Flight International

23-29 January 2018

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Good times
Production hike stays on track as Airbus and Boeing boost massive order backlogs 10

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ANALYSIS

Not out of the woods

Airlines improve safety record, but is chance a crucial factor?

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Transportation Safety Board of Canada

COVER IMAGE
To accompany our report on another remarkable year for airline safety, we chose this dramatic shot of a West Wind Aviation ATR 42, which crashed on 13 December 2017 P22

BEHIND THE HEADLINES
Max Kingsley-Jones (*above*) looked behind the numbers as **Airbus** and **Boeing** gave their **orders and deliveries** breakdowns for the year just gone (P10). Our annual **airline safety review** comes from **David Learmount** (P22)

Airbus

NEXT WEEK SINGAPORE
As we prepare for the first major show of the year, our Singapore preview looks at Southeast Asia's carriers

NEWS

THIS WEEK

NEWS FOCUS

AIR TRANSPORT

DEFENCE

BUSINESS AVIATION

US Air Force

USAF to shelve re-winging plans for A10 fleet P16

COVER STORY

REGULARS

Russian Helicopters, AirTeamImages

Mi-171A2 enters cold weather testing P21. 2017's mainline jet output breaks manufacturing records P10

Image of the week

Stephan Widmer supplied this shot of Qinetiq's first PC-21 making its flight debut from Pilatus's Stans site in Switzerland on 15 January. Two of the trainers will be used by the UK's Empire Test Pilots' School from Boscombe Down in Wiltshire, replacing Hawk and Alpha Jet airframes

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

flightglobal.com/flight-international

Stephan Widmer

The week in numbers

45%

Flight Dashboard

Ethiopian Airlines is to buy nearly half of Zambian Airways; the flag carrier collapsed in 2009, but is set to be relaunched

€136m

Flight Dashboard

Madagascar's Antananarivo and Fascene airports set to get runway and terminal upgrades with World Bank-led financing

4

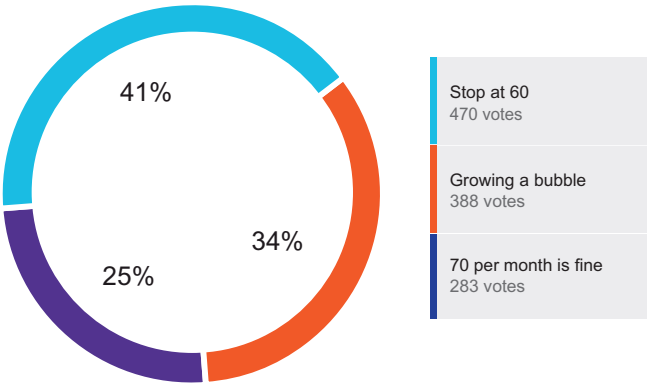
Flight Dashboard

State-owned Air India will be split into parts for sell-off: main airline, Alliance Air regional carrier, MRO, ground handling

Question of the week

Last week, we asked: **Future narrowbody rate rises?**
You said:

Total votes: 1,141



This week, we ask: **Emirates A380 commitment?**
❑ **Even more to come** ❑ **Will prompt other buyers**
❑ **Temporary salvation**
Vote at flightglobal.com

Cloud control

Boeing bested its European rival in the 2017 delivery race, but Airbus pulled in more orders. As both prepare to take output ever higher, some consideration must be given to the what-ifs

If Boeing intended to antagonise Airbus ahead of the annual order tussle, it chose to tweak the European airframer's most sensitive nerve.

"Deliveries matter," Boeing marketing vice-president Randy Tinseth wrote as the manufacturer disclosed that it had handed over 763 aircraft last year. "It's the true measure of success."

Tinseth's point is that orders are essentially just promises, whereas pushing a fully-functioning aircraft off the assembly line delivers real revenues. And Boeing has out-delivered its rival for the past six years.

Even when Airbus has ended the year with higher deliveries, this has arguably been less about overtaking Boeing than being undertaken by the US airframer: steady growth versus a fluctuating production cycle.

Airbus let its irritation over the situation slip when outgoing commercial aircraft president Fabrice Brégier boldly asserted that the European manufacturer would outperform Boeing against both metrics in 2020.

The huge backlog, while outwardly impressive, is an unavoidable source of future uncertainty

But while Airbus might fret over the perception of being second-best, its drive for higher production rates – particularly on its single-aisle lines – is nevertheless a risky exercise, already highlighted by A320neo engine supply problems which, for a second year running, forced it into a frantic end-of-year catch-up.

Airbus points to its weighty single-aisle backlog to justify its production hike, a backlog piled higher in December when, in just one month, the airframer logged 5% of all the A320 orders ever recorded, taking total firm A320 commitments to within striking distance of those for the ubiquitous Boeing 737.

Design Pics Inc/REX/Shutterstock

A darkening picture for aviation

But the backlog, while outwardly impressive, remains an unavoidable source of future uncertainty, especially when the lead times for deliveries stretch to several years, even at a 60-per-month production rate.

Tinseth observes that last year's performance had confounded concerns over a slowdown, and that 2017 had been a "better year than anyone could have predicted". Which sounds reassuring until you realise that it simply illustrates the point about uncertainty.

Flight Ascend Consultancy's Rob Morris suggests that the robust order figures might be evidence of "hysteria" brought on by prolonged exposure to a buoyant market. "The sun cannot continue to shine forever," he says.

Which is almost inevitable. What is far less certain is whether, when the sun finally disappears, it is likely to be behind a patch of light cloud or a raging thunderstorm. ■

See News Focus P10

Leahy's legacy

Any doubts that the future of Airbus's flagship product was genuinely under threat were demolished by the blunt assessment from outgoing head salesman John Leahy. If Emirates did not buy more, the A380 programme was finished, he said.

During Airbus's 2017 business review, Leahy and fellow departing executive Fabrice Brégier engaged in a bit of bad cop/good cop banter. As Brégier talked of the A380's "commercial challenge" and the potential for other orders, Leahy said simply that the superjumbo was dead without Emirates.

Hearing Leahy say these words came as a shock, which was exactly what was intended: he is nothing if not cunning.

During the A380's pre-launch activities, it was then-boss Noël Forgeard who was front of house in the global lobbying effort to secure signed "letters of interest" from potential customers. With a decision to launch never a formality, Leahy's absence – publicly at least – caused cynics to wonder if he was avoiding the risk of being associated with a high-profile flop.

Now, with retirement looming, Leahy was staring at the prospect of leaving Airbus with the A380's demise as his legacy. So he made the ultimate gamble, publicly throwing down the gauntlet to Emirates. The plan has worked, allowing him to hang up his hat with at least 10 more years of production assured. Result. ■

See This Week P7, News Focus P10

BRIEFING

E175 BOOSTS EMBRAER'S 2017 PERFORMANCE

RESULTS Embraer received a net 86 firm orders for commercial aircraft in 2017, almost doubling the 45 it logged in 2016. The airframer delivered 101 regional jets in 2017, ending the year with a firm order backlog of 435 aircraft – 15 fewer than at end-2016. In 2017, Embraer saw the most order activity for its E175 and E195-E2, adding 78 and 16 firm orders, respectively.

GE AVIATION COULD BE SPUN OFF BY PARENT

PROPULSION GE will consider spinning off the GE Aviation business as part of a wider review of the company's strategy. The portfolio review "could result" in making any of the company's three major divisions – including aviation – a separately traded asset if it makes business sense, GE says.

RYANAIR SEEKING UNION NEGOTIATORS

STAFFING Ryanair is recruiting negotiators to handle Europe-wide talks with pilot and cabin crew unions. A job posting on its website shows that the low-cost carrier is seeking experienced "employee/industrial managers" to lead talks aimed at delivering collective agreements with unions in 20 European countries that also maintain the carrier's "industry-beating productivity and low-fares model". The airline agreed to recognise pilot unions, and later cabin crew unions, in December 2017.

BOMBARDIER DOWN ON DOWNSVIEW

STRATEGY Bombardier is considering selling its Downsview facility near Toronto, where the airframer assembles Q400 turboprops and Global business jets, as part of a five-year turnaround plan. The Canadian company says it is reviewing the future of the site, which includes a 2,130m (7,000ft) runway, but gives no timeframe for a decision. Work would be transferred to other locations, potentially including Toronto Pearson International airport.

REVISED FRONTIER ERODES A319NEO BACKLOG

NARROWBODY US carrier Frontier Airlines has converted its entire order for Airbus A319neos to the larger A320neo, the airframer's latest backlog data shows. Frontier's move – which covered 18 aircraft – leaves Airbus with total orders for 33 A319neos, including 20 for Avianca, three for private operators, and 10 allocated to an undisclosed customer. Airbus has yet to secure certification for the A319neo.

RUSSIA RULES OUT POLISH TU-154 EXPLOSION

SAFETY Russia's federal Investigative Committee has stressed that there was no evidence of an explosion on board the Polish presidential Tupolev Tu-154M which crashed in Smolensk in April 2010. The committee was responding to a statement from a Polish re-examination of the accident which suggested that the left wing of the aircraft was "destroyed by an internal explosion", rather than a tree impact.

CONAIR PICKS Q400 FOR FIREFIGHTING ROLE

SELECTION Canada's Conair has ordered six new-build Bombardier Q400s that will be used as multirole aerial firefighting aircraft. The aircraft, worth $206 million at list prices, will be equipped with Conair's retardant-delivery system, which also allows the twin-turboprops to be used in passenger transport, medical evacuation, cargo, or combi-freighter configurations.

Boeing

The deal reflects concerns at a repeat of manufacturing bottlenecks

INTERIORS **STEPHEN TRIMBLE** WASHINGTON DC

Initiative cushions Boeing production

Airframer sets up joint venture with automotive supplier to develop passenger seats, addressing capacity constraints

Boeing will form a joint venture with automotive supplier Adient to develop a new line of passenger seats for aircraft, addressing a critical gap in supplier capacity as the industry continues to ramp up production until at least 2020.

"Seats have been a persistent challenge for our customers, the industry and Boeing, and we are taking action to help address constraints in the market," says Kevin Schemm, Boeing senior vice-president of supply chain management, finance and business operations.

However, the seats produced will not just be for new-build aircraft, or solely for Boeing types. "[They] will be available for installation on new airplanes and as retrofit configurations for aircraft produced by Boeing and other commercial airplane manufacturers," the company says.

The relationship between Adient and Boeing has been building for about five years. In 2013, then-Boeing Commercial Airplanes chief executive Ray Conner joined the board of automotive seating supplier Johnson Controls, later rebranded as Adient.

Conner's appointment came just before a dearth of capacity in the aircraft seating industry briefly paralysed Boeing deliveries.

In the meantime, Boeing also formed a relationship with aircraft seating start-up Lift by Encore. Working with Boeing engineers and designers, the California-based company introduced a new line of seats for the 737 Max.

Conner also testified in 2016 in the US House of Representatives on the need to de-regulate aircraft seating, but his calls went unheeded by Congress and the Federal Aviation Administration.

Boeing also announced forming a partnership with Adient in March 2017, which led to the unveiling of the Adient Aerospace joint venture, based in Kaiserslautern, Germany, on 16 January this year.

"Adient has a strong set of transferable competencies that will offer a unique opportunity to create value for our company and for Boeing, our shareholders and the broader commercial aircraft market," says Adient chief executive Bruce McDonald.

Adient Aerospace becomes a rare example of a Boeing-involved joint venture, with the airframer generally preferring to acquire companies rather than partner with them. ■

Indonesia closes in on $1.14bn Su-35 acquisition
This Week P8

ORDER **DAVID KAMINSKI-MORROW** LONDON

Emirates averts early sunset for A380

Commitment for up to 36 more superjumbos prevents closure of programme, ensuring 10 more years of production

Emirates' 18 January decision to take up to 36 more Airbus A380s offers life support to the programme just as the airframer had been openly talking about the possibility of its closure.

Airbus says it is committed to produce the A380 for "at least" another 10 years, but had recently acknowledged that Emirates was central to supporting the programme through its current period of weak sales.

"I'm personally convinced more orders will follow Emirates' example and that this great aircraft will be built well into the 2030s," declared chief operating officer for customers John Leahy – who had warned just three days earlier that, without the Middle Eastern carrier's participation, the outlook for the A380 programme was bleak.

The airframer had stated on 15 January that it was drawing up plans to reduce output to just six aircraft per year if necessary.

During last November's Dubai air show the two sides did not manage to reach an agreement on further A380 orders, a failure which became evident during a high-profile Emirates briefing.

But Emirates has underscored the A380's appeal to the Dubai-based carrier in the wake of the new commitment, a memorandum of understanding covering 20 firm orders and 16 options.

Emirates chairman Sheikh Ahmed bin Saeed Al Maktoum says: "We've made no secret of the fact that the A380 has been a success for Emirates. Our customers love it, and we've been able to deploy it on different missions across our network, giving us flexibility in terms of range and passenger mix."

Airbus

Middle East carrier has yet to select engine type for latest batch of aircraft, but is "evaluating" options

> "We will continue to work closely with Airbus to further enhance the aircraft"
>
> **Sheikh Ahmed bin Saeed Al Maktoum**
> Chairman, Emirates

The airline has 142 of the type on order – of which 101 have been delivered – and the additional agreement, once finalised, will take the firm commitment to 162, and potentially 178 if all the options are exercised.

The carrier says some of the aircraft will be used to replace older A380s in its fleet.

"We will continue to work closely with Airbus to further enhance the aircraft and on-board product, so as to offer our passengers the best possible experience," says Al Maktoum.

Emirates has not decided on the engine type to be installed on the new jets. It has started taking Rolls-Royce Trent 900-powered aircraft, after years of receiving A380s fitted with the rival Engine Alliance GP7200.

The carrier says it is "evaluating engine options" for the jets, to be delivered starting in 2020.

While Airbus has been studying an enhanced version of the A380 – which it designated the A380plus – there is no immediate indication that Emirates intends to acquire this model. The discussions at the Dubai air show had centred on the current version of the double-deck jet.

Airbus has total orders for 317 A380s, but its backlog has been whittled to 95 and there are doubts over whether all of these remaining aircraft will be produced.

Fifteen A380s were delivered last year – nine to Emirates and two each to Etihad Airways, Qatar Airways and Singapore Airlines.

But Airbus is winding down production further this year, aiming to deliver 12 aircraft, and output will be cut further, to eight, in 2019. The airframer has yet to confirm the impact of the new Emirates agreement on production rates from 2020. ■

SALES **MAVIS TOH** SINGAPORE

'Biggest market deserves the biggest aircraft', insists Brégier

Airbus says China is aware that it is open to industrial co-operation on the A380, but faces a challenge to persuade the country's airlines to buy the superjumbo.

"We need to convince the airlines that they can increase their market share and increase tremendously their image by buying the A380 and operating them from big Chinese hubs," says Airbus commercial aircraft president Fabrice Brégier.

"The Chinese market will be the biggest in the world and I believe the biggest market deserves the biggest aircraft."

Brégier describes as "premature" reports that Airbus has offered China an opportunity to participate on the programme, but stresses the manufacturer's strong relationship with Beijing, "so they know that we're open to an industrial co-operation, for instance, on the A380, but the challenge is more commercial."

China Southern is the only Chinese operator of the A380, with five in its fleet. ■

For more in-depth coverage of the global rotorcraft sector, go online to: flightglobal.com/helicopters

REQUIREMENT **GREG WALDRON** SINGAPORE

Indonesia closes in on $1.14bn Su-35 acquisition

Jakarta could be close to finalising an order for 11 Sukhoi Su-35 fighters, with the Indonesian air force's new chief of staff Yuyu Sutisna having told local television that concluding the long-awaited acquisition could be formalised in the coming months.

Last August, the Indonesian government confirmed that it intends to buy the aircraft for $1.14 billion, with a major component of the deal involving agricultural commodities.

It had previously expressed interest in acquiring up to 16 of the advanced type.

The Russian-supplied aircraft will be used to replace Indonesia's remaining six Northrop F-5E fighters, which Flight Fleets Analyzer records as having an average age of 38 years. Its air force's combat inventory already includes a combined 16 Su-27SKs and Su-30MKs.

Indonesia recently received its last of 24 Lockheed Martin F-16s refurbished in the USA. The project covered 19 single-seat F-16Cs and five D-model trainers, originally produced in the Block 25 configuration and previously operated by the US Air Force and US Air National Guard.

Longer term, Indonesia plans to obtain 80 Korea Aerospace Industries KF-X fighters, via a South Korean-led programme in which it holds a 20% stake. ■

Jakarta will boost an already 16-strong fleet of Russian fighters

Commonwealth of Australia

INQUIRY **STEPHEN TRIMBLE** WASHINGTON DC

Feedback loop led to fatal crash of 525

Design flaws in control system created severe airframe vibrations and contributed to main rotor blades striking tail boom

US investigators have attributed the fatal crash of a Bell Helicopter 525 prototype on 6 July 2016 to a series of system design flaws in the fly-by-wire helicopter, which aggravated severe vibrations caused by the crew's unusually slow recovery of rotor speed following a simulated one-engine inoperative (OEI) test at high airspeed.

These factors combined to cause the main rotor speed to further decay, resulting in such severe blade oscillations that the tail boom was severed by a blade-strike, causing the in-flight break-up of the helicopter (N525TA) and the death of its two pilots.

In its final report into the tragedy, the US National Transportation Safety Board (NTSB) says a feedback loop caused severe airframe vibrations, with vertical oscillations of as much as 3*g* up to six times per second.

Lessons from the fatal crash have already prompted Bell to make several changes to the 525 Relentless's flight-control systems, including the biomechanical feedback filters for the collective and the attitude and heading reference system (AHRS). The 525 test fleet returned to flight last July after a one-year hiatus.

The aircraft crashed within 30s after the flightcrew began the last in a series of simulated OEI tests. Each measured how the aircraft performed at progressively higher speeds with one engine shut down and a forward centre of gravity. The final test was set up to examine the 525 at 180kt (333km/h), the twin-engined helicopter's fastest speed in level flight.

For reasons not fully understood – investigations were hampered by the lack of a flight-data or cockpit-voice recorder – the pilot flying returned the main rotor to about 92% of its maximum speed, and maintained that rotation rate for several seconds, rather than regaining full speed as planned.

Extended flight operations in the sub-100% range caused a sequence of events that exposed unforeseen gaps in the flight-control systems, the NTSB says.

First, the main rotor blades entered into a "scissors mode", with the lead and lagging blades on either side converging, creating a severe airframe vibration. In the cockpit, the vibration forced the pilot to inadvertently push on the collective, which, in turn, increased their severity through a "biomechanical feedback loop".

Although Bell had designed a damping system to limit such closed-loop effects on the cyclic control, a similar filter was not present on the collective.

In addition, the AHRS system – which is designed to deal with events such as wind gusts – could not cope with the oscillations and instead contributed to worsening them. ■

Bell Helicopter

Initial flight-test prototype was destroyed in 6 July 2016 accident

The good times keep rolling, for now
News Focus P10

RESULTS **DAVID KAMINSKI-MORROW** LONDON

Airbus tightens single-aisle order gap

Figures show European airframer is closing in on Boeing's lead in narrowbody sector on the back of A320neo's success

Airbus has narrowed by nearly 75% the order gap between its A320 family and the rival Boeing 737 over the past decade, its latest annual order and delivery figures reveal.

The European airframer has gained substantially on Boeing in the single-aisle market, particularly since the launch of the re-engined A320neo in late 2010.

Analysis of the manufacturers' order figures show that, at the end of 2007, the 737 family had logged a total of 7,419 orders – a lead of 1,570 aircraft over the A320.

But over the following 10 years Airbus has closed this gap to just 412 aircraft, with the A320 securing total orders of 14,120, compared with 14,532 for the 737.

The A320 landed 1,054 net orders last year against 745 for the 737, a difference of more than 300 aircraft.

Airbus took its first orders for the A320 in 1984, nearly 20 years after Boeing's initial orders for the 737, which it logged in 1965.

Over the past 10 years the A320's market share of total single-aisle orders has risen from 44.1% in 2007 to 49.3% in 2017.

Airbus's re-engined A320neo has been particularly successful, having taken just short of 6,000 orders against a little over 4,300 for the 737 Max.

Despite Airbus's success in the narrowbody segment, and in 2017 orders, Boeing has continued to dominate both the widebody market and deliveries, beating its European rival against the latter metric every year since 2012.

