that experience gained during such manoeuvres has proven the benefits of Thailand’s Link T datalink, which is also currently being integrated with its F-5 fleet by TAI. “It doesn’t matter which exercise we go to, we see everything that happens around us: we can see the friendly force and the enemies,” he notes. While the nation’s F-16s use the US-supplied Link 16 standard, he adds: “we have no problem working with two links. It is better for us to have both, as we can stand on our own, but also fight with another partner.”

“It doesn’t matter which exercise we go to, we see everything that happens”

Group Captain Prachya Tippayarat

Deputy commander, Wing 7, Royal Thai Air Force

While Thailand’s current cohort of Gripen pilots transitioned to the type after previously reaching combat-ready status on the F-5 or F-16 – a conversion process which Sukdee says lasts between six and 12 months – its in-country training path is being simplified. Thanks to the air force’s ongoing introduction of a dozen Korea Aerospace Industries T-50s, future pilots will transition to the Swedish

fighter directly after flying the advanced jet trainer. There is no shortage of potential recruits, according to Tippayarat, who notes: “Everyone wants to fly Gripen.”

Bangkok’s satisfaction with its Swedish-supplied integrated air-defence system could eventually lead to follow-on business for Saab. Noting that the company has not secured a so-called “mega-deal” in the region since its last Gripen deliveries to Thailand, head of Saab Asia-Pacific Dean Rosenfield says he views the nation as representing a further opportunity with the type.

The company, which is also present in Australia, India, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea, and China for non-military systems only, is currently also eyeing fighter opportunities with Manila and New Delhi. The operational experience gained by 701 Sqn at Surat Thani could be a supporting factor in any future sales success.

“Eleven air forces came here in 2017,” Sukdee says, and two Brazilian air force pilots are currently nearing the end of a three-month detachment in order to learn about the logistics demands faced by the Thai service.

With 10,000h of operational experience already gained by the Royal Thai Air Force and the service having flown its Gripens alongside other prospective users in the Asia-Pacific region, Saab’s lightweight fighter could yet succeed in securing further buyers locally. ■

SURVEILLANCE CRAIG HOYLE SURAT THANI AIR BASE

How Thailand’s air-defence network thrives on more than Swedish fighters

In addition to supplying the Royal Thai Air Force with a squadron of Gripen fighters, Sweden’s Peace Suvarnabhumi deals with Bangkok also involved the transfer of three Saab 340 twin-turboprops drawn from its own military inventory.

Supplied to Thailand as a “no cost option” via Sweden’s Defence Materiel Administration (FMV), this package included two examples equipped with Erieye airborne early warning (AEW) radars, plus another for transport/training use.

A first AEW platform and the transport were flown to Surat Thani air base in southern Thailand in December 2010, with the second Erieye arriving in mid-2012. A ground command and control system was transferred in the first quarter of 2011, with work performed to modify a trio of Thai radio and radar sites with datalink equipment. The limited geographical coverage enabled

by this update was subsequently expanded, with Saab also supplying a more comprehensive national command and control infrastructure. Martin Mann, the FMV’s programme director, Gripen for Thailand, describes this as an integrated air-defence system spanning the whole of southern Thailand.

More recently, Thailand has doubled the size of its Saab 340 fleet, independently acquiring a further three examples. Two are configured for electronic intelligence (ELINT)-gathering duties, with the other a transport. Its ELINT aircraft are understood to have been prepared by national maintenance, repair and overhaul specialist Thai Aircraft Industries (TAI), using mission equipment from Israeli suppliers.

The twin-turboprops are operated by the air force’s 702 Sqn, nicknamed “Orca”. Its AEW assets

– which have a five-strong crew of two pilots, a radar operator, radar technician and an aircraft technician – relay information to a ground station using the Swedish-supplied Link T system. Derived from Stockholm’s national datalink standard, but owned and controlled by Thailand, this is also used for uplink to the Gripen, and

is now being installed on the air force’s aged Northrop F-5s.

TAI provides in-service support for all six of the air force’s Saab 340s, with Sweden responsible only for mission system support on the AEW examples. However, Bangkok could potentially consider a future upgrade to the type’s capabilities. ■



A pair of Erieye radar-equipped Saab 340s flown by nation's 702 "Orca" squadron keep watch on airspace



Where is the way out for crew exposed to cabin air, frequent changes of air pressure and time zone, and disrupted sleep cycles?