AirTeamImages

Toulouse gained launch orders for first narrowbody in 1984, some 20 years after 737's initial commitments

Nonetheless, Airbus chief operating officer Fabrice Brégier is confident that Airbus will be able to overtake Boeing as the primary supplier of commercial aircraft by the beginning of the next decade, saying he is "willing to bet" that "Airbus will become the leader in not only the sales but also the deliveries." ■

OUTPUT

Engines key to powering production towards 800-unit target

If a smooth production ramp-up on the A320neo can be maintained, Airbus expects to achieve nearly 800 deliveries this year – an 11% rise over the 718 aircraft it handed over in 2017.

The total of 181 A320neo-family jets accounted for almost one-third of the 558 single-aisle aircraft handed over in 2017, but chief operating officer Fabrice Brégier expects this ratio to double this year.

Brégier says the number of delivered A320neos in 2018 will be "probably closer" to two-thirds of the overall A320 output – with the "caveat" that a sufficient number of engines are supplied for a continuing ramp-up.

This effort will be assisted by clearing a backlog of A320neos that have been parked without engines while technical issues with the powerplants are resolved.

At one point around 60 aicraft were affected, but that figure has been reduced to about 30 of the parked "gliders" which have still to be delivered; these will form part of the company's 2018 output, he says.

Targets for single-aisle aircraft deliveries in 2017 were "supposed to be less ambitious", Brégier says, but instead "became extremely ambitious".

The 181 A320neo-family aircraft handed over last year was against a target of 200. Despite this, its overall single-aisle delivery total of 558 aircraft in 2017 represented an increase of 13 units from the previous year. ■

See News Focus P10

Xinhua/REX/Shutterstock

INCIDENT

Pegasus excursion ends in cliffhanger

All 162 passengers and six crew members survived an extraordinary runway excursion accident which left a Pegasus Airlines Boeing 737-800 precariously balanced on a steep slope at Trabzon, Turkey. The aircraft (TC-CPF) had arrived at the Black Sea resort as flight PC8622 from Ankara on 13 January. It had conducted an approach to Trabzon's runway 11, which has a length of around 2,600m (8,530ft). Images from the scene show the aircraft departed the left side of the runway and travelled part of the way down a steep coastal slope, coming to rest a short distance from the sea.

See Feature P22

ANALYSIS **MAX KINGSLEY-JONES** LONDON

The good times keep rolling, for now

Production records were broken again in 2017, and orders were stronger than forecast. But analysts warn on future risk

AirTeamImages

Issues with the Pratt & Whitney PW1100G engine for the A320neo led to slower than anticipated deliveries of the re-engined narrowbody

The relentless rise in mainline jet output continued in 2017, with Airbus and Boeing both setting production records and reaching almost 1,500 deliveries between them. There has also been a significant uptick in orders – which was not forecast a year ago – and the outlook, for the near term at least, remains positive.

Airbus saw a 4% increase in deliveries to a personal best of 718 aircraft in 2017 and the manufacturer's commercial aircraft president, Fabrice Brégier, expects a further increase to "close to 800" deliveries this year.

> "The stock market is stronger, the economies of the world are all firing at the same time"
>
> **John Leahy**
> Chief operating officer for customers, Airbus

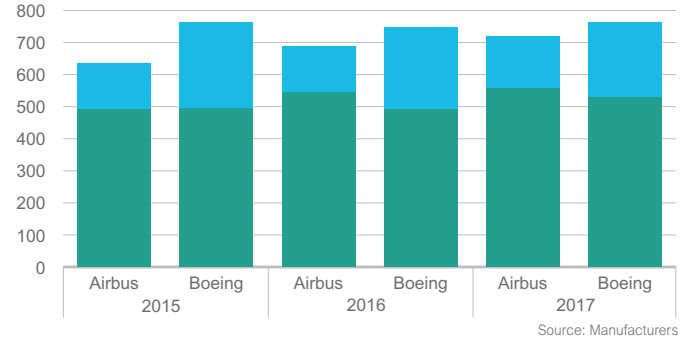
INCHING AHEAD

Boeing's output also broke records – its own and the industry's – but by only one unit. The airframer shipped 763 aircraft – up 2% on 2016's 748 deliveries, but only slightly ahead of its previous record, the 762 aircraft it delivered in 2015. This put combined 2017 deliveries at 1,481 – 3% higher than the 2016 total of 1,436.

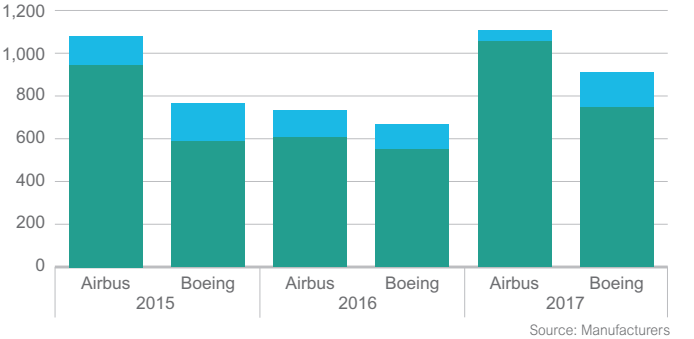
Airbus's 2017 production was close to its original target from a year ago – which was set prior to the industrial problems that engine supplier Pratt & Whitney suffered during 2017. This affected A320neo deliveries, resulting in 60 "gliders" in storage awaiting engines, says Brégier.

By year-end, half of these had been delivered. Airbus handed over a total of 181 A320neos – 73 P&W-powered and 108 with CFM International Leap-1A engines – compared with 377 A320ceos. Brégier is confident that in the absence of further engine industrial issues,

Airbus/Boeing delivery breakdown: 2015-2017



Airbus/Boeing net order breakdown: 2015-2017



A320neo deliveries will transition this year from the one-third share of all A320 shipments in 2017, to nearer two-thirds.

The rise in overall output was driven entirely by narrowbody demand. Deliveries of widebodies actually declined slightly year-on-year through production cuts at Boeing. A320 and 737 deliveries rose 5% in 2017, to a combined 1,087 units, with Airbus just getting its nose ahead.

Although it reduced overall widebody output, Boeing continues to dominate this arena. Despite Airbus pushing up twin-aisle output by more than 10% to 160 aircraft, its US rival still delivered close to 60% of widebodies, or 234 units. Overall, combined widebody shipments declined by seven units, largely as a result of 777 production falling by a fifth, along with flat output on the 787 line.

From a sales perspective, 2017's tally of 2,021 net orders makes it only the sixth year ever that net sales have exceeded 2,000 units. It is the highest annual order total since the record of 2,888 net orders in 2014, and marks the fifth consecutive year that Airbus has been overall market leader; Toulouse's 1,109 net orders represent a 55% share.

The industry's full-year sales performance – which beat predictions made at the start of 2017 – restored the overall net book-to-bill ratio to the healthy level of more than 1.3, after its decline to less than one over the previous 12 months.

"The market is just stronger everywhere," explains Airbus chief operating officer for customers John Leahy. "The stock market is stronger, the economies of the world are all firing at the same time in the right direction, and IATA's telling us that air traffic should be about 7% up. Yeah, and airplane orders are stronger than we thought at the beginning of the year. And it should spill off into 2018 – we would think we'll still maintain a book to bill of one."

Airbus/Boeing deliveries, orders and backlog

	2017			2016	
	Deliveries	Net orders	Backlog*	Deliveries	Net orders
Airbus					
A320ceo	377	128	395	477	58
A320neo	181	926	5,746	68	549
A330ceo	67	15	97	66	41
A330neo	0	6	220	0	42
A350	78	36	712	49	41
A380	15	-2	95	28	0
Total	718	1,109	7,265	688	731
Boeing					
737NG	455	45	436	490	16
737 Max	74	700	4,232	0	534
747	14	-2	12	9	17
767	10	15	98	13	26
777	74	40	102	99	17
777X	0	20	326	0	0
787	136	94	658	137	58
Total	763	912	5,864	748	668
Grand total	**1,481**	**2,021**	**13,129**	**1,436**	**1,399**

Source: Manufacturers Notes: Data includes corporate and military versions. *31 December 2017

CYCLICAL RISK

Rob Morris, head of Flight Ascend Consultancy, is not convinced that current economic drivers alone have propelled orderbooks higher, given the very long lead times for deliveries. "Perhaps airlines and lessors are getting caught up in the hysteria of this increasingly long and high growth cycle, which is causing them to commit to orders for delivery in several years' time without thinking through the risk in the cycle," he says.

"If airlines and lessors are willing to so commit, then of course Airbus and Boeing will take the orders and take some element of certainty in their future volumes and pricing. While there appear no warning signs on the horizon yet, the sun cannot continue to shine forever."

Airbus strengthened its position in the single-aisle market, with the A320 taking 58% of the orders. In overall terms, single-aisle sales surged by more than 50%, to 1,799 orders.

Morris says: "Perhaps [Airbus's strong performance] is some continued reflection of the A321 position compared with the 737 Max 9/Max 10, where even the launch of the latter seems not to have slowed the Neo order momentum. I guess this will exert further pressure for a Boeing NMA [New Mid-market Airplane] launch, or at least authority to offer, in 2018."

WIDEBODY WINNER

Overall, sales in the widebody sector declined year on year to 222 net orders. Boeing more than compensated for being shaded in single-aisles with a whopping 75% share of widebody net orders. This was driven largely by strong sales for the 787 (94 net) and 777/777X (60), with the 40-aircraft deal for 787-10s announced by Emirates at the 2017 Dubai air show yet to be counted.

At Airbus, widebody net orders declined to a disappointing 55, from 124 in 2016. The A330neo, which is currently in flight test, gathered just six net orders.

"Airbus must be concerned about lack of A330neo momentum because comments at the start of last year indicated that they saw this as a priority in 2017," Morris says. "With the relative weaker performance for the A350 also, Airbus must be increasingly concerned about twin-aisle market performance in 2018 and beyond."

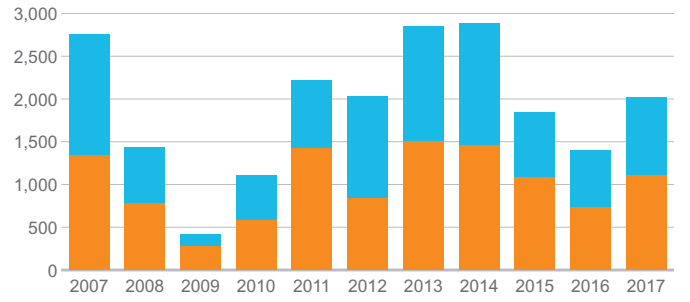
Until the breakthrough commitment from Emirates this month for 36 more A380s, the situation on Airbus's flagship programme had been dire, with the superjumbo seeing a contraction in its firm orderbook by two aircraft during 2017.

Speaking a few days before the deal was confirmed, Leahy warned that without a new Emirates order, there would be "no choice but to shut down the programme". The outgoing sales boss added that Airbus had "about three widebody deals that I would hope we could sign within the next 30-60 days. Watch this space."

The overall industry backlog rose again after the blip in 2016, growing by more than 4% to 13,129 aircraft at 31 December 2017. Based on current rates, this equates to about eight years of production. ■

> "If airlines and lessors are willing to commit, then of course Airbus and Boeing will take the orders"
>
> **Rob Morris**
> Head of consultancy, Flight Ascend Consultancy

Annual net orders 2007-2017



Source: FlightGlobal analysis of delivery data from Flight Fleets Analyzer

INVESTIGATION **JON HEMMERDINGER** BOSTON

CSeries trade inquiry asks Boeing for detail on Embraer interest

But US airframer argues that talks with Brazilian counterpart "have absolutely no bearing" on commission's investigation

The US International Trade Commission (ITC) has asked Boeing to provide information regarding a potential deal with Embraer as part of the body's investigation into Bombardier's CSeries.

An email from the ITC to Boeing attorney Patrick McLean states: "The commission requests that Boeing provide additional detailed information regarding the status and nature of its discussions to acquire/partner with Embraer, as announced on December 21, 2017."

The email, posted on the commission's website, does not specify what information it is seeking, but asked Boeing to respond by 16 January.

Boeing, however, says discussions with Embraer have no relevance to the ITC's investigation. "As a matter of law, the discussions Boeing has held with Embraer have absolutely no bearing on the ITC proceedings," it says.

The airframer also points to a legal brief in which it says Bombardier's proposed partnership with Airbus on the CSeries is irrelevant to the ITC's investigation.

If, however, the ITC does consider the Airbus-Bombardier deal, the commission should also consider the talks with Embraer, Boeing's legal brief says.

The ITC is investigating whether Boeing suffered harm from Bombardier's sale of CSeries aircraft to Delta Air Lines in 2016.

A determination is expected from the ITC in late January. If it finds that Boeing lost out as a result of the CS100 deal, the US Department of Commerce will impose hefty import duties. ■

AirTeamImages

MD-88s will be retained until carrier has more clarity on import tariffs

FLEET **EDWARD RUSSELL** WASHINGTON DC

CS100 arrival unclear, as Delta awaits final decision on duties

Delta Air Lines has put on hold taking any decision on its narrowbody fleet plan until there is clarity on the US import duties hanging over the Bombardier CSeries.

The Atlanta-based carrier has 75 CS100s on order, but a trade complaint by Boeing and subsequent tariff ruling, if confirmed, would rule out delivery of those aircraft from Bombardier's Montreal final assembly line.

Instead, it may have to wait until 2019 for US-built jets to arrive, assuming Airbus is given the go-ahead to acquire a majority stake in the CSeries programme and the partners open a final assembly line in Mobile, Alabama.

Speaking on a full-year earnings call on 11 January, Delta chief executive Ed Bastian reiterated his position that the airline will not pay tariffs on the CSeries.

"We do know that we will not take the CSeries under our original schedule," says Bastian; CS100 deliveries were scheduled to begin this spring.

Delta has postponed the retirement of some of its Boeing MD-88 aircraft to fill the gap left by the CS100, he says. However, it will not know how many aircraft it needs to keep flying, and for how long, until a decision by the US authorities. ■

STRATEGY **MAVIS TOH** SINGAPORE

Garuda delays deliveries amid mounting losses

Flag carrier Garuda Indonesia will not take any new aircraft in 2018 in a bid to shore up its balance sheet, pushing out deliveries into 2019 and beyond.

The airline says it has delayed taking 49 Boeing 737 Max 8s, which were due to be handed over in 2017-2020 as replacements for its current 737-800s; the re-engined narrowbodies will now arrive from 2020 to 2024.

The Indonesian carrier will also receive in 2019 the first three of an eventual 14 Airbus A330neos.

However, Garuda has still to reach agreement with ATR over rescheduling delivery of 14 ordered ATR 72-600 turboprops.

FlightGlobal reported last June that Garuda had approached Airbus, ATR and Boeing seeking to defer the majority of its aircraft deliveries in the coming years, amid financial difficulties.

The airline has also previously said it was considering removing smaller aircraft, such as the ATR and Bombardier CRJ, from its fleet, and in its latest investor presentation lists finding a "solution" for the two aircraft types as an objective for 2018. It currently operates 18 CRJ1000s as well as 15 ATR 72s.

Garuda reported an operating loss of $109 million in the first nine months of 2017, as its attributable net loss widened to $222 million, from a $44 million loss a year earlier. ■

Boeing

Handover of 49 737 Max 8s has been postponed until 2020-2024

EasyJet A319 sustained gear damage during flat landing
Air Transport P14

FINANCIAL **MICHAEL GUBISCH** LONDON

GKN rejects 'opportunistic' takeover

Aerostructures and automotive supplier says "unsolicited" offer "fundamentally undervalues" prospects for business

UK aerostructures manufacturer GKN has begun 2018 in the unwanted position of having to fend off an unsolicited takeover bid from a turnaround specialist, which claims the company's management has consistently failed to deliver promised returns to shareholders.

In response, GKN has disclosed a plan to separate its aerospace and automotive activities as part of a two-year business-improvement initiative.

GKN described Melrose Industries' "preliminary and unsolicited" offer, revealed on 12 January, to purchase its entire shareholding, as "entirely opportunistic", and said the terms "fundamentally undervalue the company and its prospects".

Under the proposal – which values GKN at about £7 billion ($9.5 billion) – Melrose is offering a combination of cash (20%) and new Melrose shares (80%); existing GKN shareholders would end up with 57% of the combined business.

GKN says: "The proposal would materially dilute the exposure of [our] shareholders to the meaningful upside opportunities that the board believes are present within the company."

Melrose says the deal would deliver "significant operational and commercial benefits" and reverse "a history of existing GKN management not delivering on margin target".

Having submitted its proposal on 8 January, Melrose has until 9 February to indicate whether it wants to follow up with a firm offer for GKN.

Meanwhile, GKN believes that value for its shareholders will be "maximised" by the separation of its aerospace and automotive divisions in order to set "distinct strategic, operational and financial objectives for the [two] businesses, with clear focus, accountability and better-aligned incentive plans".

GKN

Aerospace division is to be separated out into stand-alone operation

The timeframe has not been specified, but the separation will "maximise the economic benefits and minimise the costs", says GKN, which declines to provide further details, citing stock market regulations.

The company has launched a separate two-year programme, dubbed "Project Boost", to "significantly" improve performance across the business. GKN acknowledges that profit margins and cash generation have been "below expectations", despite a rise in sales.

The programme is aimed at optimising procurement, processes, productivity and capital allocation. "Portfolio rationalisation of our non-core product segments will also be a priority," it says.

After becoming interim chief executive in late 2017, Anne Stevens' position has been made permanent. She was previously chief executive of speciality metals producer Carpenter Technology and a senior executive at car maker Ford.

Following fourth-quarter trading "in line with expectations", GKN foresees a full-year pre-tax profit "slightly ahead" of the £678 million recorded in 2016.

However, that does not take into account a working-capital write-off signalled in November, related to its US aerospace operation; the figure will be "nearer the upper end" of an £80-130 million range, GKN indicates. ■

STRATEGY

Aggressive turnaround plan includes sale of non-core activities

Melrose Industries has outlined its plans for GKN, including the sale of non-core operations, should it be successful in its pursuit of the UK aerostructures and automotive specialist.

Melrose – which specialises in the acquisition, restructuring and sale of manufacturing businesses – said on 15 January that it had started a series of shareholder meetings to outline its bid.

In its investor presentation, Melrose says GKN is an "overly complex and under-managed organisation without focus" which "needs a fundamental change of culture and leadership".

GKN has a "conglomerate-like structure" – with "parts that do not fit with each other" – and has a "history of missed margin targets" since 2011, Melrose adds.

Immediately following the acquisition, Melrose would "simplify" GKN's management structure, reduce costs and concentrate efforts on raising profitability rather than revenue.

GKN

Tier one parts supplier Fokker Technologies was acquired in 2015

GKN acquired engine specialist Volvo Aero in 2012 and Dutch aerospace supplier Fokker Technologies in 2015.

Melrose says GKN's powder metallurgy operation would be divested in the "medium term".

Non-core activities in the aerospace and automotive divisions would be sold too, it adds.

Melrose chief executive Simon Peckham says GKN is "capable of significant value enhancement". He says Melrose's plan is "in stark contrast to a break-up of the business by a GKN management, which has consistently underperformed, or a hasty possible sale of parts or all of the business". ■

For *Flight International's* full analysis of airline safety and losses in 2017, go to: flightglobal.com/safetyreport2017

INCIDENT **DAVID KAMINSKI-MORROW** LONDON

EasyJet A319 sustained gear damage during flat landing

With both autopilot and autothrust disabled, sidestick input led to 3.01*g* runway impact

UK investigators have determined that an EasyJet Airbus A319 sustained heavy damage to its undercarriage during a hard landing after it touched down with a relatively flat attitude.

The UK Air Accidents Investigation Branch says the crew had been coping with a flight management computer failure which occurred after the jet was established on the instrument landing system approach to Munich's runway 26L.

Investigators state that the computer "froze" and the pilots were unable to alter the target approach speed. The aircraft's engines also began to spool up, uncommanded, just below 1,300ft and the crew opted to disengage the autopilot and autothrust and fly the approach manually.

As the A319 descended through 30ft there was a nose-down sidestick input. The reason could not be determined but the inquiry says the computer failure would have been a "distraction" and landing under manual control would have increased the pilots' workload.

AirTeamImages

Crew landed manually after the flight management computer froze

"The [captain] did not notice the control input because he was looking ahead and did not notice the abnormal landing attitude until it was too late to act effectively," the inquiry says.

As the aircraft touched down it was flying with 0.7° nose-down pitch and descending at 11.9ft/s. It landed with a flat attitude and contacted the runway with an impact of 3.01*g*.