Elaine Thompson/AP/REX/Shutterstock

Cabin fever strikes hard

New research into the physical and mental health of flight attendants shows an adverse correlation between flying and wellbeing, raising the question: what is to be done?

KERRY REALS LONDON

Much has been written about aviation's impact on the environment outside the aircraft, but the spotlight is also intensifying on conditions inside the cabin. As flights grow longer and technology advances, more attention is being paid to improving the onboard health and wellbeing of crew and frequent-flying passengers.

Studies have been carried out and are ongoing on the effects of frequent flying on pilots'

and flight attendants' health, and the extent to which cabin air quality and other factors associated with spending long periods of time on board aircraft affect health and wellbeing.

The second part of a study conducted by Harvard University's Department of Public Health, which compares flight attendant health with that of the general public, was published in the BMC Public Health journal in 2018. Its findings suggest a higher risk among flight attendants of a number of medical conditions, including cancer.

After surveying a cohort of 5,366 US-based

flight attendants, researchers contrasted the results with equivalent information on the general public collected for the US Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey during the same 2014-2015 timeframe.

"To our knowledge, we have conducted the largest study characterising the overall health of flight attendants relative to the general population. Consistent with previous studies, we report a higher prevalence of fatigue, depression, anxiety and sleep disorders, as well as reproductive and all cancers," say the authors in their report.

"We also report associations between job tenure and reproductive, perinatal, mental health, and cancer outcomes, as well as peripheral artery disease and sinusitis. Our study informs future research priorities regarding the health of this understudied group of workers, and raises the question of what can be done to minimise the adverse exposures and health outcomes common among cabin crew."

DATA DEARTH

The report's authors say they carried out the study because little information was available on the health effects on workers who are "consistently exposed to cosmic ionising »

TECHNOLOGY

Industry rises to challenge of passenger care with array of innovative equipment

Airlines, airframers and technology companies are increasingly paying attention to the wellbeing side of flying, particularly as flights become longer and people become more focused on the health effects of frequent air travel.

Lighting systems, apps, in-flight wellness programmes and even electronic devices that neutralise the air around individual passengers are all being offered with the promise of alleviating some of the less pleasant aspects of flying.

Panasonic Avionics announced in September 2018 the launch of Wellness, a solution aimed at improving the comfort, health and wellbeing of passengers in flight. The solution, available as part of Panasonic's NEXT in-flight entertainment and connectivity platform, includes three elements: active noise control; premium seat lighting; and an air deodorising system featuring its "nanoe" purification technology.

The response from airlines has been "highly positive", says Gary Kaplan, manager product marketing strategy at Panasonic. He says two carriers have already committed to the solution and will put it into service in 2019.

The active noise control system aims to reduce background aircraft noise without the use of headphones. It uses "patented technology to produce targeted sound waves to reduce ambient noise", says Kaplan.

"It involves multiple speakers

and microphone arrays embedded in the seating space and integrated into the Panasonic IFE system to reduce the ambient aircraft noise at the seat with no impact on human voices."

The Premium Seat Lighting feature is designed to tailor each passenger's lighting to different phases of flight, using "specialised sleep and wake algorithms", says Panasonic.

"Whilst it is centrally located, the technology is adaptable to each seat configuration and will calibrate automatically to a passenger's seat in flight. It can be both pre-programmed and controlled individually by the passenger," explains Kaplan.

The air neutralisation system claims to eliminate odours and improve air quality in the cabin through the use of electrified water nanoparticles that are 15,000 times finer than the width of a human hair.

"The electrostatic atomised water nanoparticles destroy odour-causing molecules in the air and suppress airborne and surface viruses, bacteria, moulds and pet-related allergens," says Kaplan.

Panasonic plans to announce additional elements of its Wellness solution "in due course".

LIGHT WORKS

Another company focused on improving the in-flight experience through lighting is STG Aerospace, which produces a ret-



In-flight programmes offer relief for less pleasant aspects of travel

rofit LED lighting system called LiTeMood.

"For years lighting has been limited and there was no choice when it came to colour or brightness. But now, as technology has progressed, we can refine the properties of lighting to provide the best possible experience for the passenger," says Lauren Fleming, a research and development scientist at the company.

STG is "continuously expanding" its product range, says Fleming, adding: "As new technologies and research become available on the topic of lighting and passenger experience/wellbeing, we will look into how we can incorporate this into our designs."

While lighting "can certainly be used to reduce the effects of jet-lag", Fleming says STG's focus is on enhancing the passenger experience, and it prefers to "leave the

specialist area of wellbeing and/or medical benefits to the medical experts".

There are also signs that airlines are beginning to enter into agreements with companies specialising in wellness, particularly as flights become longer. For instance, Singapore Airlines (SIA) last year announced a partnership with Canyon Ranch, which the airline said at the time would "reinvent ultra-long-haul travel with a focus on wellness cuisines, rest and relaxation and general wellbeing on the world's longest flights".

The programme launched in October on the carrier's 18h 45min Singapore-New York Newark flight, operated by its first Airbus A350-900ULR. SIA says the results of the partnership will be rolled out across all of its ultra-long-haul routes as they launch. ■

» radiation, circadian rhythm disruption due to night shift work and frequently crossing time zones, poor cabin air quality, elevated ozone levels, hypoxia, pesticides from cabin disinfection, high levels of occupational noise, heavy physical job demands, and verbal and sexual harassment".

Dr Eileen McNeely, one of the report's co-authors, tells FlightGlobal that "people are starting to pay attention" to the health impacts of flying, but more studies need to be done. She says that "the fact we had such a good response" from the cohort used in the study is indicative of the high level of interest in this topic.

"Flight attendants said: 'I'd love to know

about my health, because nobody told me how tiring this job would be or whether this is hurting me.' Flight attendants, especially with regional jets, often have 8h [between shifts] in which to eat, sleep, shower and get back to the airport," says McNeely. She would like to see airlines that place greater emphasis on the health of cabin crew recognised for their efforts, noting: "It would be great when the health effects are visible and empirical evidence is gathered."

David Space, an associate technical fellow in Boeing Commercial Airplanes' environmental controls and systems group, concedes that "the flight attendant job is tough", pointing to the number of cabin

pressurisations and depressurisations that cabin crew on a US East Coast shuttle service, for instance, have to go through on a typical day.

He says the forthcoming results of another study, known as ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) 1262, will be "illuminating and helpful" when it comes to gaining a better understanding of the health effects of frequent flying.

Boeing served as a co-author of the report's statement of work, chair of the aviation research committee, member of the project oversight committee and co-founder, along with the US Federal Aviation Administration

and ASHRAE. Publication of the results is expected imminently.

The principal aim of the ASHRAE 1262 project, according to information on its website, is “to relate perceptions of discomfort or health-related symptoms of flight attendants and passengers to possible causal factors, including cabin and bleed air quality and other factors, such as reduced air pressure, jet lag, inactivity, humidity, flight attendant duty schedule and fatigue, circadian rhythm, stress and noise”.

Part two of the project focuses on measuring contaminants in cabin air that are introduced via the environmental control system (ECS), as well as contaminants that are not introduced by the ECS.

According to Space, the gaseous contaminants created by people on board aircraft – described more succinctly by the airframer’s director of differentiation strategy, Blake Emery, as “sweat, farts and perfume” – are the most likely to draw a negative response from flyers.

DREAMLINER BENEFITS

Taking this into account, Boeing has been evaluating the performance of air purification technologies, including that on the 787, says Space. These evaluations have shown that these air purification units “have a very good performance, even at end of life”, with “good capacity remaining” in them after heavy use.

Boeing also points to a study released in 2017 by the European Aviation Safety Agency

(EASA), known as the Cabin Air Quality Measurement Campaign. The study, carried out by the Fraunhofer Institute for Toxicology and Experimental Medicine and Hannover Medical School, analysed cabin air quality on aircraft equipped with traditional engine bleed air systems and on the 787, which features electrical air compressors instead of engine bleed air systems.

“Flight attendants said: ‘I’d love to know about my health, because nobody told me how tiring this job would be’”

Dr Eileen McNeely

Department of Environmental Health, Harvard University

“EASA looked at all the data without the 787, and then targeted the 787 and compared the results. Hundreds of contaminants were measured. The 787 was lower on virtually all contaminants, and this was attributed to the air purification technology,” says Space.

Adds Emery: “There was an absolutely marked difference. This didn’t happen randomly, it happened because of the things we did.”