Inspection of the jet (G-EZAW) revealed damage to the nose-gear and right-hand main landing-gear, as well as cracking of paint and sealant in the nose-gear and avionics bays. All three landing-gear assemblies were replaced, and subsequent examination found that the damaged ones had sustained excessive loads and could not be repaired.

None of the 149 passengers and six crew members was injured during the event on 3 July last year. ■

SAFETY
JON HEMMERDINGER BOSTON

737 lined up on incorrect runway at San Francisco

There has been another landing-related safety incident at San Francisco International airport – the third in six months – when the pilots of an Aeromexico Boeing 737-800 lined up to land on the wrong runway before executing a go-around.

At about 11.45 on 9 January, a Virgin America Airbus A320-family aircraft was on runway 28L awaiting take-off, the US Federal Aviation Administration says.

Air traffic controllers had cleared the Aeromexico flight to land on runway 28R, and the instruction was acknowledged by the flightcrew, the FAA says.

"When the plane was about a mile from the airport, air traffic controllers noticed the aircraft was lined up for runway 28L and instructed the crew to execute a missed approach," it says.

Incidents at San Francisco last year both involved Air Canada aircraft: in July, an A320 lined up to land on a busy taxiway; and in October, narrowbody pilots ignored repeated instructions to abort their approach. ■

INQUIRY **DAVID KAMINSKI-MORROW** LONDON

'Unqualified' assistant left Q400 cowl unlatched

An SA Express-operated Bombardier Q400 engine cowling had not been properly latched before it detached from the aircraft during take-off, according to South African investigators.

The turboprop (ZS-NMO) had been departing Cape Town for Bloemfontein on 18 July 2014.

Bombardier

Component detached from turboprop during take-off, hitting wing

South Africa's Civil Aviation Authority says the left-hand access cowl on the starboard Pratt & Whitney Canada PW150A engine was not closed or latched properly following engine oil uplift conducted during a night-stop inspection.

Line maintenance and cockpit crew also failed to examine the aircraft adequately during the pre-flight inspection.

The inquiry notes that the uplift and other activities were carried out by an assistant who, it states, was "not qualified" to perform work on the aircraft.

As the Q400 departed runway 01 at Cape Town it shed the unlatched cowl. A passenger notified cabin crew that the component was missing as the aircraft climbed through 16,000ft, but the pilots opted to continue the flight.

Inspection of the aircraft after landing showed that the cowl had struck the airframe, causing "substantial damage" to the wing leading edge, says the inquiry, as well as the outer de-icing boot.

The cowl was located about 660m (2,170ft) from the threshold of the departure runway. ■

See Feature P22

USAF abandons A-10 re-winging effort
Defence P16

OPERATIONS **STEPHEN TRIMBLE** WASHINGTON DC

Boeing positive on 787 battery safety

Five years on from grounding, redesigned installation of lithium-ion cells appears to have fully mitigated the risk of fire

Lithium-ion batteries on board the Boeing 787 have failed twice since battery fires caused the US Federal Aviation Administration to ground the global fleet on 16 January 2013.

The first failure came less than a year later, on 14 January 2014. An All Nippon Airways 787-8 vented smoke from a newly-installed exhaust port after one of the battery's eight powerful cells showed signs of overheating.

The second known failure reportedly occurred only two months ago. The crew of a United Airlines 787-8 was alerted that the main battery was overheating on approach to Paris Charles de Gaulle airport. A post-flight inspection revealed signs that a cell in the battery had overheated and vented fumes off-board, according to the *Aviation Herald*.

Those two incidents represent the entire public record on the safety performance of Boeing's redesigned battery installation, which the FAA approved in April 2013 to allow the fleet to return to service a month later.

If those two public incidents are representative of Boeing's internal data, the rushed redesign amidst the costly fleet grounding through the winter and spring of 2013 must be viewed as an unmitigated success.

Neither the US National Transportation Safety Board nor the FAA track routine battery failures in commercial aircraft, so long as the failure is contained within the battery and exhaust system, causes no damage to other systems and does not release fumes that can be breathed in by the flightcrew or passengers.

Boeing

Fumes were vented off-board during an overheating incident on United Airlines flight last November

HIGH CONFIDENCE

Boeing also declines to release data on the safety performance of the 787's lithium-ion batteries since the grounding event five years ago. Instead, the company reiterates its confidence in the redesigned battery installation.

It is important to note what has not entered the public record on the 787's lithium-ion batteries since the 2013 grounding order. No evidence has appeared showing that a short circuit in one cell caused a chain reaction within the battery, leading to multiple cells over-heating and venting toxic fumes. Moreover, nothing in the public record indicates that any fumes released by an overheating cell within the battery escaped Boeing's redesigned containment system.

The absence of such evidence suggests that Boeing's package of fixes for the battery is working as designed. The company never promised that the installation redesign would prevent a cell within the battery from ever failing. Instead, its redesign was intended to contain a failure within the battery system, preventing damage to other systems or harm to passengers and crew.

Indeed, the redesigned installation for the 787's lithium-ion batteries in 2013 was inspired by lessons learned from the previous generation of battery technology.

In the early 1970s, the aviation industry transitioned from using lead-acid batteries to nickel-cadmium (NiCd) systems. The latter featured a more energetic chemistry, which the battery industry promoted as lighter and more reliable than lead-acid. But the aviation industry quickly discovered the dangers of using more powerful batteries. In 1972, a headline in *Flight International* warned of the "great nickel cadmium battery scare", as over-heating NiCd systems caused several crashes of general aviation aircraft.

Six years later, the FAA adopted a set of regulations to prevent NiCd venting events from posing a danger to the rest of an aircraft. The regulations included sealing the battery in a stainless steel enclosure and installing an exhaust system to vent any fumes directly offboard.

INITIAL DESIGN

Boeing – with the FAA's approval – ignored those regulations with the initial design of the installation for the 787's even more powerful lithium-ion batteries. Although the chemistry of these batteries was inherently volatile, the airframer and the administrator believed the technology was fundamentally more reliable and safer than earlier designs. Early experience with the 787 in operation proved those assumptions were inaccurate, and the redesign moved the battery installation into compliance with the FAA's regulations for NiCd systems.

Flight Fleets Analyzer shows that there are 624 Dreamliners in current active service with 43 airlines. Boeing says it has now delivered a combined 636 examples of the -8 and -9 variants, with another 658 on order – including 171 of the stretched -10 version. ■

AirTeamImages

All Nippon Airways -8 was involved in January 2014 system failure

For insight and analysis of the latest developments in the defence sector, visit: flightglobal.com/defence

PROGRAMME **LEIGH GIANGRECO** WASHINGTON DC

USAF abandons A-10 re-winging effort

Watchdog warns ground-attack fleet faces cuts, after service leaders decide against continuing key structural upgrade

The US Air Force will let its close air support workhorse die a slow death, by shelving plans to replace the wings on the rest of its Fairchild Republic A-10C fleet, according to a government watchdog.

Despite appeals from Congress to keep the A-10 flying and retain funding for new wings as outlined in the fiscal year 2018 defence policy and appropriations bills, USAF leaders do not plan to implement the re-winging programme or continue flying more aircraft than have already received the upgrade, according to a 17 January report from the Project on Government Oversight (POGO).

The Air Combat Command's (ACC) civilian programme manager for the ground-attack type has told USAF personnel that the re-winging effort will not continue, the report states. If confirmed, the move will force the service to cut three of its remaining nine A-10 squadrons.

In 2007, the USAF awarded Boeing a $2 billion contract to deliver 242 replacement wing kits and extend the A-10's service life by 20 years. The company says 173 kits have been delivered to date, with several more remaining on back order, while the POGO report cites a figure of 171.

Boeing rejects a suggestion by the watchdog that the upgrade award lapsed in 2016, saying: "The contract has not closed, and we are still delivering wings."

The airframer must now wait on funding for additional wing sets in order to finish work on the entire fleet. A Congressional allocation of $103 million within the FY2018 National Defense Authorization Act defence policy bill would complete the award, by establishing a new wing production line.

Congress continues to debate its spending bill, but if it chooses to pass a short-term award to fund the government until mid-February, this would prevent the USAF from launching any new programmes, including the last phase of the re-winging effort.

Close air support veteran is facing retirement threat

US Air Force

In December, members of Congress warned that more than 100 aircraft in the almost 290-strong A-10C fleet will be grounded if the USAF does not receive funding for new wings.

The USAF has tried to phase out the A-10 several times over three decades, but Congressional supporters have repeatedly come to its rescue. In an exit interview with FlightGlobal in 2017, outgoing ACC commander Gen Herbert Carlisle indicated that the new Boeing-produced wings could stretch the type's life out as far as the 2030s.

However, USAF chief of staff Gen David Goldfein early last year outlined a schedule to begin drawing down its A-10 inventory from this year, with the last examples likely to be removed from use in 2021. ■

UNMANNED SYSTEMS **STEPHEN TRIMBLE** WASHINGTON DC

Triton to rise with sense-and-avoid modification

Northrop Grumman will prepare to modify the MQ-4C Triton unmanned air system with an emerging technology that can be used to help the maritime surveillance aircraft sense and avoid other objects in flight.

The US Naval Air Systems Command (NAVAIR) intends to award Northrop a contract to execute a risk-reduction phase of the new sense-and-avoid technology, the agency announced on 10 January. The contract should smooth the process of integrating the new technology – an unmanned version of the Airborne Collision Avoidance System X (ACAS Xu) – in the future, it adds.

Following the risk-reduction phase, NAVAIR plans to award a contract to Northrop to complete an engineering change proposal on the MQ-4C that will integrate the hardware and software for the ACAS Xu.

US Navy

Technology will help MQ-4C operate in non-segregated airspace

NAVAIR plans to initially deploy the MQ-4C with a due regard radar to help avoid other aircraft in non-segregated airspace. The Triton's role with the US Navy will be to fly surveillance orbits above 50,000ft, scanning the oceans and seas, but it will need to descend to lower altitudes to take a closer look at some targets.

The traffic collision avoidance system (TCAS II) has been mandated on manned transport aircraft since 2000, to automatically warn pilots of potential collision threats, but is not designed to use the satellite navigation mandated by the US Federal Aviation Administration's NextGen system.

The Lincoln Laboratory in the Massachusetts Institute of Technology has developed ACAS X to work with the NextGen system as a replacement for TCAS II. The laboratory also is developing the Xu version for use with unmanned aircraft. ■

EU to test maritime UAV performance
Defence P19

PROGRAMME **CRAIG HOYLE** LONDON

A400M deliveries hit new high, while testing fuels hopes

German air force receives first Atlas handed over in 2018, as airframer confirms output climbed to 19 units last year

Airbus Defence & Space

Berlin has accepted 15 from an eventual 53 of the tactical transports

Airbus Defence & Space delivered its first A400M of the year on 12 January, taking its total output of Atlas tactical transports to 56 units so far. Its most recent shipment was the German air force's 15th A400M, from a total commitment for 53 of the four-engined type.

Germany has the second-largest active fleet of A400Ms, behind the UK, which has received 18 of its eventual 22 examples. France has taken delivery of 13, with another 37 on order. Additional recipients are Spain (2), Turkey (4) and export customer Malaysia, which has already completed its four-strong fleet of the type.

Airbus Defence & Space confirms that 19 A400Ms were handed over in 2017 – its highest annual output for the Atlas since deliveries began in late 2013. The company's order backlog for the airlifter now stands at 118 aircraft, to be delivered to the current European operators, plus fellow programme partners Belgium and Luxembourg. It continues to market the type to export customers.

Recent programme highlights have included a "Grizzly" test aircraft providing in-flight refuelling support for six Spanish air force Boeing F/A-18 fighters during a test conducted on 13 December 2017. Airbus Defence & Space says 11.4t of fuel was transferred from the A400M's under-wing hose and drogue refuelling pods, and its centre hose refuelling unit.

The UK also late last year concluded a series of flight trials to assess the transport's ability to participate in maritime rescue operations. The activity included deploying container-housed inflatable life-rafts from its rear cargo ramp by parachute. ■

TANKERS

MRTT nearing service entry with Singapore, South Korea

Near-term first deliveries of A330 multi-role tanker transports (MRTT) for the air forces of Singapore and South Korea will boost Airbus Defence & Space's list of operators of the adapted widebody to six nations.

The company in late December announced that its lead A330-200-based MRTTs for the two Asia-Pacific-region customers will be handed over soon, ahead of "imminent entry into service for both countries".

Singapore has ordered six, and South Korea four. They will follow Australia, Saudi Arabia, the UK and the United Arab Emirates in fielding the type. France is also set to receive up to 12 examples from this year.

Meanwhile, Airbus on 15 January confirmed that its defence unit ordered five A330-200s in December. These will equip a future pooled tanker fleet championed by the European Defence Agency.

Airbus Defence & Space received a contract for the five aircraft last September via Europe's OCCAR defence procurement agency, acting on behalf of Germany and Norway. Under a previous commitment, two more were funded by Luxembourg and the Netherlands. Deliveries will run between 2020 and 2022.

Belgian media reports suggest Brussels has also confirmed its intention to participate in the initiative, adding an eighth MRTT. ■

ACQUISITION **CRAIG HOYLE** LONDON

Pilatus trio to replace Irish Air Corps' Cessna fleet

Pilatus

PC-12NGs will be used in utility role

The Irish Air Corps will replace its aged fleet of Cessna FR172H utility aircraft with a trio of Pilatus PC-12NGs to be introduced from next year.

Valuing the purchase at about €32 million ($39 million), the Irish defence department says the PC-12NGs "will be equipped for intelligence, surveillance, target acquisition and reconnaissance, logistics support and transport, and medical evacuation/air ambulance taskings. The first two aircraft will be delivered in 2019, and the third in 2020."

To be operated from Casement Aerodrome, Baldonnel, the single-engined turboprops will replace five Cessnas that have been in operational use since 1972.

Flight Fleets Analyzer records 67 PC-12NGs as being in active service with military operators, from a global fleet of almost 1,500 of the Swiss-built type.

Additional investment planned for the Irish Air Corps before 2021 will include replacements for its two Airbus Defence & Space CN-235 maritime patrol aircraft, which entered service in 1994. ■

Reimagining Aviation's Future

SINGAPORE AIRSHOW 2018 6 – 11 Feb

an experia event

These are exciting and challenging times for the global aviation industry: technology innovation and ingenious new business models are making air travel more affordable and accessible to more people than ever before. This rising demand for air travel is powering robust passenger growth. Conversely, surging demand is applying added pressure on airports and aviation infrastructure that are already operating beyond normal capacity, and also contributing to growing airspace congestion.

These challenges are some of the discussions that the Singapore Airshow Aviation Leadership Summit (SAALS), held in conjunction with the Singapore Airshow, will address.

Held biennially, the SAALS has established itself as the definitive global aviation conference for top-level decision-makers in aviation to advance the interests of civil aviation and strengthen the nexus between government and the industry. The SAALS gathers key stakeholders in aviation, including top government representatives, civil aviation authorities and senior executives of airlines, aircraft manufacturers, airport operators and air navigation service providers for a frank exchange of views on key issues and challenges facing aviation. More than 300 senior aviation leaders from 80 countries attended SAALS 2016.

To be held from 4 to 5 February 2018 at a new venue, the Pan Pacific Singapore, the SAALS 2018 will explore the theme of **"Reimagining Aviation's Future"**, addressing both the challenges and opportunities arising from such the continued demand for air travel, and chart a sustainable approach to support future growth in the global aviation industry.

Aviation leaders must make the right choices today to create the right pathways for a sustainable and brighter future for aviation

SAALS 2018 will see prominent and diverse senior officials participating in the Summit. Distinguished luminaries addressing the SAALS include Mr Khaw Boon Wan, Coordinating Minister for Infrastructure and Minister for Transport, Republic of Singapore. Other prominent personalities include Dr Olumuyiwa Bernard Aliu, President of the Council, International Civil Aviation Organization (ICAO); Mr Alexandre de Juniac, Director General and Chief Executive Officer, International Air Transport Association (IATA); Mr Henrik Hololei, Director-General for Mobility and Transport, European Commission; Mr Alan Joyce, Chief Executive Officer and Managing Director of the Qantas Group; and Mr Tewolde GebreMariam Tesfay, Group Chief Executive Officer, Ethiopian Airlines.

Mr Kevin Shum, Director-General, CAAS, said, "The aviation industry is at a crossroad. While the industry is expanding exponentially, opening up opportunities for economic growth and businesses, these developments also bring about immense challenges and complexities. Aviation leaders must make the right choices today to create the right pathways for a sustainable and brighter future for aviation. The SAALS will provide a timely platform to catalyse critical conversations among the movers and shakers in global aviation, bringing them together to reimagine aviation's future and unlock its full value."

SAALS 2018 WILL FEATURE HIGH-LEVEL DISCUSSIONS INCLUDING

Ministerial and Chief Executive Panel	Unlocking Aviation's Potential; What Do We Need to Do?
Session #1	Future Aircraft Technologies
Session #2	The Airline Industry beyond LCCs
Session #3	The Future Of UAVs

SAALS is jointly organised by the Ministry of Transport (MOT), Civil Aviation Authority of Singapore (CAAS), International Air Transport Association (IATA) and Experia Events Pte Ltd.
For more information, visit **http://www.aviationleadershipsummit.com/**.

Innovation spurs rising charter demand
Business Aviation P20

OPERATIONS **CRAIG HOYLE** LONDON

EU to test maritime UAV performance

European Defence Agency picks Leonardo-led team for OCEAN2020 demonstration of surveillance and interdiction

Leonardo is to lead an EU-funded demonstration of the use of unmanned air vehicles during maritime operations, with the work to include flight trials from next year.

Following a selection announced by the company on 12 January, the "OCEAN2020" activity will integrate a variety of unmanned systems – including fixed- and rotary-wing designs – for use during major maritime operations. Involving 42 partners from 15 countries, the work will showcase the ability to deliver a recognised maritime picture via satellite to a prototype European command and control centre to be established in Brussels.

A first series of trials will take place off Italy's Mediterranean coast during 2019, led by the Italian navy and Leonardo. Involving the manufacturer's Hero and Solo unmanned rotorcraft, this will demonstrate "surveillance and interdiction" functions.

To be conducted in the Baltic Sea in 2019, a second phase will be co-ordinated by the Swedish navy and Saab.

Leonardo says the OCEAN2020 project involves the defence ministries of Greece, Italy, Lithuania, Portugal and Spain, with further support coming from Estonia, France, the Netherlands, Sweden and the UK. Industry partners include MBDA, Qinetiq and Safran.

The maritime integration project is to be conducted under the aegis of the EU Preparatory Action on Defence Research programme, and follows a selection made by the European Defence Agency.

Leonardo Helicopters

Solo rotorcraft will be involved in first flight trial phase during 2019

Saab says it expects contracts to be placed "in the coming weeks".

Leonardo Helicopters demonstrated the capabilities of its 1,800kg (3,960lb) PZL Swidnik SW-4 Solo airframe in an optionally-piloted intelligence, surveillance, target acquisition and reconnaissance configuration during the UK Royal Navy's Unmanned Warrior exercise in 2016. Its SD-150 Hero UAV has a maximum take-off weight of 180kg, including a payload totalling up to 70kg, and an operating endurance of over 5h. ■

STUDY **MICHAEL GUBISCH** LONDON

France powers up rotary demonstrator project

Airbus Helicopters and its partner, Naval Group, have been contracted by France's DGA defence procurement agency to develop technologies for a projected rotary unmanned air vehicle (RUAV) to operate from warships.

The agreement covers "de-risking studies" before a demonstrator RUAV will be built and tested aboard French navy vessels, the manufacturer says. The contract is designed to "identify, deploy and test the technologies necessary for the integration of a tactical drone-system capacity within a heavily-armed vessel," it adds.

Airbus Defence & Space

SDAM activity will build on experience with the unmanned VSR700

Entry into service for the planned navy airborne drone system, or SDAM, is projected to be around the middle of the next decade, but Airbus Helicopters says technical risks have yet to be determined for "initiating and realising the programme".

The company plans to conduct a first flight of its under-development VSR700 RUAV later this year. The 700kg (1,540lb) rotorcraft is derived from Hélicoptères Guimbal's Cabri G2 light, piston-engined civil helicopter. Flight tests began with an unmanned Cabri G2 prototype in 2017 to validate flight control system integration and the aircraft's engine.