Additional research carried out by Boeing on how passengers felt after flying on the 787 also found that “people feel a lot better and experience fewer symptoms associated with pressurisation and mucous membranes”, according to Emery.

Further improvements to air purification technology will be introduced on the 777X, some of which will also be offered on a retrofit basis.

“We’re going to look at smart systems where you can modulate the outside air flow... to get the cabin environment that people prefer,” says Space, adding that this is an area that “will continue to evolve”.

Another consideration on the health and wellbeing aspect of flying is noise. However, blocking out engine noise can have the adverse effect of amplifying the sounds of people inside the cabin. Indeed, in the early days of the Airbus A380, pilots at Emirates complained that the cabin was so quiet they were unable to sleep during rest periods because the noise of the engine no longer drowned out the sounds of the hustle and bustle of the cabin.

Installing extra insulation between the cabin wall and the fuselage to muffle the sound of the engines also carries a weight penalty, so there are always trade-offs, points out Emery. He says that Boeing will be introducing an advanced speaker on the 777X that will improve the sound quality inside the cabin.

It is clear that improvements have been and continue to be made to the environment inside the aircraft cabin, but more studies are needed as people become increasingly focused on health and wellbeing issues. As McNeely points out: “Most of the pressure on airlines comes from the public”. ■



Compared to the general population, cabin crew suffer a higher prevalence of fatigue, depression, sleep disorders and all cancers



Hard facts and carbon targets

Regulators have aviation in their sights as efforts to fight climate change take on new urgency – can electrification help the industry dodge ever-tighter emissions restrictions?

KERRY REALS LONDON

Emissions restrictions for aviation will grow “tighter, not looser”, and reducing passenger demand “has got to be a possibility”, according to a senior member of the UK government’s Committee on Climate Change (CCC). However, the committee will include the possible implications of electrifying the air transport sector in its upcoming advisory report to the government, amid rising optimism that battery-powered commercial aircraft for short-haul flights could be on the horizon.

Adrian Gault, chief economist at the CCC, told delegates attending the Royal Aeronautical Society’s Greener By Design conference in London in November that aviation has found itself “in a rather privileged position in our

work” up until now. But he warns that the committee “will need to look again at aviation” ahead of providing advice to the government in March on the implications of the Paris Agreement for the UK’s 2050 emissions reduction targets.

The government asked the CCC in 2018 to advise it on setting the UK’s long-term emissions targets. Committee chairman Lord Deben said at the time that it would look at whether the current 2050 goal – which requires an 80% reduction in emissions by 2050, compared with levels in 1990 – is still “fit for purpose”. The committee will also “set out the necessary steps to clean up the UK’s homes, industry, transport and agriculture to help drive down emissions further, as well the associated costs and benefits”.

“Our overall message in terms of the tight-

ness of targets is that we can only envision them getting tighter in light of Paris, not looser,” says Gault. “Any emissions left from difficult-to-reduce sectors [including aviation] will have to be offset by greenhouse gas removal, carbon capture and storage, and reforestation.”

Whereas 10 years ago the power sector was the biggest source of emissions in the UK, “this is no longer the case”, says Gault. “Transport is now the biggest single sector and aviation within that is about 4%. But when you look at 2050, it’s becoming a very substantial share,” he notes, adding that finding ways to reduce air passenger demand “has got to be a possibility”.

The CCC “will have electrification in our scenarios” for aviation for the first time when it issues its upcoming report. However, Gault

By 2050, aviation could account for a quarter of global CO₂ emissions

powered, says Thomson, and “only when we move to large aircraft does hybrid-electric come into its own”.

“Transition to electric propulsion is required if aviation at a global level is to remain close to today’s carbon dioxide emission [levels],” says Thomson.

According to data cited by Roland Berger, the aviation industry’s share of global carbon emissions by 2050 could be as much as 24% if there are no electric or hybrid aircraft and if fuel efficiency improves by 1% per year.

In the best-case scenario, if there were to be a regulatory-driven transition to electrical propulsion, under which all aircraft had to retire once they reach 10 years old and be replaced by electric or hybrid aircraft from 2030, this share could drop to between 3% and 6%. However, it would also result in a “bloodbath” for leasing companies, which rely on the residual value of aircraft.