Naval Group and Airbus Helicopters will jointly manage the project, which will also involve Safran, Thales and French aerospace research centre ONERA. ■

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RESEARCH **KATE SARSFIELD** LONDON

Innovation spurs rising charter demand

European market is thriving as new operators and user-friendly technologies make business aircraft more accessible

Research suggests that the European business aviation charter market is at its strongest for nearly a decade, according to one of the continent's largest and oldest online charter platforms, PrivateFly, and German data company WingX Advance.

The pair forecast that this surge is set to continue, triggered by the introduction of new aircraft programmes and an explosion in innovative new operators and user-friendly technologies that are helping make business aviation more accessible and affordable.

WingX says business jets flew about 450,000 charter hours in Europe in 2017, up more than 10% on the previous year. Long-range and light jets saw the steepest rises in usage, ending the year 15% higher than in 2016 at 71,000h and 93,000h, respectively.

More than 102,000 departures were recorded at airports across Europe between June and September, marking the busiest quarter since 2009, WingX reports. Paris Le Bourget and Geneva, Switzerland were the top destinations for charter customers.

"The industry is performing very well, as chartering a business aircraft is no longer regarded as 'something only for the rich'," says Adam Twidell, founder and chief executive of PrivateFly.

Pilatus Aircraft

Arrival of the Pilatus PC-24 this year is expected to sustain demand

The UK company says year-on-year charter sales climbed by more than 50% in 2017, contributing to turnover of more than £22 million ($28.8 million). It expects another year of "exceptionally high growth" in 2018.

Twidell believes the introduction of membership-based business aircraft programmes, such as Surf Air and Wheels Up, and scheduled business jet shuttles such as JetSmarter, have introduced a new generation of travellers to private aviation.

"The charter industry is benefiting from their high-profile, multimillion-dollar marketing campaigns," he says. "Once people have experienced the convenience of flying by private jet – compared with the headache of travelling on a commercial airline – they don't look back."

Twidell says the new wave of high-tech, user-friendly booking platforms is attracting a younger "digitally literate clientele who want to access services at the touch of a button – from taxis to seats on a private jet".

This is reflected in a fall in the average age of the typical business aircraft user, from 41 years in 2016, to 38 today, PrivateFly reveals. "Many people assume that the typical private jet customer is 50-plus, but that's not the case these days," says Twidell.

"As millennials continue to enter the workforce, this younger generation will become the next private jet audience – demanding more choice and personalisation."

This includes new methods of paying for charter flights. PrivateFly describes this area as "ripe for disruption" in 2018, with blockchain technology having the potential to become a more mainstream solution in the charter industry. In 2014, PrivateFly became one of the first private aircraft companies to accept the Bitcoin digital currency, and has seen demand for this offering rise significantly. "Payment in cryptocurrency may still be niche," says Twidell, "but its popularity is growing rapidly."

New aircraft coming on to the market over the next couple of years will help to sustain demand for charter, and challenge many of the sector's established players. At the lower end of the sector, Twidell singles out the recently certificated Pilatus PC-24 as a "rival to the highly successful Embraer Phenom 300". At the top of the market, Bombardier's Global 7000 – set for service entry later this year – will be looking to "steal share from the Gulfstream G650ER", which Twidell describes as "the ultra-high-net-worth's iconic jet of choice". ■

LAUNCH **KATE SARSFIELD** LONDON

Gogo gets personal with Avance L3

Gogo Business Aviation has introduced Gogo Avance L3, a new in-flight connectivity system tailored to the needs of business aircraft passengers and flight departments, offering what it calls "the most affordable pricing options" in the industry.

Gogo says its technology lets users customise their in-flight experience. While the platform can be installed on business aircraft of all sizes, the US company, based in Chicago, says it is an "ideal solution for smaller aircraft including turboprops and light jets".

The Gogo Avance platform integrates a range of "Smart Cabin" features, allowing passengers to connect for data or voice services and access maps, entertainment and cabin management systems.

Avance L3 features a built-in router that allows flight departments to control and manage the number of devices allowed to connect, which can be scaled up or down as needs change, says Gogo.

Users also have access to email and flight applications, as well as Gogo Vision and Gogo Text & Talk in-flight entertainment services, the company says. The orderbook is now open, it adds, and deliveries are scheduled to begin in the first quarter. ■

Textron Aviation

Company says system is ideal for small types such as King Air 350i

Are we safe, or lucky? Cover Story P22

PRODUCTION **KATE SARSFIELD** LONDON

Sector weakness blamed for decline in Embraer deliveries

Airframer says figures are still within expectations, with sales hopes pinned on upgrades

Embraer recorded a 7% fall in business jet output in 2017 as a result of continued weakness across the sector, but says the deliveries were "within outlook ranges for the year".

The Brazilian airframer shipped 109 aircraft in the 12 months ended 31 December, comprising 72 light and 37 large jets, against a total of 117 the previous year, comprising 73 light and 44 large jets.

A backloaded delivery profile resulted in a surge in fourth quarter deliveries, with Embraer handing over 50 aircraft between October and December – more than twice the total for each of the previous quarters, and seven more units than for the final three months of 2016.

Embraer deliveries

	2016	2017
Phenom 100	10	18
Phenom 300	63	54
Legacy 450	12	14
Legacy 500	21	15
Legacy 650	9	7
Lineage 1000E	2	1
Total	**117**	**109**

Source: Embraer

Embraer

EV variant of the Phenom 100 has rekindled interest in the type

Analysis of the manufacturer's delivery figures shows that its top performer last year was the Phenom 100, with a total of 18 shipments. Entry into service in April of the upgraded EV variant – featuring a Garmin G3000 touchscreen flightdeck and higher-thrust Pratt & Whitney Canada PW617F1-E turbofans – has helped to boost the fortunes of the entry-level jet and increased its appeal within the hugely competitive owner-flyer market, which makes up a large share of its customer base.

Embraer will be hoping the wave of upgrades set for introduction across most of its product line this year will help to rekindle sales.

The first E-model variant of the Phenom 300 light jet is set to enter service with its unnamed South African launch customer in February. It features a redesigned cabin, restyled and improved seating and a high-end in-flight entertainment system from Lufthansa Technik. Embraer says the initial aircraft, serial number 448, is now being painted at its US facility in Melbourne, Florida and will then return to the production line for interior completion. ■

MAINTENANCE
STEPHEN TRIMBLE
WASHINGTON DC

StandardAero to close LA engine repair operation

StandardAero will close a business aviation repair station at Los Angeles International airport by the end of March, blaming a "severe and unexpected" fall in Honeywell TFE731 shop visits.

In addition, the Arizona-based MRO provider says there has been a decline in airframe inspections at the site, with operators increasingly preferring "other, more convenient business aviation airports in the area".

StandardAero had also failed to secure a long-term lease for the site, it says.

The company says it has seen a 40% decline in MRO events for TFE731 powerplants since 2015, which it attributes to an ageing population of aircraft equipped with the turbofan, and declining residual values of older aircraft, which have made maintenance costs "unfeasible".

Honeywell has delivered more than 11,000 units in the family of geared TFE731 engines since introducing the type 46 years ago. It powers aircraft including the Dassault Falcon 50 and 900 and the Gulfstream G100. It remains in production for several new models, including the Bombardier Learjet 75. ■

ROTORCRAFT **DOMINIC PERRY** LONDON

Low-temperature flight tests on new Mi-171A2

Russian Helicopters is to begin low-temperature operating trials on the Mil Mi-171A2.

The latest variant of the long-running twin-engined model gained Russian airworthiness certification in August last year. The company will perform about 20 test flights using two helicopters in Yakutia in Russia's far north to confirm the Mi-171A2's operational capabilities at temperatures as low as -50°C (-58°F).

However, unusually cold weather in Yakutia may defeat even the Mi-171A2: on 16 January thermometers recorded a low temperature of -67°C.

Russian operator UTair will be one of the first to receive the new type, with a pair due to be handed over this spring. ■

Russian Helicopters

Two aircraft will be used for effort, which will encompass 20 sorties

Amazingly, West Wind ATR 42 crash at Fond-du-Lac, Canada, killed just one of the 25 people on board

Are we safe, or lucky?

In 2017, for the second time in three years, no-one died in a passenger jet airliner accident and long-term safety trends are encouraging – but expectations of zero fatalities should be tempered given the persistence of near-catastrophes

DAVID LEARMOUNT LONDON

Again the world's commercial air transport industry has smashed all records for keeping passengers safe – in 2017 there were no fatal accidents involving a passenger jet airliner, making for a perfect score in two of the past three years and bringing within reach the expectation of zero fatalities.

Meanwhile, out of sight beneath the low fatal accident statistics, growing quantities of "big data" from accident and incident reports around the globe reveal how frequently flights come perilously close to disaster, but since no one actually dies the event is less visible, especially to the news media. Sometimes these mishaps start with a technical problem, but more often they are the result of inadequate crew knowledge, poor procedural discipline or simple human carelessness.

Another growing development requiring industry review, passenger awareness and regulator oversight is associated more with changes in traveller lifestyle choices than actual danger. As the global population's disposable income grows, so do the choices of exotic holidays or bespoke holiday add-ons that entail flights in small aircraft or helicopters. While these are generally safe excursions in absolute terms, the risk is statistically far greater than the almost risk-free travel that travellers enjoy today on mainline carriers. The 2017 accident list (*see P30*) records three fatal crashes involving chartered single-engined aircraft associated with holiday trips, two of which occurred on the last day of the year. As this industry sector grows, perhaps regulators need to review its performance.

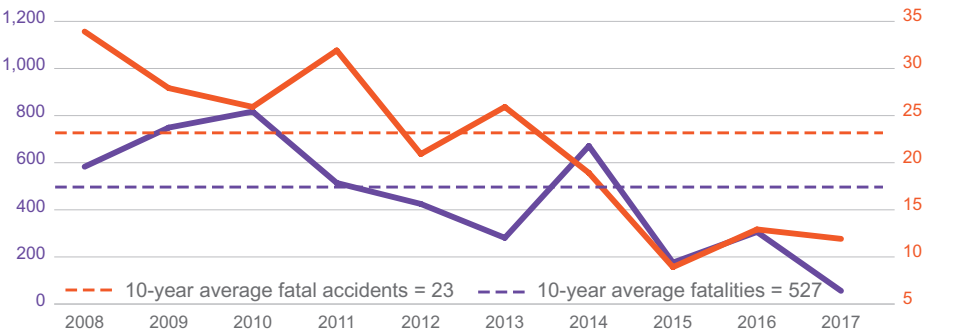
USING BIG DATA

International Air Transport Association (IATA) director-general Alexandre de Juniac has voiced his growing faith in the use of "big data" gathered from the global industry to ensure continuing safety. "The aim is to build the greatest possible collection of data that will enable us to identify and eliminate potential issues before they arise," he says. When luck is the only factor that stands between a non-fatal accident and a catastrophe, clearly there is still safety work to do, which is what de Juniac is talking about. The accident list and the section of this review summarising recently published final accident and incident reports are testimony to how many near-disasters happen but are forgotten because, whatever trauma the passengers were put through, they survived.

In 2017 there were 12 commercial air transport fatal accidents that resulted in a total of 56 deaths. That is a global figure that no other mass public transport mode could possibly match. The best figures previously were in 2015, when there were nine fatal accidents

Transportation Safety Board of Canada

World airline fatal accidents and fatalities 2008-2017*



Source: FlightGlobal Note: *Not including fatal events known to be caused by deliberate action

Fatalities | Fatal accidents

AirTeamImages

A Shaheen Air 737-400 landing incident at Lahore in 2015 followed catalogue of mistakes

and 176 deaths. Just to illustrate the fact that things can temporarily get worse, in the following year – 2016 – the figures were respectively 13 and 306; but that was still a good year sustaining the longer-term trend.

The simple accident numbers for 2017 are small (*see graph above*), but the long-term accident rates trend bears witness to a steady but accelerating improvement (*see graph P24*) in the number of flights per fatal accident, with the five-year moving average line for all aircraft categories showing a steeper improvement since 2011. A glance at the fatal accident rate for Western-built jets tells the same story, with zero fatal accidents in 2015 and 2017. The rates for Western-built turboprops are less good than for jets, but also improving, with a big leap in the figure for 2017.

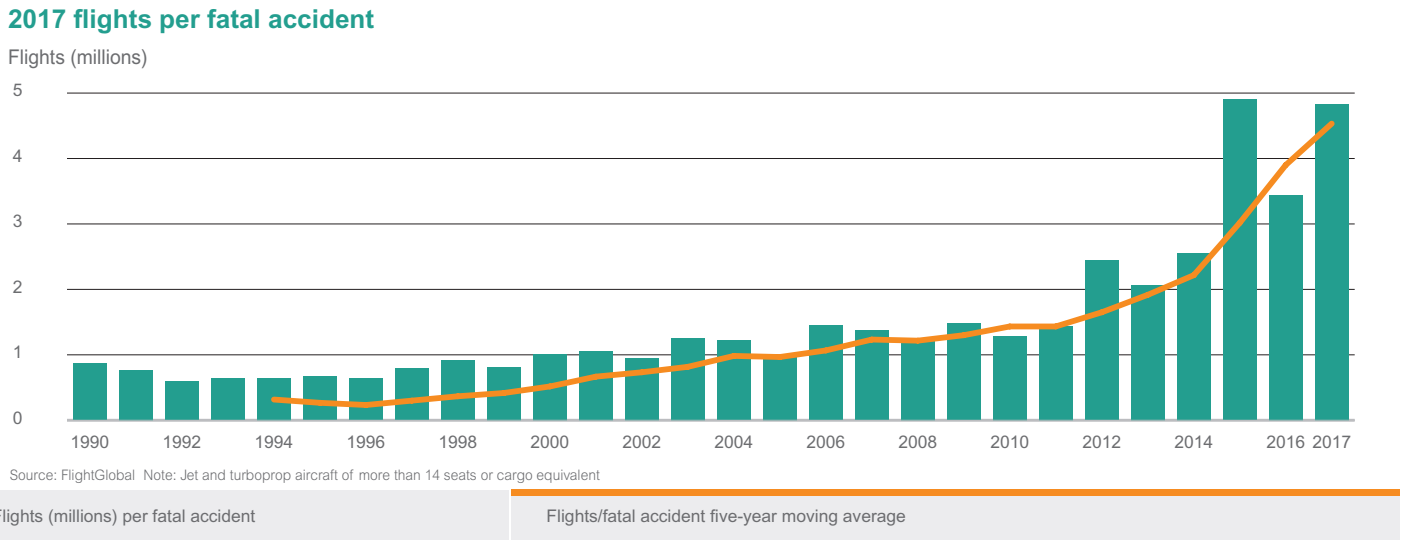
The main reason for the particularly low number of fatalities in 2017 is that no mainline passenger jets crashed. Also, the fatal passenger accidents that did occur involved small commuter types, and the remaining fatal accidents involved freight or other non-passenger operations. In fact one of the freighters was indeed a big jet – the MyCargo Airlines Boeing 747-400F that crashed at Bishkek, Kyrgyzstan, as a result of a tortuously badly managed descent and approach. The other large aircraft involved in a fatal accident last year was the West Wind Aviation ATR 42 that crashed in freezing conditions in Canada, killing one passenger.

The badly managed descent at Bishkek ended in tragedy, but in the section summarising the findings of recently published final reports from previous years (*see P26*) there are several examples of poor aircraft management that nevertheless avoided actual disaster while coming very close to it. On 20 July 2014 an EasyJet Switzerland crew mismanaged the autopilot flight modes during the descent and were slow to respond as the aircraft's speed began to nudge the top end of the flight envelope. The crew finally resorted to manual flying to regain proper control but, in doing so, injured the cabin crew. The report comments on the "lack of diligence" in visually monitoring flight parameters.

DESCENT MANAGEMENT

On 15 May 2015 in Australia a Skytraders Airbus A319 also flew a mismanaged descent but got away with it. There are several other examples of poor descent and approach management in the same section, the worst involving a Shaheen Air Boeing 737-400 approaching Lahore, Pakistan in November 2015. Almost every mistake that could be made during the descent was made, but in the end the six crew and 142 passengers survived a landing in which both main undercarriage units were sheared off.

As a scan of the accident list for 2017 will quickly confirm, the most common kind of airline accident is still a runway excursion during landing. It is usually not fatal, but almost always results in damage to the aircraft »



» – sometimes serious damage. This has always been a weakness, but until the past decade it was masked as a potentially preventable accident category by the fact that it usually was not fatal, and by a focus on the accident categories that posed a greater risk to life at a time when accident rates were higher.

The Flight Safety Foundation (FSF) began carrying out studies in 2007 about how the risk of excursions and overruns might be reduced, and the main proposal was for airlines to brief their crews to ensure that they achieved a "stable approach" by a certain "gateway": for example passing 500ft on final approach. The basic criteria for a stable approach were these: at the gateway height the aircraft should be configured for landing; at or very close to the correct airspeed; and close to the correct glideslope and extended runway centreline. Weather conditions should have been confirmed to be within minima.

The hope was that the discipline imposed by having this defined objective would encourage pilots to work hard to achieve stabilised approaches early, rather than allowing the pilot the discretion to continue an unstable approach if a safe landing was deemed feasible. The FSF advice was that, on the rare occasion in this slightly idealised new world that the approach was still unstable at the gateway, the crew should abandon the approach and go around.

It has since become apparent from further FSF studies that runway excursions on landing remain commonplace, and that the guidelines for go-arounds are largely ignored. This is partly because go-arounds themselves – previously considered an uncomplicated manoeuvre – were found to involve potential hazards that needed to be balanced against the risk of continuing an unstabilised approach to land. This created confusion about what best to do.

So in March 2017 the FSF published updated guidance in its go-around decision-

PROCEDURES

The right time to make a go-around decision – and why pilots still choose not to

In March 2017 the Flight Safety Foundation's (FSF) Runway Safety team published the latest version of its report "*Reducing the risk of runway excursions*". Runway excursions continue to be the most common accidents involving airlines today.

The report states confidently that the implementation of its recommended procedures for flight discipline during final approach is the key to eliminating – or at least reducing – this most common accident type. But although airlines have been advised for more than 10 years to require their crews to abandon an approach if it is not stabilised – and to go around instead – crews have continued to ignore this standard operating procedure (SOP). The result has been a continued high rate of runway excursions during landing.

The FSF explains: "The problem of go-around policy noncompliance is real and is arguably the largest threat to flight safety today. The potential impact of improvement in compliance is significant. No other single decision can have such an impact in the reduction of aviation accidents as the decision to go around."

The foundation's headline change in March to its earlier guidelines is to declare that the 500ft go-around decision gate should be reduced to 300ft above airfield level, but it adds a qualification: "It should be understood that the 300ft AGL value is not intended to be absolute; it can be approximated to take advantage of aircraft automatic callout systems. For example, consider an ILS minimum set for 200ft AGL. Some manufacturer automatic callout systems provide an alert 80ft above minimums, so in such cases, 280ft AGL could be established as the go-around gate value and utilised in the auto callout in the active call procedures."

In providing this qualification to its advice, the FSF shows that it is fully aware of the complexities of decision-making for pilots at this most intense of all flight phases. Indeed, it spells this out: "Analyses indicate that flight crews who continue an unstable descent below 300ft do not recognise the need for increased concern – or the need for a go-around." So 300ft – or close to it – has been nominated as a kind of psychological tipping point beyond which the pilot should know that risks will increase – either the risk of continuing an unstable approach or of further delaying a go-around decision.

If the report has a fault it is that it tries to describe every single consideration, and there are hundreds. So while an airline operations policy team would do well to read the whole screed, they must still ensure that their SOPs are simple and clear.

The FSF identifies where the industry needs to start: "The first and foremost change required is that the industry must improve its awareness of the problem; to achieve this, a shift in focus and cultural norms is required. It is believed that significant improvement is attainable; however, the cultural shift will be much easier if the industry shifts collectively, as opposed to individual companies making changes on their own."

A part of the preparation for adopting the go-around philosophy is for airlines and crews to know what risks are associated with an all-engines-operating go-around. The most dramatic recent

making and execution project, which considers how best to achieve this balance between two sets of risks. It proposes that getting this decision right represents the best single chance that commercial air transport has to reduce accidents further (*see below*). While not abandoning the intention to establish a stable approach by 500ft, the most tangible recommendation of the new report is that the actual decision to land or go-around can be taken at 300ft above runway level.