“This scenario would require a rapid transition to hybrid and electric aircraft, adding up to 70% of the global fleet by 2050,” says Thomson.

ONGOING DEVELOPMENT

While this might seem overly optimistic, he points to “significant progress” towards breaking down barriers to electrical propulsion on the technology, policy and market demand side.

For instance, EasyJet – which is working with US-based start-up Wright Electric to develop an all-electric commercial passenger jet capable of operating short-haul flights within a decade – is “seeing pressure from passengers, particularly younger people, for more environmentally friendly forms of aviation”, says Thomson.

EasyJet’s ambition to operate such an aircraft “is going to require enormous amounts of work”, admits Wright Electric chief executive Jeffrey Engler. “I don’t think it’s impossible, but it’s going to require lots of support,” he says.

points out that the committee “doesn’t like to make assumptions that there will be huge shifts in technology”. Therefore, any estimates on the extent to which all-electric and hybrid aircraft could help to reduce the sector’s carbon footprint will likely err on the side of caution.

“We’re not [here] to make bold assumptions that technology is going to come to the rescue,” says Gault.

AMBITIONS AROUND

Optimism is rising in other quarters, however, about the speed of progress in the electrification of commercial aircraft. Robert Thomson, managing partner at consultancy Roland Berger, points to a “huge swathe” of new electric and hybrid aircraft programmes – “80 new programmes in the last two years” – which form part of what he describes as an “electrical propulsion revolution”.

Two-thirds of these programmes are “down the bottom end of size” and are all-electric-

powered, says Thomson, and “only when we move to large aircraft does hybrid-electric come into its own”.

Huge challenges still remain with battery technology and Wright Electric accepts that, in reality, a hybrid aircraft will likely precede EasyJet’s all-electric dream.

“We’ve been encouraged by higher-density batteries, but we’re looking internally at all-electric and hybrid. If the first small step is hybrid-electric, we’re okay with that,” says Engler.

“We’re starting small and building up on a stepping-stone basis.” Wright Electric aims to fly the first version of its nine-seat hybrid-electric aircraft in 2019.

John Fox, business development director at Thurso, Scotland-based battery cell manufacturer AMTE Power, agrees that a lot needs to happen before all-electric aircraft with the size and range to operate a network such as EasyJet’s take to the skies.

“We’re seeing advancements in batteries but they’re slower than in other fields,” he says. “I think there will be pure electric [commercial aircraft], but there’s going to be hybrid-electric as we travel through.”

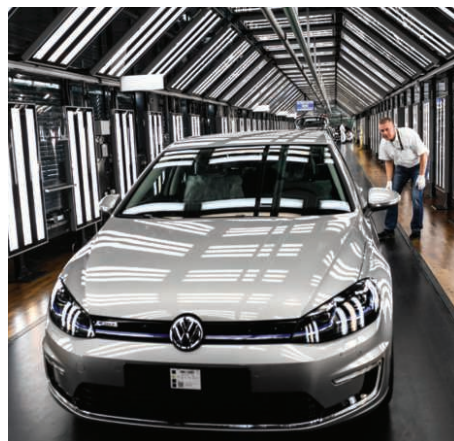
It is not only a question of developing the battery technology to make electric air travel feasible. Demand for battery cells is increasing in all sectors and aviation will have to compete with other industries, as Fox explains: “The issue facing the aeronautical industry is going to be supply. There’s a limited supply and that’s being gobbled up by the EV [electric vehicle] industry. Product development is being driven by the standard cells everyone uses, so the same thing that powers your laptop could be the same thing that powers aircraft.

“You are, by volume, a niche player and you might not get the attention of manufacturers,” adds Fox, noting that demand is outstripping supply and that by 2020 the market for batteries will be demand-led.

While battery technology is advancing, these advances are “slower than in other fields”, because of the tendency of battery cells “to go wrong and catch fire”, says Fox. Some of the well-known drawbacks of lithium-ion batteries are that they are fragile in nature, their capacity deteriorates with age and they “have the potential to become unstable at high temperatures”, says Fox. Sodium-ion batteries are now “being examined as a potential alternative”.

Despite the challenges that lie ahead, a survey carried out by Roland Berger found that aerospace and defence professionals “broadly agree that hybrid-electric aircraft could enter commercial service by the early 2030s” on short-haul routes such as London to Paris, says Thomson.

However, the expected service-entry date for all-electric aircraft is “less clear”, with many of those surveyed not expecting to see them in operation until 2045 and beyond. ■



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

Jumping to conclusions

If the latest research published in the highly respected *British Medical Journal* is to be believed, then you need not give a second thought to baling out of your stricken aircraft without a parachute.

The *BMJ* has confidently detailed a randomised trial on the effectiveness of parachutes in preventing injury, which includes the – somewhat controversial – conclusion that they don't make the slightest bit of difference.

"Although decades of anecdotal experience have suggested that parachute use during jumps from aircraft can save lives, these observations are vulnerable to selection bias and confounding," the paper points out.

Its research into the matter claims to pop this particular bubble of aeronautical wisdom. "Parachute use did not significantly reduce death or major injury," it says.

But don't sell your stock in chute manufacturers just yet. The details of the trial are rather important.

Twenty-three candidates were split into two groups – those with parachutes and those without – and instructed to jump from an aircraft.

"Opponents of evidence-based medicine have frequently argued that no one would perform a randomised trial of parachute use," says the paper. "We have shown this argument to be flawed."



"I've got my nose on you"



"And after this one, maybe try it with a parachute?"

It concedes, however, that it was necessary to restrict its experimental scope to "limited and specific" scenarios – notably to jumping from "small stationary aircraft on the ground".

Neither group suffered injuries – having plummeted from an average height of 2ft – but the paper recommends "cautious extrapolation to high-altitude jumps". Use of a "sham parachute" could also have explored possible placebo effects, but the findings nevertheless should give "momentary pause" to the parachute lobby.

Our preliminary diagnosis is that the *BMJ* must be suffering from a temporary case of tongue-cheek convergence. Do you concur, doctor?

K9GB

How does your dog smell? Pretty good, it seems, if you are Aeroflot. The Russian flag-carrier has created its own breed of security dog by crossing a Lapponian Herder and Turkmen golden jackal.

The resulting "jackal-dog",

the Shalaika, is ideally suited for sniffing out explosives and drugs. Aeroflot has registered the breed with the country's cynological authorities.

Snack adder

A notice for the new-year gathering at the renowned Brooklands Museum in Surrey included an invitation to head for the refreshments van, which was "open from 8:30am – [for] hot and cold drinks, snakes, pastries, pies, and soups..."

Python's flying circus perhaps?

Doctor on call

Overheard in an airport lounge by one of our globe-trotting colleagues – a chap who clearly had no idea how loud he was on the phone: "I'm glad I could help you with this bowel procedure."

Do me a flavour

"Peach to start integrating Vanilla" was an airline news headline at the end of 2018. Sounds like a recipe for success.

Churchill ascends

Writing on the future of the R. A. F., we mentioned that

100 YEARS AGO

rumour associated Mr Winston Churchill with

the dual appointment of Secretary of State for War and the Air. Unfortunately, the rumour was right.

The full Monty

Every student of war must be grateful to General

75 YEARS AGO

Montgomery for making a frank statement of this principle. "We

never," he said, "fought a land battle until the air battle was won. That is the first great principle of war."

Soviet Concorde

The Tupolev Tu-144 SST made an initial 38min flight

50 YEARS AGO

on December 31, after a three-day postponement

because of bad weather, from an unnamed Moscow airport. The prototype had been assembled and ground tested at the Tupolev plant at Khukovsky, near Moscow.

Mir co-operation

NASA and the Russian Space Agency have

25 YEARS AGO

formally agreed the first phase of a joint manned-spaceflight

programme involving the Space Shuttle and Mir 1 space station. It will involve up to ten Space Shuttle flights to the Mir 1 and two years' flight experience on the space station by at least four NASA astronauts.

100-YEAR ARCHIVE

Every issue of Flight from 1909 onwards can be viewed online at flightglobal.com/archive

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The opinions on this page do not necessarily represent those of the editor. Letters without a full postal address supplied may not be published. Letters may also be published on flightglobal.com and must be no longer than 250 words.

Time to tackle drone menace

The drone debacle at London Gatwick airport in December was a dreadful Christmas present for several thousand holidaymakers.

It seems that the authorities were caught totally by surprise and had no contingency plans for an event that was bound to happen sooner or later.

I think we have the wettest administration since King Canute – self-deluded, with no concept whatsoever of reality and who feel we can turn our backs on our friends and neighbours.