Although 2017 did not include any fatal accidents resulting from loss of control in flight (LOC-I), it remains the biggest killer accident category of the past decade. For that reason the European Aviation Safety Agency has published initial changes to simulation requirements to improve pilot training for stall and in-flight upset scenarios. These changes are part of a rulemaking task designed to update flight simulation training device (FSTD) capabilities and specifications over the next two years.

The first package, WP1, is intended to exploit FSTD technological advances, and support authorities and training organisations by providing a "competencies framework" to guide inspectors. EASA adds that the package will support approach-to-stall training as well as upset and recovery requirements, and increase the fidelity of simulated airframe and engine icing effects. It also aims to approve full-flight simulators for training in the post-stall flight envelope, which had not previously been replicated by FSTD manufacturers because it is so unpredictable in the real aircraft, being subject to so many potential atmospheric variables.

Badly mismanaged descent led MyCargo 747-400F to crash at Bishkek, Kyrgzstan

Xinhua/REX/Shutterstock

EASA says 19 accidents during commercial air transport operations, over the five years from 2012 to 2016, were classified as LOC-I – of which 17 were fatal. Two of these fatal accidents involved companies with an EASA air operator's certificate. "Analysis of accidents and serious incidents shows that, in many cases, flight crew are caught by surprise in the event of an upset, or have limitations and difficulties in detecting the upset and the approach to stall," EASA says, adding: "In certain cases, the flight crew does not realise that the [aircraft] is in an actual stall." The agency says an analysis of 58 serious events over the 2012-2016 period indicated that in 10 cases – including four fatal accidents – training the crew in a simulator that has these advanced capabilities would have improved their ability to recognise and handle the approach to a stall, as well as recover from a full stall.

Meanwhile, with all those near-catastrophes in 2017 and the years before it that did not actually kill any passengers, it seems apparent that luck – an unfashionable concept these days – is playing an uncomfortable part in making the airlines' safety performance look better than it actually is. ■

example of the risks, especially at night or in instrument meteorological conditions, is the 2016 Flydubai Boeing 737-800 crash at Rostov-on-Don, Russia. A full-power go-around creates rapid linear acceleration, which can create somatogravic illusion in pilots. This is a powerful signal from the balance organs that the aircraft has pitched up dramatically, even when it has not, and the reaction can be – as at Rostov – to push the nose down.

When aircraft had a lower power/weight ratio, go-arounds were gentler. With today's jets, plentiful power means things happen fast – so pilots need to be ready for it. That means there is a need for recurrent crew training in all-engines go-arounds.

Str/EPA/REX/Shutterstock

Flydubai 737 tragedy at Rostov-on-Don in 2016 highlights risks of full-power go-arounds

The FSF has found that "go-arounds occur at an average rate of one to three per 1,000 approaches, but there is a large variation of go-around rates among different aircraft operators and operational environments." On average, the foundation observes, a short-haul pilot will conduct one or two in a year, and a long-haul pilot one every two or three years.

Finally, the FSF says: "A just culture must prevail if problems in go-around safety are to be sufficiently understood and addressed." Also, airlines must ensure their pilots do not perceive that they are under pressure to make a first-time landing, come what may. ■

INVESTIGATIONS

Accident reports issued during the second half of 2017

BH Air Airbus A320, Verona, 1 September 2009

Italian investigator ANSV has issued a final report on an event in which a dangerously out-of-balance BH Air Airbus A320 sustained several violent tail-strikes during take-off from Verona. The crew nearly lost control, but initially they chose to continue the flight. The agency said 77 passengers from Hurghada, Egypt, had disembarked at Verona, but the remaining 87 passengers continuing to Rome were not redistributed in the cabin. Fifty-eight of these passengers were seated aft, another 25 in the centre, and just four at the front. Although the ramp agent had submitted a load and trim sheet to the captain, and had told the cabin manager that passengers needed reseating, this was not done, possibly owing to a language misunderstanding. ANSV states that the pilots used the "flex" thrust setting for departure. The nose of the aircraft began to lift at just 30kt and both pilots pushed their side-sticks fully forward as the pitch reached 11°. Seven seconds into the take-off roll the captain reduced thrust briefly before increasing it to maximum. At 60kt the tail struck the runway, then there were repeated strikes, says the inquiry. With 15° nose-up, the aircraft became airborne at about 110kt. The pitch increased to 23° and, at 125kt, a stall warning sounded for 5s. The jet switched from direct to alternate flight-control law and a cabin altitude warning sounded as it climbed through 9,750ft. The crew initially asked to maintain 10,000ft and continue to Rome, but then advised they would return to Verona. Airbus calculated that the aircraft's centre of gravity would have been 43.75% mean aerodynamic chord – outside the operating limit. None of the occupants was seriously injured in the event.

Air India Airbus A319, Mumbai, 12 April 2013

Indian investigators believe crew fatigue was a causal factor when an Air India Airbus A319 landed on Mumbai's runway 27 when it had been temporarily closed for an inspection after a departing aircraft reported a bird strike. India's aircraft accident investigation bureau says the A319 (VT-SCL), arriving from Abu Dhabi, had been 8-10nm from Mumbai when it was instructed to contact Mumbai tower. Then, despite several air traffic control go-around instructions there was no response. A crew member of one of two vehicles on the runway saw an aircraft on short final, told the other vehicle and both left the runway. The captain had tried to establish contact with the tower but failed. The report says: "At the time there was a lot of disturbance and garbling on the frequency." None of the 88 occupants was injured and the aircraft was undamaged.

EasyJet Airbus A319, Basel, 20 July 2014

Swiss investigation authority SUST reports that an EasyJet Switzerland crew caused an Airbus A319 (HB-JZQ) to descend at excessive speed, before a sudden sidestick input threw several cabin crew to the floor. The aircraft was cleared to descend to 24,000ft approaching its destination at Basel, and had been operating in "open descent" mode, which sets engines at idle and uses pitch to achieve a selected airspeed – in this case Mach 0.76. SUST says the aircraft accelerated to 315kt IAS and was further cleared to descend to 18,000ft. The crew changed the descent mode to "vertical speed", setting 2,500ft/min, but the target speed was still M0.76. The engine power had to increase to achieve this combination. The airspeed reached 345kt, close to the A319's maximum operating speed of 350kt. The co-pilot became concerned about possible turbulence as the aircraft approached a cloud formation at around 20,000ft, and called for a speed check. The captain reduced the target speed to M0.54, but the aircraft had reached 349kt and he tripped out the autopilot and, the report says, "instinctively and abruptly" pulled back the sidestick. The overspeed warning sounded and the A319's pitch transitioned from 2.5° nose-down to 2° nose-up, pulling 2.33*g* in the process. The captain eventually set the speed at 275kt and the aircraft continued its descent normally. The aircraft was undamaged. The investigator comments that the cause of the incident was poor handling of autopilot flight modes during descent and a "lack of diligence" in monitoring flight parameters.

HESA IrAn-140, Tehran, 10 August 2014

Iranian investigators have provided their version of the causes of a fatal HESA IrAn-140 crash during departure from Tehran, revealing substantial disagreement with Ukrainian and Russian investigators. According to the Iranian Civil Aviation Organisation, the Sepahan Airlines aircraft (EP-GPA) suffered an electronic engine control system failure 2s before lifting off from Tehran Mehrabad airport, shutting off the fuel supply to the starboard engine's combustion chamber. Investigators state that the crew had used a departure flap setting of 10°, which was not approved by the airline, and the aircraft's take-off weight of 19,800kg exceeded the calculated maximum of 17,200kg. The inquiry says the aircraft flight manual procedure for calculating take-off weight was "not clear and confused the crew". It adds that, on engine failure when the autofeather system was slow to act, the crew failed to perform the manual propeller feathering procedure. The aircraft deviated to the right, climbed to about 130ft, stalled and crashed. Just eight of the 48 occupants survived. But the findings were challenged by the Interstate Aviation Committee (MAK) and the NBAAI, the respective investigative authorities for Russia and Ukraine. The IrAn-140 is an Iranian-built version of the Antonov An-140. MAK states that HESA has not requested certification of the IrAn-140 from the Russian authority, and points out that the An-140 type certificate "does not cover" the Iranian turboprop. It believes the engine failure was caused by uncontained damage of the air duct caused by separation of the air-bleed flange, and the failure was "nothing to do" with components of the electronic engine control. NBAAI says the aircraft could have been flown safely with the power loss, even in its over-weight state, but "erroneous" crew actions, including failure to retract the landing-gear, allowed the situation to evolve from being "major" to "catastrophic". The parties look highly unlikely to agree on the accident and its causes.

Zuma/REX/Shutterstock

Investigators disagree on factors leading to HESA IrAn-140 crash

Transportation Safety Board of Canada

Remains of Carson Air Metro II freighter were gathered inside TSB laboratory for detailed analysis

Safari Express Cargo Fokker F27, Serengeti national park, 31 August 2014

Investigators have been unable to determine the reason behind the destruction of a Safari Express Cargo Fokker F27 Mk 500 (5Y-SXP) on a positioning flight from Mwanza, Tanzania to Nairobi, Kenya. No data from the cockpit-voice recorder was available because of the damage, and only limited information from the flight-data recorder. On the previous flight, out of Nairobi, the payload had been explosives for mining. The report was not formally published, but the accident investigator of the certificating country – the Netherlands – took part and was supplied with a copy. Radar contact with the aircraft was lost 22nm before the boundary of Tanzanian and Kenyan airspace. The report says: "No radio contact could be established with the aircraft… The wreckage was located in the Serengeti national park. None of the occupants survived." There was no distress call. The flight-data recorder showed that the airspeed in the cruise had slowly declined, from 200kt to 150kt, while the aircraft's altitude had remained constant. Then the speed fell from 150kt to 63kt over a 25s period before rising to 123kt and falling again to 54kt – below the F27's stall speed. At the last point registered the aircraft's speed was given as 318kt, with its height at 5,861ft – in line with the elevation of the accident site. The report says: "There were no indications in the wreckage of an explosion."

SpiceJet Bombardier Q400, Karnakata, 8 March 2015

Pilot handling errors and a loss of visual cues resulted in a runway excursion by a SpiceJet Bombardier Q400 (VT-SUA) at Hubli airport, Karnataka, India. India's Aircraft Accident Investigation Bureau (AAIB) reports that the accident caused extensive damage to the aircraft's fuselage, its left and right wings, and the left propeller. Inbound from Bengaluru, the aircraft landed at Hubli at 19:15 local time in rainy weather. The aircraft had been cleared to conduct a non-directional beacon approach into runway 26, but for unknown reasons the captain opted to conduct a VOR/DME trial procedure instead. The crew flew a holding pattern for 20min as weather conditions had deteriorated again, then resumed the approach without requesting details of conditions, and air traffic control did not offer a weather update. The AAIB listed as contributory factors poor handling by the pilot-in-charge when trying to maintain directional control after landing, a non-standard callout by the pilot monitoring intended to correct the approach profile, and impact of the landing gear with non-frangible runway edge lighting units that did not comply with requirements. No injuries were reported among the four crew and 78 passengers, but the aircraft was written off.

Carson Air Swearingen Metro II, near Vancouver, 13 April 2015

The Transportation Safety Board of Canada (TSB) has concluded that the captain's consumption of alcohol contributed to the crash of a Carson Air Swearingen Metro II freighter near Vancouver. Post-mortem toxicology reports showed the 34-year-old captain's blood alcohol content was triple the legal limit for driving in the USA. Despite citing intoxication as a contributory cause, the agency was not able to determine the definitive cause of the accident, in which both pilots died. The Metro had disappeared from radar at 8,700ft altitude about 7min after take-off from Vancouver, bound for Saint George, the report says. It explains: "The aircraft entered a steep dive, then accelerated to a high speed which exceeded the aircraft's structural limits and led to an in-flight breakup." This suggests two possible causes: pilot incapacitation, or failure to use correct anti-icing procedures which could have caused erroneous airspeed indications.

Skytraders Airbus A319, Melbourne, 15 May 2015

The Australian Transport Safety Bureau (ATSB) has concluded that a number of autoflight mode selection errors and pitch-up illusions experienced by the pilot flying resulted in a Skytraders Airbus A319 (VH-VCJ) flying below the minimum safe altitude on approach to Melbourne's Tullamarine airport. The aircraft was operating from Perth with five crew and 18 passengers. Following clearance to descend to 3,000ft, the pilot flying made a number of autoflight mode selections, which led to the autothrust system disengaging and the engines entering the thrust lock condition, says the ATSB's final report. The pilot's actions to correct the situation resulted in an unexpected increase in thrust. He then reacted to the pitch-up illusion resulting from the acceleration by selecting a series of pitch-down inputs, and also retarded the thrust levers. The inputs resulted in a high rate of descent with an accelerating airspeed. This led the jet to descend below the cleared altitude, and triggered a terrain avoidance and warning system (TAWS) alert. The pilot declared a go-around and advanced the thrust levers to full power. When the engines responded, the pilot again reacted with pitch-down inputs. Two more TAWS alerts were activated before the pilot reversed the descending flight path and started a climb. The ATSB found that errors in the autoflight mode selection induced the thrust-locked condition.

IndiGo Airbus A320, Kolkata, 14 July 2015

Indian investigators believe the captain of an IndiGo Airbus A320 (VT-IEO) intervened too late to arrest a rapid descent before an extremely hard landing on runway 19L at Kolkata. The aircraft

»

INVESTIGATIONS

Accident reports issued during the second half of 2017

» touched down at a descent rate of 838ft/min, and registered an impact of more than 3.1*g* – higher than the 2.6*g* structural limitation. When giving clearance for the approach air traffic control had warned the crew of rain. The pilots discussed the possibility of windshear, and the first officer – the pilot flying – asked the captain whether he wanted to take control. The Indian Directorate General of Civil Aviation says the captain did not reply, despite the fact that the airline had issued a notice, just five days before, stating that supervised landings by the first officer were not permitted during monsoon or other marginal weather conditions. Two minutes before touchdown the wind dramatically changed direction, from south-east to north-west, and visibility deteriorated to 2,000m. Flight-data recorder information shows the pitch and rate of descent were normal until the A320 reached a height of 150ft. The rate of descent then increased from 528ft/min to more than 1,100ft/min. The captain noticed this sudden increase and instructed the first officer to correct it, then intervened, but too late to slow the descent. The aircraft touched down with a pitch of 5.6°.

Shaheen Air Boeing 737-400, Lahore, 3 November 2015

Investigators have detailed an extraordinary series of blunders by the captain of a Shaheen Air Boeing 737-400 before a landing accident at Lahore. The flight was so incompetently managed that it would sound like a comedy of errors if it had not come so close to tragedy. According to the Pakistani investigation authority (SIB), the captain was later found to have alcohol in his blood. The crew had been briefed to expect a VOR/DME approach to Lahore's runway 36L. This approach, says the SIB, was an "uncommon practice", because there is an instrument landing system on 36R, but that runway was closed for maintenance. Although the VOR/DME approach required 1,600m visibility and only

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R-R was advised to review Trent 1000 production following failure

1,200m was available, the crew opted to continue. Peshawar was the alternate airport but the forecast there was for rain. The aircraft was cleared for the VOR/DME approach to 36L, but the captain requested an ILS approach to 36R, intending to follow the ILS and then sidestep to complete the landing on 36L. The request was denied. The captain instructed the first officer to request an area navigation approach, even though the aircraft was not equipped with satellite navigation systems. When the first officer checked the flight management system, he found that the captain had incorrectly selected runway 18L for arrival. The report observes: "The conversation between captain and first officer at this time indicates that the captain had difficulty in identifying [or] reaching and entering the correct arrival procedure due to inability [to concentrate]. The first officer was continuously prompting the captain for decision-making." After informing Lahore approach that the aircraft was following the RNAV approach for 36L, the flight was cleared for the LEMOM 1C arrival pattern. But controllers noticed that the aircraft was 2,000-2,500ft above the required altitude at 20nm distance and suggested they abort the approach. The crew replied that they would continue. The aircraft passed over waypoint ELAMA, located 9.7nm from the threshold, above 5,000ft, instead of the cleared 3,000ft. The approach controller expected the crew to execute a go-around, but the captain – despite not having visual contact with the runway – disengaged the autopilot and increased the aircraft's rate of descent to between 2,000-3,500ft/min, exceeding the speed limit for the flap setting. Investigators state that, as the aircraft reached a distance of 4.6nm from the runway, it was flying at 1,200ft with speed of 170kt and a descent rate of 1,300ft/min – parameters which were "almost correct". The pilots could still not see the runway at 500ft and the first officer took over the controls before sighting the runway to the right. He levelled at 400ft and executed a right turn to align with the runway. The captain then sighted the runway at about 150ft and took back control, but was subsequently unable to align with the runway, and the 737 drifted to the right. When the first officer pointed this out, the captain told him to "relax". The first officer attempted to take control. Despite the transfer, the captain kept hold of the controls and the first officer had to urge him to release them. At touchdown some 1,400ft from the threshold at 166kt, both pilots were holding the controls. The reference speed was 134kt. After a slight bounce, the aircraft's left-hand main landing-gear suffered shimmy and separated, the right-hand main gear was then lost as the jet veered off the runway. None of the 142 passengers and six crew members was injured.

ASL Boeing 737-400F, Belfast, 4 October 2016

UK investigators have determined that a Boeing 737-400 freighter (OE-IAG) that suffered a right main landing-gear failure at Belfast International was probably the victim of wheel shimmy which fractured a torsion link. It was an ASL Airlines aircraft operating in the colours of newly acquired TNT Airways, and had arrived from East Midlands airport when it touched down on runway 25 at a ground speed of 153kt – the combination of a 148kt airspeed, already 7kt above the landing reference speed, and a 5kt tailwind component. After touchdown an "intense" vibration developed, says the UK Air Accidents Investigation Branch (AAIB), and the aircraft came to a halt at the intersection with the shorter runway 17/35, closing the airport. Metallurgical analysis of the lower torsion link, part of the structure which prevents rotation of the shock-strut piston, shows that it failed as a result of overload but there was no evidence of metal fatigue or of a maintenance error. The AAIB commented: "Accordingly it is possible that there was a failure of the damper or excessive freeplay in the joints which, combined with the high-speed landing, may have induced shimmy."

Polar Airlines Antonov An-26, Belaya Gora, 11 October 2016

Russian investigators believe an Antonov An-26 crew landed beside a runway after failing to see it under packed snow at the end of an NDB approach in conditions below minima. The Polar Airlines aircraft (RA-26660) had been approaching Belaya Gora's runway 07, following a service from Yakutsk. Russia's Interstate Aviation

Committee says tower controllers informed the crew about the snow but failed to give the visibility of 1,900m, which was below the prescribed conditions. Minimum conditions for the approach, it states, include 4,000m visibility and a 240m decision height. It adds that, on the approach path, the snow cover resulted in a more confusing landscape in the region of the Indigirka river. The crew did not make sufficient use of navigation aids during the approach which, says the investigator, resulted in "lack of proper control" over the aircraft's position on the glidepath. It landed 390m before the runway end, and displaced 230m to the left of its centreline, continuing for 720m before coming to a halt. It suffered substantial damage, but there were no fatalities among the 27 passengers and six crew.

Eastern Air Lines Boeing 737-700, New York LaGuardia, 27 October 2016

Several errors by the pilots caused an Eastern Air Lines Boeing 737-700 (N278EA) to overshoot runway 22 at New York LaGuardia airport in rain, the National Transportation Safety Board concludes. The NTSB says several crew mistakes in quick succession were the probable cause of the accident, which caused minor aircraft damage but did not harm passengers or crew. The 737 was operating flight 3452 from Fort Dodge, Iowa to LaGuardia with two pilots, seven cabin crew and 39 passengers, including then US vice-presidential candidate Mike Pence. Weather reports said LaGuardia had 2.6nm visibility in rain, and overcast at 2,200ft altitude. The crew had stabilised the 737 on an approach to LaGuardia's runway 22, but the landing flare started high, the NSTB says. The captain told the first officer: "Down, down, down, down. You're 3,000ft remaining." The first officer did not retard the throttles fully to idle until some 16s after the flare, at which point the aircraft's wheels had touched down, the NTSB says. The touchdown was more than 1,280m past the threshold of the runway, with only 841m of runway left. The NTSB observes: "When the first officer, who was at the controls, failed to get the jet's wheels on the ground within the first third of the runway… he should have executed a go-around." The captain deployed the speed brakes 4.5s after touchdown and 3.5s later commanded maximum reverse thrust, but he, also, failed to follow proper procedures, says the NTSB. "During the landing roll… the captain didn't announce he was assuming control of the airplane, which resulted in each pilot attempting directional inputs that were at odds with the other." The agency added: "This breakdown of basic crew resource management along with the captain's failure to call for a go-around demonstrated a lack of command authority." The aircraft entered the engineered materials arresting system overrun at a speed of 35kt and stopped about 52m past the runway end.

American Airlines Boeing 767-300, Chicago O'Hare, 28 October 2016

GE Aviation has issued a service bulletin calling on airlines to perform regular inspections of first and second stage high-pressure turbine disks on some CF6 turbofans following an uncontained engine failure in 2016. The second stage turbine disk of an American Airlines 767-300 (N345AN) engine ruptured as the aircraft accelerated through 80kt on runway 28R at Chicago O'Hare airport. US National Transportation Safety Board documents provide an update of the investigation into the catastrophic failure of the CF6-80C2B6, after which fire badly damaged the aircraft. The NTSB has yet to issue a probable cause. GE's service bulletin, issued in late June, recommended that airlines perform ultrasonic inspections at regular shop visits on all CF6-80C2 first and second stage high-pressure turbine disks produced before 2000. The US Federal Aviation Administration "has indicated that it may issue airworthiness directives" mandating the recommendations. The captain aborted the take-off and stopped the aircraft with 1,151m of runway remaining. All 161 passengers and nine crew evacuated using emergency slides, but one passenger was injured.

Sipa USA/REX/Shutterstock

Uncontained engine failure struck this American Airlines 767-300

Scoot Boeing 787-9, Singapore, 26 November 2016

Singapore has recommended that Rolls-Royce review the manufacture of the intermediate pressure (IP) compressor blades in the Trent 1000 to prevent future development of compressor blade cracks. The recommendation follows an incident involving a Scoot Boeing 787-9 where the right-hand engine failed, causing major mechanical and fire damage during a Sydney-Singapore flight. During the descent to Singapore, the flight crew heard a loud bang and noticed that the engine had shut down automatically. They also saw the caution message "ENG TURB DAMAGE R" on the engine indicating and crew alerting system and noted that there was no engine fire alert. The crew declared an emergency and landed at 18:42 local time. Ground checks on the right engine found that one blade from the first stage of the IP compressor and a variable inlet guide vane were missing. In addition, seven blades from the first stage IP compressor each had a crack of about 30.5mm on the front obtuse corner of the blade root, extending across the front face and along the top of the bedding flank. Some metal debris was also found to have embedded in the interior of the engine, and the trailing edges of five fan blades had significant impact damage. Local investigator the Transport Safety Investigation Bureau says it is probable that the missing first stage IP compressor blade also had a crack at its blade root. In addition, it adds that R-R has looked into the possibilities of the cracks having been caused during the blade manufacturing process, by material defect, or by excessive stress at the blade roots, but could not find any related evidence. R-R has developed a new ultrasonic inspection technique to detect cracks at the IP compressor blade root with the engine still on-wing. There were no reports of injuries or casualties among the 351 passengers and crew on board.

Accidents and incidents 2017

Notes on tables

Data comes from *Flight International*'s research in association with FlightGlobal advisory service Ascend, which compiles the World Aircraft Accident Summary, among other safety analysis products. In many countries details of non-fatal incidents are not made available officially, but *Flight International* continues to list known significant incidents to maximise the availability of relevant information. We accept that the non-fatal listing may be weighted against the airlines of those countries that make safety information more readily available.

Glossary of terms and abbreviations

AA airfield approach/early descent
AAL above airfield level
ACARS automatic communication addressing and reporting system
ADC air-data computer
ADF automatic direction finder
AF air force
AGL above ground level
AMSL above mean sea level
AOA angle of attack
ASI airspeed indicator
ATC air traffic control
C climb
CAVOK ceiling and visibility OK; no clouds below 5,000ft, 10km visibility, no bad weather forecast
CFIT controlled flight into terrain
CNK cause not known
CVR cockpit voice recorder
DME distance measuring equipment
ECAM electronic centralised aircraft monitor
EFIS electronic flight-instrument system
EGPWS enhanced ground proximity warning system
EGT exhaust gas temperature
EICAS engine indicating and crew alerting system
ER en route
ETOPS extended-range twin operations
FDR flight data recorder
FL flight level = altitude, in hundreds of feet, with international std pressure-setting (ISA) of 1013.2hPa set on altimeter (eg FL100 – altimeter reading of 10,000ft with ISA set)
FMS flight management system
G on ground
GPWS ground proximity warning system
IC initial climb
IFR instrument flight rules
ILS instrument landing system
IMC instrument meteorological conditions
ISA international standard atmosphere: sea level pressure of 1013.2hPa and standard temperature/pressure lapse rate with altitude
L landing
LP low pressure
MEL minimum equipment list
MTOW maximum take-off weight
NDB non-directional beacon
PAPI precision approach path indicator
PAX passengers
PF pilot flying
PNF pilot not flying
RA runway/final approach
SID standard instrument departure
TAWS terrain awareness and warning system
TCAS traffic alert and collision avoidance system
TO take-off
TOGA press-button selected take-off/go-around thrust
VFR visual flight rules
VHF very high frequency
VMC visual meteorological conditions
VOR VHF omni-range navigation beacon
V_1 take-off decision speed

Conversion factors

1nm = 1.85km
1ft = 0.3m
1kt = 1.85km/h

Date	Carrier	Aircraft type/registration	Location	Fatalities (crew/pax)	Total occupants (crew/pax)	Phase
Fatal accidents: scheduled mainline passenger flights						
None						
Fatal accidents: non-scheduled passenger flights						
27 Mar	**ETA Air Charter**	**B-N Islander (C9-AOV)**	Nr Mutare, Zimbabwe	2/4	2/4	ER
En route from Beira, Mozambique to Mutare the aircraft encountered storms and crashed into Mount Vumba near its destination.						
15 Nov	**Coastal Aviation**	**Cessna Grand Caravan (5H-EGG)**	En route, Empakaai, Tanzania	1/10	1/10	ER
Little detail is known at present. The operation involved the routine delivery of tourists and safari camp personnel to a camp and the accident occurred en route, killing all on board. This was the second accident in a month involving the same carrier, aircraft type (5H-THR) and operation. The other event, on 25 October, involved a runway excursion on landing and impact with a tree. In the latter case the aircraft was badly damaged and three occupants were injured.						
31 Dec	**Sydney Seaplanes**	**de Havilland Canada DHC-2 Beaver (VH-NOO)**	Jerusalem Bay, nr Cottage Point, New South Wales, Australia	1/5	1/5	IC
This chartered floatplane flight took off from the water near Cottage Point bound for Sydney. Witnesses say that, soon after lift-off, the aircraft turned sharply right, hit the water and sank.						
31 Dec	**Nature Air**	**Cessna Grand Caravan (TI-BEI)**	Punta Islita airport, Costa Rica	2/10	2/10	IC
This chartered aircraft carrying American tourists from a resort to San Jose crashed into a wooded area soon after take-off, killing all on board.						
Fatal accidents: regional and commuter flights						
15 Nov	**Khabarovsk Airlines**	**Let L-410 (RA-67047)**	Nelkan, Khabarovsk, Russia	2/4	2/5	RA
The aircraft was carrying out a daylight approach in good visibility to runway 04 at Nelkan when, at about 500ft above the ground, its right propeller effectively began producing reverse thrust. According to preliminary data from the FDR there are indications that the propeller had entered the fine-pitch beta range, normally only used on the ground. The investigating authority is still trying to discover what might have triggered this, because it does not appear to have been the crew that did so. The aircraft rolled right and slowed, descending almost vertically to crash about 1,500m from the runway threshold.						
13 Dec	**West Wind Aviation**	**ATR 42 (C-GWEA)**	Nr Fond du Lac airport, Saskatchewan, Canada	0/1	3/22	IC
The aircraft carried out a night take-off in snowy conditions with low cloud and temperature well below 0°C. Very soon after take-off it descended into an area of trees and scrub less than a kilometre beyond the airfield boundary. The aircraft was written off, clearly having impacted the ground with a high forward speed and taken some 750m to come to rest. One of the crew and six passengers were injured, and one of the passengers died about two weeks later of injuries received in the crash.						

Date	Carrier	Aircraft type/registration	Location	Fatalities	Total occupants	Phase
Fatal accidents: non-passenger flights						
16 Jan	**MyCargo Airlines**	**Boeing 747-400F (TC-MCL)**	Nr Bishkek airport, Kyrgyzstan	4	4	L

The aircraft, operating a flight from Hong Kong to Istanbul via Bishkek for Turkish Airlines, was totally destroyed by impact and post-impact fire when it crashed into the residential district of Dachi Suu during a go-around attempt from runway 26 at Manas International airport, Bishkek. The aircraft apparently struck the airport perimeter fence about 930m beyond the end of the runway and slightly to the right of the extended centreline, and continued into the housing estate, destroying a number of the buildings and killing many residents. The accident happened in darkness and poor weather with reduced visibility in freezing fog. Runway 26 is 4,204m long, the sky was obscured and vertical visibility was 50m. The aircraft appears to have followed the TOKPA 1 STAR, which required it to overfly waypoints RAXAT and TOKPA. The flight correctly overflew RAXAT as cleared at 18,000ft before handover to approach control, which instructed a further descent to 6,000ft. While the TOKPA waypoint should be overflown at 6,000ft, the aircraft actually crossed it at 9,200ft. The crew set the QNH and the flight was cleared to descend to 3,400ft. This altitude should be reached at 5.4nm distance from the airfield VOR and then maintained until ILS glideslope capture at 3.2nm. At this point the pilots were monitoring the flight's altitude and were apparently aware that they were high. The aircraft captured the ILS localiser 6nm from the VOR, but was still at 5,700ft. Investigators state that three autopilots were engaged in "flight level change" mode. It did not reach the required 3,400ft altitude until 1.7nm from the VOR. Although the glideslope mode was armed the aircraft was too high and missed the glideslope intercept, so it maintained level flight at 3,400ft. Just before the VOR, say the investigators, the aircraft intercepted and captured a false glideslope – the reflection at 9˚ rather than the real 3˚ slope – and it automatically commenced a descent, at rates of up to 1,425ft/min, as the airport and runway passed beneath it. The aircraft crossed the far end of the runway at a height of 110ft AGL and, after a ground-proximity warning system call-out at 100ft, the first officer declared: "Minimums". With no visual references, the captain ordered a go-around, although go-around thrust was not applied until the aircraft was just 58ft above the ground. The aircraft collided with upwardly-sloping terrain and obstacles at 165kt, with a 6*g* vertical impact, 3.5s after the go-around button was pressed.

12 Apr	**Spirit Avia Sentosa**	**Cessna Caravan (PK-FSO)**	Nr Oksibil, Indonesia	1	1	ER

En route from Tanahmerah bound for Oksibil, the aircraft hit high ground at about 7,000ft AMSL approximately 15km short of its destination.

01 May	**Grant Aviation**	**Cessna Caravan (N803TH)**	Nr Perryville, Aleutian peninsula, Alaska	1	1	ER

On a scheduled commuter flight that was only carrying mail at the time, the aircraft hit high ground en route from Port Heiden to Perryville, in the Aleutian peninsula, Alaska.

05 May	**Air Cargo Carriers**	**Shorts 330 (N334AC)**	Charleston-Yeager airport, USA	2	2	L

The aircraft, operating a flight from Louisville for UPS, was on a VOR approach and had been cleared to land on Charleston's runway 05. A witness at the airport reports that, following a hard touchdown about 100m beyond the threshold, the aircraft veered sharply left off the runway and dropped down a wooded slope. Investigators have revealed that the aircraft was not fitted with a CVR or FDR, and was not required to be.

27 May	**Summit Air**	**Let L-410 (9N-AKY)**	Lukla airport, Nepal	2	3	L

The aircraft crashed just short of Lukla's notorious sloping runway in the Himalayan mountains. Airport CCTV footage showed the aircraft had attempted to climb on final approach, possibly in an attempt to go around, but lost height with a nose-high attitude shortly before impact.

14 Oct	**Valan International**	**Antonov An-26 (ER-AVB)**	Abidjan airport, Cote d'Ivoire	4	10	L

The aircraft crashed into the sea on approach to runway 30, impacting the water well short of the runway and coming to rest on the shore 650m from the runway threshold. Reports suggest that the approach was conducted in heavy rain and gusting winds as a thunderstorm was passing through.

Date	Carrier	Aircraft type/registration	Location	Injuries (crew/pax)	Total occupants (crew/pax)	Phase
Significant non-fatal accidents/incidents (all commercial airline categories)						
02 Jan	**Doren Air Cargo**	**Let L-410 (9Q-CZR)**	Shabunda airport, DR Congo	0/0	2/2	L

The aircraft ran off the runway into trees after landing. It is believed to have suffered a tyre failure. The aircraft was written off.

03 Jan	**Aeroflot Russian Airlines**	**Airbus A321 (VP-BES)**	Khrabrovo airport, Kaliningrad, Russia	0/0	7/167	L

The aircraft overran runway 24 at night in sleet and snow showers with visibility reduced to 1,700m. The nose-gear collapsed.

10 Jan	**Philippine Airlines**	**Airbus A320 (RP-C8613)**	Kalibo airport, Philippines	0/0	?/?	L

The aircraft made a night landing on runway 05 with its main wheels 4m to the left, and ran thus for 500m before correcting onto the tarmac. The landing was completed safely but the aircraft sustained major damage.

25 Jan	**Air New Zealand**	**Airbus A320 (ZK-OXC)**	Christchurch airport, New Zealand	0/0	?/?	L

The aircraft landed hard (3.6*g*) on runway 29 in gusty conditions and suffered significant damage. The crew made a go-around and returned to land safely on runway 02.

MyCargo 747-400F crashed into a residential district near Manas airport in Bishkek, Kyrgyzstan

Xinhua/REX/Shutterstock

Xinhua/REX/Shutterstock

Approaching Wau in South Sudan, this South Supreme Airlines-operated An-26 struck a fire tender and burst into flames after landing

Date	Carrier	Aircraft type/registration	Location	Injuries (crew/pax)	Total occupants (crew/pax)	Phase
28 Jan	**Aer Caribe**	**Boeing 737-400F (HK-5197)**	Leticia airport, Colombia	0	4	L
The aircraft overran runway 21 after landing, and both main gear bogeys were later found to be significantly misaligned. Investigators are looking at information that may suggest the landing gear had been badly damaged on an earlier flight.						
01 Feb	**Garuda Indonesia**	**Boeing 737-800 (PK-GNK)**	Yogyarkarta airport, Indonesia	0/0	5/123	L
The aircraft veered left during a night landing on runway 09 and ran off onto soft ground. The aircraft itself suffered only minor damage, but the engines are believed to have ingested debris.						
07 Feb	**Western Air**	**Saab 340 (C6-HBW)**	Freeport airport, Grand Bahama	0/0	3/33	C
The aircraft suffered a significant electrical failure (left main essential bus) shortly after take-off from Freeport, and the crew elected to return. During the landing on runway 06 the left main gear collapsed and the aircraft swerved off the runway. There were some minor injuries.						
07 Feb	**Dniproavia**	**Embraer ERJ-145 (UR-DNP)**	Ivano-Frankivsk, Russia	0/0	4/44	L
Inbound from Kiev-Borispol the aircraft touched down on runway 10 in wet and snowy conditions, overrunning the end of the 2,475m-long runway by about 160m. It had arrived over the threshold about 8kt above the 138kt reference speed, and theoretically had sufficient distance to land, but the crew delayed braking by 4s. The surface co-efficient of friction was also probably lower than reported, the investigator observed.						
09 Feb	**North-Wright Airways**	**Beechcraft 1900D (C-FNWH)**	Tulita airport, Canada	0/0	2/6	G
While manoeuvring to park on the ramp the aircraft began to slide, and the captain's attempts to control it with differential power and braking were ineffective. The left wing hit the terminal building and suffered damage.						
17 Feb	**VIM Airlines**	**Boeing 737-500 (VP-BVS)**	Riga International airport, Latvia	0/0	7/40	TO
The pilot lost directional control during take off and the aircraft swerved left off the runway. The crew steered it back on before stopping, but the 737 was damaged by hitting equipment and signage.						
23 Feb	**Flybe**	**Bombardier Q400 (G-JECP)**	Amsterdam Schiphol airport, Netherlands	0/0	4/55	L
During the landing roll in gusty conditions a wing dropped at the flare and the aircraft touched down hard on the right main gear. The right gear leg slowly began to collapse backwards as if retracting, and the aircraft came to rest with the right wingtip touching the runway.						
25 Feb	**Air Canada**	**Airbus A320 (C-FDRP)**	Pierson International airport, Toronto, Canada	0/0	6/117	L
Inbound from Nova Scotia in darkness and poor weather associated with local thunderstorm activity, the aircraft veered off the right side of runway 15R, striking runway edge lights. The aircraft recovered to the runway before the end of its landing run, but suffered some minor damage.						
01 Mar	**BADR Airlines**	**Boeing 737-300 (C5-BDO)**	Nr Port Sudan, Sudan	0/0	6/119	ER
The aircraft ran off the runway into trees after landing. It is believed to have suffered a tyre failure.						
08 Mar	**Ameristar Charters**	**Boeing MD-83 (N786TW)**	Detroit Willow Run airport, USA	0/0	7/109	TO
During its take-off run the aircraft failed to rotate when the crew moved the control column, so the crew carried out a late abort. The aircraft overran the end of the runway by 350m, destroying approach lights, crashing through the perimeter fence and crossing a road. NTSB investigators found that the right elevator was jammed in a position that would have provided a nose-down input, although the control column moved normally and the left elevator was free to move. The agency also found that there had been damage to the pushrod system that operates the right elevator geared tab, and it was this that was restricting elevator movement. The FDR indicates that the aircraft reached a maximum IAS of 173kt before the abort drill started. The aircraft had been chartered to carry the University of Michigan basketball team to a match in Washington DC.						
17 Mar	**Cargo North**	**Douglas DC-3 (C-FKGL)**	Pickle Lake, Ontario, Canada	0	3	TO
The aircraft had an apparently normal take-off run from runway 27 and lifted off at 83kt IAS, but it then failed to accelerate or climb further. The crew chose to make a belly landing straight ahead on the frozen surface of Pickle Lake, and the aircraft eventually came to rest on the lake about 1,300m beyond the departure end of runway 27. There was light snow falling, the temperature was -1˚C and the dew point -3˚C.						
17 Mar	**Regional Express**	**Saab 340 (VH-NRX)**	Nr Sydney airport, Australia	0/0	3/16	ER
Noticing vibration from its right engine, the crew began an engine shutdown procedure, but the propeller separated. The crew continued to Sydney and landed safely. Initial reports from the Australian Transport Safety Board (ATSB) report that fatigue cracking in the propeller drive shaft led to its failure and propeller separation. The ATSB report says: "Fatigue cracking in the propeller main shaft originated within a dowel pin bore that was located on the forward face of the propeller flange from the propeller reduction gearbox." Working with the ATSB, engine manufacturer GE Aviation has released two service bulletins detailing inspections for operators of CT7-series engines.						