Am I judging with hindsight? No. The probability of the drone movement getting out of control has long been discussed in the Woking Model Flying Club. Model flying has been strictly controlled for a very long time now by the governing body, the British Model Flying Association, with insurance and competence at the controls demanded and achieved before being let loose in the skies.

The safety record was – and still is – very good.

Then along come these clever

DIVERSITY

Treat illness – not the symptom

The aerospace and aviation industries are dominated at every level by men.

It's hard to appoint women to the top jobs when there are so few in the ranks to promote.

The problem is so much deeper; the current drive is only treating the symptom and not the illness.

So airlines, manufacturers and the military all need female pilots, engineers and managers coming in at the bottom to provide capable employees for those at the top to choose from.

Unfortunately, most girls are not interested in working in these industries for cultural reasons. Effecting cultural change is a long-term project and no amount of hand-wringing will solve the top-job gender disparity problem.

Paul Burch

Farnham, Surrey, UK



Recruiting women is a challenge

aerial robots that more or less fly themselves. No training is required, no registration, no adequate rule book and no compulsory insurance.

And what did those who should have had the influence and power to tighten things up do? Virtually nothing.

It seems from the Gatwick disaster that there had been absolutely no preparations made whatever to deal with errant drones.

Why not? I think the public is entitled to some answers, and if incompetence is discovered there should be dismissals and prosecutions.

David Stevens

via email

Justifiable alarm

With the UK's looming departure from the EU entering a critical phase, it is crystal clear to me when looking back at Peter Gambardella's letter of a year ago, "Post-Brexit UK will be a 'dod-dle'" (*Flight International*, 12 December 2017-1 January 2018), that he was missing the point.

When Airbus set up its plant in the USA, it was planned as a more or less stand-alone assembly operation that imports components from outside the country, as well as shipping in those made locally. Arrival of parts is thus less critical.

Airbus Europe is a totally different operation. Major components (wings in the UK, for ex-

ample) are manufactured in plants distributed around Europe, and transported based on a very tight and precisely timed schedule to final assembly.

Viewed from above, the operation can be seen as a single production line, albeit with some sizeable geographical gaps to be bridged.

In the main, this is done using the Airbus Beluga transport aircraft, rather than a dolly from one shop floor area to another. This means that exact timing and guaranteed access on the dot is essential if a dysfunctional chaos is not to set in, crippling production.

Let us not forget about the development history of the Boeing 787, where a just-in-time supply of parts was planned, and for a period of time it was dysfunctional, and responsible in no small part for the record-breaking delay of the Dreamliner's final roll-out.

It is therefore perfectly understandable that Airbus views Brexit with alarm. At best, it will involve mountains of additional paperwork resulting in increased costs. At worst, it is going to mean a link in the production line is unreliable or broken, with unthinkable consequences for the company.

Richard Chandless

Creches-sur-Saone, France

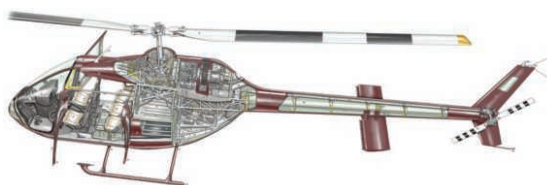
Let's celebrate

The 50th anniversary of the first flight of the Let L-410 Turbolet will be on 16 April 2019.

You might not think it important, but unlike some other programmes that will be celebrated this year, there are variants of the L-410 still in service around the world today.

Andrew Shields

Orphir, Orkney, Scotland



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okinawa.bciaerospace.com

19-22 February
Aero India
Air Force Station Yelahanka,
Bengaluru, India
aeroindia.in

26 February-3 March
Australian International Airshow
Avalon, Australia
airshow.com.au

5-7 March
HAI Heli-Expo
Atlanta, Georgia, USA
helixpo.rotor.org

10-12 March
Routes Asia
Cebu, Philippines
routesonline.com/events/200/
routes-asia-2019

25-28 March
Langkawi International Maritime
& Aerospace Exhibition
Langkawi, Malaysia
limaexhibition.com