Date	Carrier	Aircraft type/registration	Location	Injuries (crew/pax)	Total occupants (crew/pax)	Phase
19 Mar	**Pelita Air Services**	**ATR 72 (PK-PAV)**	Jakarta International airport, Indonesia	0/0	4/22	L
Inbound from Cilacap, Jawa Tengah, the aircraft carried out a daylight ILS approach to runway 24 in light winds. It bounced on landing, touching down a second time and bursting the nosewheel tyres, disabling the aircraft on the runway.						
20 Mar	**Total Linhas Aereas**	**ATR 42 (PR-TTH)**	Porto Urucu airport, Brazil	0	4	L
Landing in darkness and conditions of heavy rain, the crew lost directional control during the landing run, and the aircraft swerved off the runway to the left about 700m from the runway threshold, and its nose gear collapsed.						
20 Mar	**South Supreme Airlines**	**Antonov An-26 (S9-TLZ)**	Wau airport, South Sudan	?/?	5/44	L
Approaching Wau runway 27 from Juba in poor visibility, the aircraft's main gear struck a fire and rescue tender next to the runway, damaging it badly. The aircraft continued to land but burst into flames. The numbers on board are uncertain, and although no-one was killed it is not known if, during the evacuation, there were any injuries.						
20 Mar	**Western Air Express**	**Swearingen Metro II (N158WA)**	Boise airport, Idaho, USA	0	1	TO
At rotate during take-off the left propeller was damaged by debris on the runway. The pilot noticed vibration and returned to Boise, landing safely. It was discovered that one of the blade tips had detached and penetrated the fuselage just aft of the main passenger door. A check of the runway near the aircraft's rotation point revealed further blade tip fragments and a tool that had been used to maintain the aircraft during turnaround.						
27 Mar	**Taban Airlines**	**Boeing 737-400 (EP-TBJ)**	Ardabil airport, Iran	0/0	185	L
The aircraft, inbound from Mashhad, burst a tyre on landing and the right main gear collapsed.						
28 Mar	**Peruvian Airlines**	**Boeing 737-300 (OB-2036P)**	Jauja airport, Peru	0/0	9/141	L
The aircraft landed hard, the right main gear collapsed, and it veered to the right off runway 31, coming to rest at the perimeter fence. A small fire spread rapidly and the aircraft was destroyed.						
01 Apr	**Eagle Air**	**Let L-410 (5X-EIV)**	Yei airfield, South Sudan	0/0	3/20	TO
The aircraft left the runway after failure to lift off from its take-off run.						
08 Apr	**Malaysia Airlines**	**Boeing 737-800 (9M-MXX)**	Sibu airport, Malaysia	0/0	6/63	L
The aircraft, having gone around from its first approach because of heavy rain, landed on runway 13 in a squally shower that dramatically reduced visibility, and touched down 540m from the threshold and 13m right of the centreline. The pilot monitoring called for a go-around but the pilot flying continued the landing run. The aircraft ran off the runway right side and continued nearly 500m on soft ground parallel to the runway, coming to a halt diagonally across the runway edge with the nose gear collapsed and damage to the fuselage, engine cowling and flaps. The investigator remarked that the airline should provide crews with clearer guidance on approaches in heavy rain and storms, particularly on runways with no centreline lighting.						
13 Apr	**Daily Air**	**Viking Air Twin Otter (B-55571)**	Orchid Island airport, Taiwan	0/0	2/17	L
Landing on runway 13 in a strong crosswind, the aircraft veered left off the runway and hit obstacles causing damage to the left wing and engine and the aircraft's nose.						
28 Apr	**Nesma Airlines**	**Airbus A320 (SU-NMC)**	Abha airport, southern Saudi Arabia	0/0	?/?	L
The aircraft, carrying out a night landing inbound from Cairo, overran the far end of runway 31 by 186m and suffered foreign object damage to both engines. Thunderstorms and rain were reported in the area at the time.						
02 May	**Malaysia Airlines**	**Boeing 737-800 (9M-MXN)**	Kuala Lumpur airport, Malaysia	0/0	?/?	L
Both tyres on the aircraft's left main gear failed during landing, and tyre debris damaged the fuselage and left wing. The aircraft stopped safely on the runway and the passengers were disembarked using airstairs.						
08 May	**Iran Aseman**	**Fokker 100 (EP-ATF)**	Tehran Mehrabad airport, Iran	0/0	?/?	TO
The aircraft, scheduled for a domestic flight, was cleared for take-off on runway 29R, but an ATA Boeing MD-83 that was supposed to be taxiing to the 29R holding point entered the runway uncleared. The Fokker crew saw the MD-83 but, having reached V1 decision speed, were commited to take-off, rotated and flew over the top of it. The aviation authority has recommended a language proficiency review.						
24 May	**China Eastern Airlines**	**Airbus A321 (B-6366)**	Hong Kong Chek Lap Kok airport	0/0	?/?	L
The aircraft landed from an ILS approach from Nanjing when it left the runway's right-hand side. Windshear is suspected, because there was turbulence and a strong wind from the north. The runways are orientated approximately east-west (07/25).						
27 May	**Trans Maldivian Airways**	**de Havilland Canada DHC-6 Twin Otter (8Q-TMV)**	Male water aerodrome, Maldive Islands	0/0	3/9	L
The aircraft suffered damage in a bad water landing and beached with its nose and left wing on the surface.						
31 May	**Sriwijaya Air**	**Boeing 737-300 (PK-CJC)**	Manokwari airport, Indonesia	0/0	6/146	L
After landing long on Manokwari's runway 35 in heavy rain, the aircraft overran the hard surface by some 20m and the nosewheel collapsed.						
02 Jun	**Aeronaves TSM**	**Swearingen Metro III (XA-UAJ)**	Tampico airport, Mexico	0	2	L
En route from Saltillo to Puebla, Mexico, the crew made a decision to divert to Tampico, reportedly for fuel reasons. One of the engines had stopped in the cruise and the crew decided to divert to Tampico. During the descent the second engine also stopped. The aircraft made a forced landing in the dark, landing within the airfield area but short of runway 31.						
03 Jun	**Safari Express Cargo**	**Fokker F27 (5Y-FMM)**	Garbaharey airport, Somalia	0	4	L
This UN charter flight was carrying humanitarian supplies. During the approach to Garbaharey the 50-year-old Fokker F27 hit the top of a 2m-high wall short of the runway. When it touched down the right main undercarriage failed, the aircraft veered right off the runway, and the right wing broke off outboard of the engine.						
25 Jun	**AirAsia X**	**Airbus A330-300 (9M-XXE)**	Off Western Australian coast	0/0	?/359	ER
About an hour out of Perth, just offshore from the Western Australian coast near Carnarvon en route to Kuala Lumpur, the No 1 Rolls-Royce Trent 772B-60EP engine suffered a fan blade fatigue failure and separated about a quarter of its length from its base. The crew shut the engine down and flew the aircraft back to Perth, where it landed safely. The blade and associated debris was contained within the engine cowling. Once shut down the engine had continued to windmill, causing airframe vibration.						
03 Jul	**Martinaire**	**Cessna 208B (N9714B)**	Nr Alpine airport, Texas, USA	1	1	C
Climbing through about 500ft after a daylight take-off a mechanical failure occurred and the engine lost power. The pilot feathered the propeller and made a forced landing more or less ahead, and both wings were wrecked by hitting obstacles before the aircraft came to rest.						
21 Jul	**Sunwing Airlines**	**Boeing 737-800 (C-FWGH)**	Belfast International airport, UK	0/0	?/?	TO
The aircraft barely became airborne by the runway departure end and made a very shallow climb. Boeing believes the crew had entered an incorrect air temperature into the FMS, resulting in a low thrust setting for take-off that the crew did not notice. The UK Air Accidents Investigation Branch observed that in a slightly different scenario – if the runway had been shorter or surrounding terrain higher – the result could have been catastrophic. "Once the thrust had been set for take-off, there were no effective barriers in place to prevent the worst possible outcome," said the report. Investigators observed that in several similar occurrences pilots have also failed to notice the slow acceleration, and therefore failed to apply full power. In 2014 Boeing published an operations bulletin citing three similar events and urging pilots to verify their air temperature data entry.						

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Date	Carrier	Aircraft type/registration	Location	Injuries (crew/pax)	Total occupants (crew/pax)	Phase
29 Jul	**Cavok Air**	**Antonov An-74 (UR-CKC)**	São Tomé airport, São Tomé and Príncipe	0	5	TO
A birdstrike during the take-off run caused the crew to abort take-off, but the aircraft overran the runway end, ran down a slope and was so badly damaged it was written off.						
03 Aug	**Lion Air**	**Boeing 737-900 (PK-LJZ)**	Medan Kualanamu airport, Indonesia	0/0	7/144	L
The 737 was landing on runway 23, weather was daylight CAVOK, and a Wings Air ATR 72 (PK-WFF) was lining up on the same runway from the left. The left wing of the 737 collided with the right wing of the ATR, damaging both wings severely. The ATR 72 was written off.						
28 Aug	**Coco Aviation**	**Antonov An-26 (EK-26006)**	Maban airstrip, South Sudan	0	?	L
In wet conditions the aircraft overran the runway end and suffered damage that started a fire.						
10 Sep	**Serve Air**	**Antonov An-26 (9S-AFL)**	Goma airport, Democratic Republic of the Congo	0	4	L
The aircraft suffered a No 1 engine power loss soon after departure from Goma and the crew elected to return. Touchdown was half-way along runway 35, and the aircraft overran onto an old lava field, causing the gear to collapse. The aircraft was written off.						
10 Sep	**Emirates**	**Airbus A380 (A6-EEZ)**	Moscow Domodedovo airport, Russia	0/0	?/446	RA
On the aircraft's first of three ILS approaches to runway 14R the aircraft had descended to 400ft above airfield level while still 7.5nm from the runway threshold – at which distance it should have been passing 2,400ft height – and the EGPWS sounded a ground proximity alert. The crew carried out a go-around and returned to the same approach, but much the same happened and the crew aborted the approach for a second time. The third time the aircraft landed safely.						
17 Sep	**Royal Wings**	**Boeing 737-300 (JY-SOA)**	Aqaba airport, Jordan	0/0	6/120	L
Inbound from Amman, the aircraft was carrying out an approach to runway 19 in clear weather with a slight tailwind. It touched down more than half-way along the 3,000m runway and overran the end by 200m, suffering major damage.						
30 Sep	**Air France**	**Airbus A380 (F-HPJE)**	En route over Greenland	0/0	24/497	ER
The aircraft's No 4 engine suffered an uncontained failure in the cruise over Greenland at FL370 heading west, which resulted in the separation of the whole fan and inlet cowling. The crew diverted to Goose Bay airport, Canada and landed safely on runway 26. There was also damage to the wing leading edge near the failed Engine Alliance GP7200.						
13 Oct	**Cebu Pacific Air**	**Airbus A320 (RP-C3237)**	Iloilo airport, Philippines	0/0	6/174	L
After landing on runway 20 in heavy rain and strong winds the aircraft veered off the left side of the runway and came to rest on soft ground with its nosewheel collapsed.						
06 Nov	**TAP Portugal**	**Embraer 190 (CS-TPV)**	Nice Côte d'Azure airport, France	0/0	?/?	TO
Cleared for a night departure on runway 04L, the crew inadvertently lined up on a parallel taxiway and began the take-off roll. BEA, the French investigator, said the tower controller realised what was happening after a few seconds and told the crew to abort, which they did, but they had reached 92kt and travelled about 1,000m. Having stopped, the crew turned the aircraft around, taxied to the correct runway and took off as planned for Lisbon. The BEA has classified the event as "serious".						
08 Nov	**Airlink**	**BAE Systems Avro RJ85 (ZS-ASW)**	En route Harare-Johannesburg, South Africa	0/0	?/?	ER
Full details have not yet been released, but there was an uncontained failure of the aircraft's left outboard Honeywell LF507 engine, and the resulting debris released by the No 1 damaged the adjacent No 2 engine, so the crew shut them both down. The crew elected to continue to Johannesburg, where they landed safely using the two remaining serviceable engines.						
16 Nov	**Philippine AirAsia**	**Airbus A320 (RP-C8977)**	Tagbilaran airport, Philippines	0/0	150	L
The aircraft suffered major damage in a very hard night landing.						
25 Nov	**Starbow Airlines**	**ATR72 (9G-SBF)**	Accra Kotoka airport, Ghana	0/5	5/63	TO
During the take-off roll on runway 21 the captain's seat suddenly slid backward and to the left on its rails. The captain's hand was on the nosewheel tiller, and the seat movement caused him to pull it inadvertently to the left. The aircraft, which had achieved a speed of about 70kt, veered leftward off the runway and eventually came to rest near the perimeter fence after the copilot had closed the throttles. The aircraft and propellers suffered serious damage.						

Starbow ATR 72 leaving Airbourne Colours' paint shop in the UK, two weeks before being badly damaged in Ghana, as 9G-SBF

AirTeamImages

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Flight International

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Trump reveals secret warplane

Just before he took office, President Trump warned "the F-35 program and cost is out of control". Now, after claiming credit for slashing the price of the Lockheed Martin fighter, the greatest military brain to occupy 1600 Pennsylvania Avenue appears to be a huge fan. In November, he praised the F-35 as an aircraft the "enemy literally cannot see", even when fighting close up.

But Trump has also been hailing another type: the F-52. An F-52? Trump explains: "In November we started delivering the first F-52s and F-35 fighter jets," he told a White House event attended by the Norwegian premier just after her country began accepting its new Joint Strike Fighters.

Had Trump just revealed a secret warfighter dispatched to Oslo to counter a frontline Russian threat?

Sadly, the F-52 exists only in the game Call of Duty. As well as tweeting and watching Fox News, does Trump also spend part of his "executive time" playing video games?

Lav record

Lewis Hamilton "went crazy" when he discovered his pilot had made what might be delicately described as an extended pit stop in the toilet of his Bombardier Challenger 605, the Formula One ace's ex-girlfriend has revealed to a UK Sunday newspaper.

It left us wondering whether what really distinguishes a VVIP from a run-of-the-mill VIP might be the ability to afford a private jet with more than one lav, or flightcrew with robust enough constitutions to schedule their movements between… er… movements? We think the answer needs to be flushed out.

AirTeamImages

"Thank God, Hoskins, the chequered flag."

Ryanair rebound

When Ryanair cancelled thousands of flights last September over a pilot rostering mix-up, it left passengers stranded or forced to cancel travel plans. The media was full of interviews with disgruntled customers vowing never to fly with the budget airline again.

How short memories are. Earlier this month, Ryanair announced it had smashed its weekly bookings record, taking more than three million bookings in seven days. The carrier couldn't help taking a swipe at another airline fronted by a charismatic businessman, noting that the three million equates to "more than half of the total passengers Virgin Atlantic carry [sic] in an entire year".

Roger-Viollet/REX/Shutterstock

Aaah... definitely a Gipsy Moth

Gipsy spell

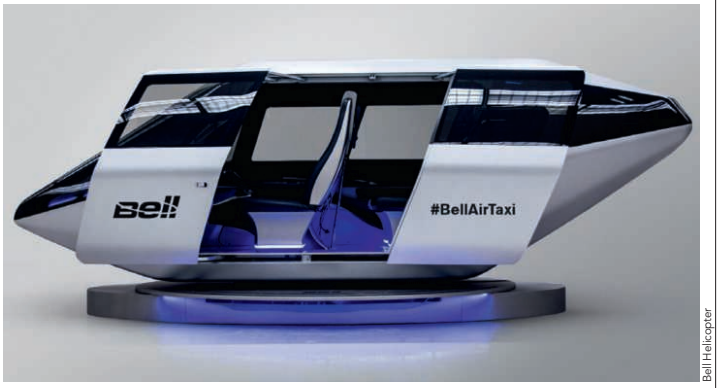
One of the pitfalls of compiling a page where we poke fun at errors or confusion in the less-knowledgeable media is that we are very exposed when we make our own cock-ups.

"Here at the de Havilland Moth Club," writes secretary Stuart McKay, "It is a capital offence to spell the name of the de Havilland DH.60 Moth fitted with a Gipsy engine, as was Amy Johnson's DH.60 Gipsy Moth, G-AAAH, Jason, in any way other than Gipsy."

Yes, in last week's Straight & Level, we wrote "Gypsy".

Yuckspeak

"A people-first engineered user experience" = a flight in a helicopter, or at least one in Bell's newly-revealed four-seat air taxi cabin concept, according to the manufacturer.



Bell Helicopter

"Fancy a quick people-first engineered user experience?"

Spies caught

100 YEARS AGO

Among the haul of spies reported from New York on January 15th was Walter Sporrman, a lieutenant in the German Navy, who was caught red-handed while endeavouring to blow up the magazine at the Hampton Aviation Base in Virginia.

New containers

75 YEARS AGO

To supply their troops with water or fuel, the Germans are using new containers. It is said that they can be dropped from the air without damage. They have been nicknamed "Jerricans."

Order cancelled

50 YEARS AGO

Something is not quite right with a system which cancels a British aircraft [the TSR-2] at a cost of about £200 million, vehemently defends a replacement order for the rival American project [the F-111], then cancels that at a cost of perhaps £50 million. As a result, the RAF will be without long-range strike and reconnaissance ability from about 1975.

After the Shuttle

25 YEARS AGO

Outgoing US Vice-President Dan Quayle, in his final report as head of the President's Space Council, has urged that a replacement for the "expensive and unresponsive" Space Shuttle be ready in 12 years.

Flight International

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The Editor, Flight International, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK
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A380's future: a jumbo question

The Reverend Craig Smith's letter (*Flight International*, 2-8 January) begs some clarification.

Obviously, wider use of the Airbus A380 could hugely alleviate airport congestion in terms of runway and taxiway congestion. As a corollary of this, sooner or later the operators will be forced to take the plunge.

On the other hand, for the airport infrastructure, especially customs, immigration and baggage, a steady flow of passengers from an equally steady flow of smaller aircraft is easier to handle as opposed to batches of 500 to 800 passengers in one lump.

Additionally, since the A380's conception, considerable progress has been made in terms of aerodynamic and engine efficiency, this has been incorporated in many newer long-range twins making them, at least on paper, a more attractive proposition. Ultimately though, this has to be a false precept, although it demands a superjumbo capable of showing a profit with the current average route load.

Several A380 operators urged Airbus to go for an A380neo, which it considered but did not take up. Perhaps time will show this was a major tactical misjudgement, since logic dictates that continued proliferation in airliner movements must eventually lead to a log jam on runways and perhaps in air traffic.

The A380 is perhaps simply, and no more than slightly, out of phase with requirements.

Richard Chandless
Crêches-sur-Saône, France

ENGINES

Rolls-Royce is a driving force

In response to Matt Wood's letter (*Flight International*, 9-15 January) regarding the Rolls-Royce Avon engine.

I wonder what caused the Avon's fan blades to fail in the first place?

The numbers show that R-R engines now have the right combination of weight, efficiency, reliability, durability and cost, leading to an orderbook measured in the billions, and competing effectively with the subsidised US industry.

Dassault Aviation

5X axed due to Silvercrest delay

This is rather different from the Conway, Spey, Avon, Olympus etc of yesteryear. Any engine designed to run with several blades missing is never going to achieve any of the above.

R-R is an excellent example of the high-quality engineering application of a fast-moving, cutting-edge technology, where one wrong decision can lead to a very expensive mistake – the recent Safran Silvercrest/Dassault Falcon 5X debacle perfectly illustrates this.

As for Mr Wood's suggestion that the company gets "back to basics": one – beware rose tinted glasses; two – don't look backwards when trying to move forwards; three – don't over-engineer the product.

Paul Burch
Farnham, Surrey, UK

Evidence is clear

In response to Peter Gambardella's letter (*Flight International*, 9-15 January): my original letter, published in the previous issue, was aimed at defending *Flight International*'s impartiality. I made no comment for or against Brexit.

The article Mr Gambardella complained of was straight reporting of evidence given to a parliamentary committee by the senior vice-president of Airbus UK.

I am sure she is as keen as Mr Gambardella to keep wing design and manufacture in the UK. She was identifying her concerns about risks to that business.

One hopes her words were heard and understood in the relevant government departments as they decide on the UK negotiating stance with the EU.

I can assure Mr Gambardella that no-one at that level makes any statements in public of this sort without giving the matter exhaustive consideration.

If the honestly held views of the most senior professionals in British aerospace are not evidence, I simply do not know what is.

Bob Owen
Sherborne, Dorset, UK

A technical issue

Recent correspondence to *Flight International* pointed to the magazine's weakening technical content.

I agree: just look at the Festive Quiz (*Flight International*, 12 December 2017-1 January) – not even one technical question.

Just questions of the learn-by-rote type after names and companies.

Clemens Zehnder
Pfaffhausen, Switzerland

Management is key to safety

Your article about the safety performance of airlines in 2017 (*Flight International*, 9-15 January) contains a statement which exposes a fundamental lack of understanding of the guiding principle of the safety management system.

The article says that airlines are now achieving an "almost risk-free performance".

The only possible way they could do that would be by staying on the ground.

Aviation safety is all about identifying operational risks and managing them to an acceptable level.