2-4 April
Aircraft Interiors Expo
Hamburg, Germany
aircraftinteriorsexpo.com

10-13 April
Aero Friedrichshafen
Messe Friedrichshafen, Germany
aero-expo.com

16-18 April
Aeromart Montreal
Montreal, Canada
montreal.bciaerospace.com

29 April-1 May
Airports Show Dubai
Dubai, UAE
theairportshow.com

18-19 May
International Conference on
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Engineering
Manchester, UK
iaem.org/Conference2019/
UK/2/ICMAE

21-23 May
EBACE
Geneva, Switzerland
ebace.aero/2019

17-21 June
AIAA Aviation Forum
Dallas, Texas, USA
aviation.aiaa.org

17-23 June
Paris Air Show
Le Bourget, Paris, France
siae.fr

19-21 July
Royal International Air Tattoo
RAF Fairford, Gloucestershire, UK
airtattoo.com

24-26 September
Aeromart Nagoya
Nagoya, Japan
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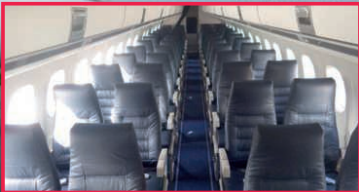
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Clearing pilot careers for take-off

As the new UK-based training school Skyborne prepares to begin its first course, chief flying instructor Alistair Checketts explains how its airline training programmes will provide students with a flying start

How did you get into aviation?

My grandfather had a passion for flying and was in the Royal Air Force during the Second World War, before getting a job with BAC. His enthusiasm was passed on to me from a very young age and I have only ever wanted to work in aviation.

How has your career progressed?

I began my career as a flying instructor at Oxford-based Pilot Flight Training, before taking up the same role with Oxford Aviation Training, prior to its acquisition by CAE. I spent 12 fantastic years at CAE as a flying instructor, standards instructor, flight lead and chief flying instructor. I developed a strong working relationship with CAE's former global operations director, Ian Cooper, who is now chief operating officer of Skyborne, and made the move across as chief flying instructor in July 2018.

What have been the highlights?

I have been extremely lucky to teach a very wide variety of students. Many of them are military or airline-sponsored cadets, who seem to sail through flight training, while others have found the process more challenging. It is down to flying instructors to adapt their teaching style to maximise a cadet's performance but, of course, hard work and the right attitude is required from both sides. Seeing cadets become competent pilots is always an instructor's career highlight.

What does your job entail?

I play a key role in developing and managing Skyborne's air-



Academy puts emphasis on adopting correct ethos, says Checketts

line training programmes, as well as overseeing all practical elements of the training academy's innovative educational approach. This includes evaluating cadets' performance in the company's state-of-the-art Alsim AL42 and Boeing 737 Max simulators, along with Diamond Aircraft's piston trainers. Our vision is to be the most respected and trusted airline training academy in the industry, and we want to make sure we enable the next generation of top airline pilots to get their careers off to the best possible start.

What sets Skyborne apart?

Skyborne is the UK's newest and most innovative airline training academy. We have developed a unique educational approach with a focus on progressive continuous learning, making sure cadets remain challenged and test-

ed throughout their time with us. We have invested in the finest training equipment on the market, including the world's first fixed-base 737 Max simulator, to give our cadets the very best experience possible. We truly value our cadets' time with us, which is why we are developing state-of-the-art on-site accommodation at our Gloucestershire airport headquarters.

What are your challenges?

Skyborne is more than a flight school, it is an airline training academy with a strong emphasis on preparing cadets for careers as international airline pilots. This means adopting airline methodologies and the correct ethos from day one. The biggest challenge is modernising the approach to ab-initio pilot training so the transition to the airline environment becomes seamless.

What do you enjoy the most?

I decided to join Skyborne to team up with like-minded aviation training professionals. Like any new business, it is an extremely dynamic environment which is very stimulating. Skyborne's ambition is to put its cadets at the centre of everything it does. To guarantee this, yearly intakes are going to be capped at a realistic level. Delivering top-quality training is what makes my job hugely fulfilling.

What next for Skyborne?

We are continuing to seek partnerships with leading airlines, to maximise our cadets' career prospects. We have invested in establishing an outstanding flight training environment, but the most important thing is that our cadets find stimulating employment at the end of their programme. We are expecting our courses to start in January, with the in-depth selection process having got under way in November 2018. We are all looking forward to working with our first intake of cadets and giving them the platform they need to become some of the very best pilots in the industry. ■



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