Steve Bond
via email

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EVENTS

6-11 February
Singapore Airshow
Changi, Singapore
singaporeairshow.com

13-15 February
Routes Americas
Quito, Ecuador
routesonline.com

26 February-1 March
HAI Heli-Expo
Las Vegas, Nevada, USA
heliexpo.rotor.org

3-10 March
IEEE Aerospace Conference
Big Sky, Montana, USA
aeroconf.org

13-15 March
IATA World Cargo Symposium
Dallas, Texas, USA
iata.org

18-20 March
Routes Asia
Brisbane, Australia
routesonline.com

3-8 April
FIDAE 2018
Santiago, Chile
fidae.cl

10-12 April
Aircraft Interiors Expo
Hamburg, Germany
aircraftinteriorsexpo.com

18-21 April
Aero Friedrichshafen
Friedrichshafen, Germany
aero-expo.com

25-29 April
ILA Berlin Air Show
Berlin, Germany
ila-berlin.com

8-10 May
AIAA Defence Forum
Laurel, Maryland, USA
defense.aiaa.org

29-31 May
EBACE
Geneva, Switzerland
ebace.aero

13-15 July
Royal International Air Tattoo
RAF Fairford, Gloucestershire, UK
airtattoo.com

16-22 July
Farnborough International Airshow
Farnborough, UK
farnboroughinternational.co.uk

23-29 July
EAA AirVenture
Oshkosh, Wisconsin, USA
eaa.org/en/airventure

19-23 September
Africa Aerospace & Defence
Waterkloof, South Africa
aadexpo.co.za

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EDITORIAL, ADVERTISING, PRODUCTION & READER CONTACTS

EDITORIAL +44 20 8652 3206
Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK
flight.international@flightglobal.com

Editor Craig Hoyle
+44 20 8652 3834 craig.hoyle@flightglobal.com
Deputy Editor Dominic Perry
+44 20 8652 3206 dominic.perry@flightglobal.com
Head of Strategic Content Murdo Morrison FRAeS
+44 20 8652 4395 murdo.morrison@flightglobal.com
Features Editor Dan Thisdell
+44 20 8652 4491 dan.thisdell@flightglobal.com
Business & General Aviation Editor Kate Sarsfield
+44 20 8652 3885 kate.sarsfield@flightglobal.com
Consulting Editor David Learmount
+44 7785 901787 david.learmount@ntlworld.com
Magazine Enquiries
flight.international@flightglobal.com

AIR TRANSPORT TEAM
Editor Flightglobal Premium News Graham Dunn
+44 20 8322 6858 graham.dunn@flightglobal.com
Managing Editor Niall O'Keeffe
+44 20 7911 1316 niall.okeeffe@flightglobal.com
Managing Editor – Flight Airline Business
Lewis Harper +44 20 7911 3105
lewis.harper@flightglobal.com
Air Transport Editor David Kaminski-Morrow
+44 20 8652 3909
david.kaminski-morrow@flightglobal.com
Aerospace Editor Michael Gubisch
+44 20 7911 1311 michael.gubisch@flightglobal.com
Senior Reporter Oliver Clark
+44 20 7911 1313 oliver.clark@flightglobal.com

AMERICAS
Americas Managing Editor Stephen Trimble
+1 703 836 8052 stephen.trimble@flightglobal.com
Deputy Americas Editor – Air Transport
Ghim-Lay Yeo
+1 703 836 9474 ghimlay.yeo@flightglobal.com
Americas Finance Editor Edward Russell
+1 703 836 1897 edward.russell@flightglobal.com
Senior Reporter Jon Hemmerdinger
+1 703 836 3084 jon.hemmerdinger@flightglobal.com
Aviation Reporter Leigh Giangreco
+1 703 836 7442 leigh.giangreco@flightglobal.com

ASIA/PACIFIC
Asia Editor Greg Waldron
+65 6780 4314 greg.waldron@flightglobal.com
Asia Air Transport Editor Mavis Toh
+65 6780 4309 mavis.toh@flightglobal.com
Asia Finance Editor Ellis Taylor
+61 498 878 583 ellis.taylor@flightglobal.com
Reporter Aaron Chong
+65 6780 4851 aaron.chong@flightglobal.com
Reporter Firdaus Hashim
+65 6780 4313 firdaus.hashim@flightglobal.com

EUROPE/MIDDLE EAST
Israel Correspondent Arie Egozi

FINANCE
Global Finance Editor Sophie Segal
+1 212 448 2253 sophie.segal@flightglobal.com
Europe Finance Editor Jamie Bullen
jamie.bullen@flightglobal.com

FLIGHTGLOBAL.COM
Editorial Content Manager
Rebecca Springate
+44 20 8652 4641
rebecca.springate@flightglobal.com

EDITORIAL PRODUCTION
Global Head of Design & Production
Alexis Rendell
Chief Copy Editor, Europe Dan Bloch
Layout Copy Editors Sophia Huang, David Mawer, Tim Norman
Global Production Editor Louise Murrell
Deputy Global Production Editor Terence Burke
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Consulting Technical Artist Tim Hall

DISPLAY ADVERTISEMENT SALES
Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK

EUROPE
Global Sales Manager Mark Hillier
+44 20 8652 8022 mark.hillier@flightglobal.com
Key Account Manager Grace Murphy
+44 20 8652 3469 grace.murphy@flightglobal.com
Sales Support Gillian Cumming
+44 20 8652 8837 gillian.cumming@rbi.co.uk

NORTH & SOUTH AMERICA
Vice-President, North & South America
Rob Hancock +1 703 836 7444
robert.hancock@flightglobal.com
Regional Sales Director
Warren McEwan +1 703 836 3719
warren.mcewan@flightglobal.com
Sales Executive Kaye Woody
+1 703 836 7445 kaye.woody@flightglobal.com
Reed Business Information, 333 N.Fairfax Street, Suite 301, Alexandria, VA 22314, USA

ITALY
Sales Manager Riccardo Laureri
+39 (02) 236 2500 media@laureriassociates.it
Laureri Associates SRL, Via Vallazze 43, 20131 Milano, Italy

ISRAEL
Sales Executive Asa Talbar +972 77 562 1900
Fax: +972 77 562 1903 talbar@talbar.co.il
Talbar Media, 41 HaGiva'a St, PO Box 3184, Givat Ada 37808, Israel

ASIA/AUSTRALASIA
Key Account Manager Jay Ee
+65 6780 4301 jay.ee@flightglobal.com
Fax: +65 6789 7575
1 Changi Business Park Crescent, #06-01 Plaza 8 @ CBP, Singapore 486025

RUSSIA & CIS
Director Arkady Komarov
komarov@worldbusinessmedia.ru
Tel/Fax: +7 (495) 987 3800
World Business Media, Leningradsky Prospekt, 80, Korpus G, Office 807, Moscow 125190, Russia

CLASSIFIED & RECRUITMENT
Business Development Manager Katie Mann
+44 20 8652 3074 katie.mann@flightglobal.com
Sales Manager Sophie Wild
+44 20 8652 4239 sophie.wild@rbi.co.uk
Key Account Manager Jay Ee
+65 6780 4301 jay.ee@flightglobal.com

ADVERTISEMENT PRODUCTION
Production Manager Sean Behan
+44 20 8652 8232 sean.behan@rbi.co.uk

MARKETING
VP Marketing Justine Gillen
+44 20 8652 8031 justine.gillen@flightglobal.com
Group Marketing Manager Jo Goodwin
+44 20 7911 1366 jo.goodwin@flightglobal.com

DATA TEAM
Director of Data Trevor Mountford
trevor.mountford@flightglobal.com
Fleet Research Manager John Maloney
+44 20 8564 6704 john.maloney@flightglobal.com

PUBLISHING MANAGEMENT
SVP, Consulting, Publishing and Conferences
Philippa Edward
philippa.edward@flightglobal.com
Executive Director Content
Max Kingsley-Jones
max.kingsley.jones@flightglobal.com
Commercial Director Publishing & Conferences
Stuart Burgess
stuart.burgess@flightglobal.com

READER SERVICES
Subscriptions
Jenny Smith
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The astronaut's astronaut

Commander of Gemini, Apollo and early Shuttle missions, John Young earned a reputation for masterly understatement and the deepest respect from his peers during a stellar career

John Young was the original "steely-eyed missile man". The master of understatement, he gave a typically laconic response on his decision to be an astronaut.

It was after hearing President Kennedy's famous address about landing a man on the Moon and returning him safely to Earth. "I thought returning safely to Earth sounded like a good idea," he quipped.

True to Kennedy's word, Young blasted off six times from Earth on board various spacecraft and returned safely. When he finally hung up his helmet in 1983, he was the astronaut with the most spaceflights and remains the only one who flew three different spacecraft – Gemini, Apollo and the Shuttle.

But even Young's renowned sangfroid melted after he and fellow astronaut Bob Crippen brought the Space Shuttle *Columbia* back to Earth after a tense maiden mission in April 1981 – the first time a new space vehicle had been manned on its debut test flight.

In his book *Into the Black*, Rowland White describes how, after landing on the vast dry lake bed at Edwards AFB in California, Young – who at that time was aged 51 – was bubbling with excitement. Eager to get out and check over the vehicle, Young could not sit still and impatiently clambered up and down the ladder between decks.

After threatening to open the hatch himself, Young was finally released, bounded down the steps and immediately begin an impromptu post-flight inspection. Whooping and punching the air with joy, Young was clearly delighted, as well as amazed that NASA had "pulled it off", writes White.

Born in San Francisco in September 1930, John Watts Young grew up in Florida, where one of his favourite pastimes was building model aircraft. After graduating in 1952 with an aeronautical engineering degree from Georgia Tech with the highest honours, Young joined the US Navy, where he flew fighters before training as a test pilot. He served three years at the USN's Air Test Center before being lured to NASA and ultimately the Moon. But before he did, on 3 April 1962, Young – then a USN commander – set a time-to-altitude world record by taking a McDonnell Douglas F-4 Phantom to "25,000m" (82,021ft) in 3min 50.44s.

That rapid ascent was good practice for what was to come in March 1965, when Young blasted off alongside Gus Grissom on the first manned Gemini mission. "We were just thinking about doing the job right," he said of his preparations.

Young flew a second Gemini mission in July 1966 as commander, alongside Michael Collins, and just under three years later, participated in a dress rehearsal for a Moon landing – Apollo 10. This May 1969 mission, on which he served as command module pilot, travelled all the way to the Moon, where it carried out a lunar module/command module rendezvous.

NASA

Young joined NASA having trained as a naval test pilot

Returning to the Moon in April 1972 as commander of Apollo 16, it was Young's turn to land. After arriving on the lunar surface with Charlie Duke, Young described the Moon as "a very nice place". The two crewmates then explored the lunar highlands in the lunar rover.

Soon after returning, in early 1973, Young became chief of the Space Shuttle Branch of the Astronaut Office at Johnson Space Center. The following year, he was appointed chief of the Astronaut Office, a post he held until May 1987.

It would be nine years until his next ride into space, as commander of *Columbia* on mission STS-1. His second and final Shuttle mission was STS-9 in late 1983, again on board *Columbia*.

During his six spaceflights (and seven blast-offs, including the one from the Moon), Young logged a total of 835h. He went on to serve as special assistant to the Johnson Space Center (JSC) director, and also became its associate director (technical) in February 1996 before finally retiring from NASA in December 2004, aged 74.

"The astronaut's astronaut, a hero among heroes who fly in space," was how then JSC director Jefferson Howell described Young on his retirement. But the last word goes to the laconic man himself. After steering *Columbia* into orbit in April 1981 and jettisoning the big white external tank, Young told Houston: "That was one hell of a pleasant ride… I recommend it." ■

John Young, 24 September 1930 – 5 January 2018

To read our reporting on John Young, go online to: **flightglobal.com/archive**

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Entry Requirements: Candidates should have (a) (i) a current Airline Transport Pilot's Licence (ATPL) (Helicopters) with Class One Medical Certificate (See Note 2) and not less than 3,000 flying hours in command of helicopters of which 2,000 hours should be in command of twin-engine helicopters; and (ii) not less than 12 years' relevant post-licence experience of which not less than five years should be as an Aircraft Rating and Instrument Rating Examiner or in other regulatory duties; **OR** (b) an International Civil Aviation Organization (ICAO) contracting state's Commercial Pilot's Licence (CPL) (Helicopter) with Instrument Rating; and a minimum of seven years' post-licence experience in civil aviation management and operations or as a regulator; and have passed the ATPL examinations; **AND** (c) strong command of written and spoken English.

Notes:

(1) Subject to the prevailing situation, candidates with additional experience may be granted increments for previous relevant experience in the civil aviation field in excess of the stipulated minimum.

(2) Applicants who do not have a current Class One Medical Certificate may also apply; if selected, appointment will be subject to their obtaining of the requisite Class One Medical Certificate.

(3) For the purpose of heightening public awareness of the Basic Law (BL) and promoting a culture of learning of BL in the community, applicants for civil service jobs will be assessed on their BL knowledge. The BL test result will constitute an appropriate weighting in a candidate's overall assessment.

(4) Candidates should submit their application forms together with an Experience Resume by mail to the enquiry address on or before the closing date for application. The **Experience Resume** can be downloaded from the Civil Aviation Department's website. (http://www.cad.gov.hk/english/recuitment.html)

Duties: A Senior Operations Officer (Helicopter Operations Inspector) is mainly deployed on helicopter operations matters including - (a) monitoring of the operating standards of helicopter operators in Hong Kong; (b) monitoring standards of crew training and associated training facilities, operations and training manuals, pre-flight briefings, flight planning facilities and the adequacy of staffing and accommodation; (c) observation of tests conducted by operators' examiners for the issue/renewal of authority to sign certificate of test and type rating tests forms; (d) investigation of aircraft accidents and incidents; and (e) assisting in formulation of policies and requirements on flight standards and operations matters. (Notes: Post holders are required to travel extensively on duty and work irregular hours.)

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Enquiry Address and Tel. No: For enquiry or request for an application form, please write to the Administration Division, Civil Aviation Department, Level 5, Office Building, Civil Aviation Department Headquarters, 1 Tung Fai Road, Hong Kong International Airport, Lantau, Hong Kong S.A.R., People's Republic of China. (Fax.: (852) 2910 6399) or e-mail to <recruitment@cad.gov.hk>, quoting reference "CAD ADMD PR/5-25/64 (2017)".

Closing Date of Application: 1 February 2018

General Notes:

(a) Persons who are not permanent residents of the Hong Kong Special Administrative Region (HKSAR) may also apply for this vacancy but will be appointed only when no suitable and qualified candidates who are permanent residents of the HKSAR are available.

(b) As an Equal Opportunities Employer, the Government is committed to eliminating discrimination in employment. The vacancy advertised is open to all applicants meeting the basic entry requirement irrespective of their disability, sex, marital status, pregnancy, age, family status, sexual orientation and race.

(c) Civil service vacancies are posts on the civil service establishment. Candidates selected for these vacancies will be appointed on civil service terms of appointment and conditions of service and will become civil servants on appointment.

(d) The entry pay, terms of appointment and conditions of service to be offered are subject to the provisions prevailing at the time the offer of appointment is made.

(e) The information on the maximum pay point is for reference only and may be subject to changes.

(f) Fringe benefits include paid leave, medical and dental benefits, and where appropriate, assistance in housing.

(g) Where a large number of candidates meet the specified entry requirements, the recruiting department may devise shortlisting criteria to select the better qualified candidates for further processing. In these circumstances, only shortlisted candidates will be invited to attend recruitment examination and/or interview.

(h) It is Government policy to place people with a disability in appropriate jobs wherever possible. If a disabled candidate meets the entry requirements, he/she will be invited to attend the selection interview/written examination without being subject to further shortlisting.

(i) Holders of academic qualifications other than those obtained from Hong Kong institutions/Hong Kong Examinations and Assessment Authority may also apply but their qualifications will be subject to assessments on equivalence with the required entry qualifications. They should submit copies of their official transcripts and certificates by mail to the above address.

(j) Civil service vacancies information contained in this column is also available on the GovHK on the Internet at http://www.gov.hk.

(k) Towards the application deadline, our on-line system would likely be overloaded due to large volume of applications. To ensure timely completion of your on-line application, it is advisable to submit the application as early as possible.

How To Apply: Application Forms [G.F. 340 (Rev. 3/2013)] can be downloaded from the Civil Service Bureau's website (http://www.csb.gov.hk). **Candidates must state clearly the details of professional qualification obtained on the application forms and attach the Experience Resume.**(See Note 4) Completed forms, together with the Experience Resume, should reach the above enquiry address of the recruiting department on or before the closing date for application. Please specify the title of the post being applied for on the envelop. Online application can also be made through the Civil Service Bureau's website (http://www.csb.gov.hk). Candidates who apply online should submit **the Experience Resume within one week after close of application period** to the above enquiry address, and the online application number should be quoted on the envelopes and the Experience Resume. **If candidates fail to provide the Experience Resume as requested by the deadline, their applications may not be considered.** Applicants should ensure that the correct address is clearly printed or written on the envelope and sufficient postage is affixed before posting so as to avoid unsuccessful delivery of application. Any underpaid mail items will be returned or disposed of by the Hongkong Post. Applicants are encouraged to provide their email addresses on the application forms. Candidates who are selected for interview will normally receive an invitation (by email or by post) in about six to eight weeks from the closing date for application. Those who are not invited for interview may assume that their applications are unsuccessful. For enquiries, please contact the department via the means stated above.

WORK EXPERIENCE JOHN WATERS

Inspiring tomorrow's heroes at 9g

Captain John "Rain" Waters is the head of the US Air Combat Command's Viper demonstration team, a recruiting tool which involves him piloting an F-16 fighter at very low altitudes and extremely high speeds

What drew you to aviation?
I grew up in Peachtree City, Georgia, which has a heavy Delta Air Lines employee presence. Most of my neighbours and friends' dads flew for Delta. My dad was not a pilot but he saw flying as a potential career path that might interest me and encouraged me to pursue a career in aviation. In high school, I was fortunate to have a close friend's father teach me and his son how to fly a Cessna 152 piston-single. I had my first flight on 10 September 2001. The events of the following day put me on the path I am today. I knew after 9/11 that I wanted to fly and I wanted to do so in the military.

Where were you trained?
I received my commission in the US Air Force following my graduation from Georgia Tech and then attended specialised undergraduate pilot training at Columbus AFB, Mississippi.

Where have you worked and served?
I worked as a lineman at Peachtree City Falcon Field airport, Atlanta. My primary job was to fuel aircraft and conduct basic aircraft servicing. While stationed at Columbus AFB, I deployed in support of Operation Enduring Freedom flying intelligence, surveillance and reconnaissance missions in the Beechcraft MC-12W Liberty, a modified King Air 350. Following my deployment, I returned to Columbus to fly the Beechcraft T-6 Texan II and eventually complete my Introduction to fighter

US Air Force

9/11 attacks convinced Waters to join the USAF and not an airline

fundamentals training in the Northrop T-38C Talon. Following my assignment at Columbus, I attended Lockheed Martin F-16 initial qualification training at Luke AFB, Arizona and was subsequently assigned to Shaw AFB, South Carolina. During my assignment there I was deployed in support of Operation Inherent Resolve. At the end of my assignment at Shaw, I was selected to be the next Air Combat Command F-16 Viper demonstration team commander and pilot. A request was sent out via email seeking interested pilots to apply for the position.

Are people inspired by the Viper demonstrations?
Absolutely. Our mission is to inspire the next generation of Americans to serve their country. Ideally, I hope to inspire the kid who will one day replace me or one of my teammates, but ultimately if we can spark a fire for a young girl or boy to serve their country through military service I think we have been successful.

What's the best part of your job?
While flying the F-16 is hard to beat, I truly enjoy interacting with young kids and hope to show them that if they work hard they can find success in their pursuits. I was fortunate growing up with several good role models and people that helped guide me to the path that I am on today. I view my opportunity to be a part of the Viper demo team as a means of giving back and a chance at hopefully inspiring the next generation.

What's most challenging about your job?
Flying demonstrations present unique challenges and keep me working. The profile lasts only 15min, but during that time I burn 6,000lb of fuel, pulling 9*g* upwards of 15 times. Not to mention most of my flying occurs between 200ft and 500ft above ground level, at speeds ranging from 125kt to 620kt. My last manoeuvre is our team's dedication pass, which I fly at 300ft, 500kt-plus, and pull over 9*g*. This happens at the end of the display, when you are tired, and requires considerable focus and a good *g*-strain. At airshows I will typically follow the dedication pass with a rejoin to the wing of a Second World War or Korea-era fighter from the Air Force Heritage Flight Foundation. This is a continued challenge as I will typically continue the 9*g* turn to deplete airspeed to rejoin 3ft from the wing of a priceless warbird. Transitioning from the Viper demo to the Heritage formation is a big transition, and keeps me working throughout.

How long would you like to be part of the team?
As the Viper demo team commander and pilot, I am assigned to the team for a two-year rotation. I will lead the team through the 2018 season, then will train my replacement for the 2019 season. ■

If you would like to feature in Working Week, or you know someone who does, email your pitch to **kate.sarsfield@flightglobal.com**

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