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COVER IMAGE

NASA supplied this shot of the quiet supersonic transport it plans to fly as an X-plane in 2020. The Lockheed Martin design features an engine inlet atop its fuselage **P20**



BEHIND THE HEADLINES

Leigh Giangreco (above) ventured to Savannah in some style, as Gulfstream intensifies its pursuit of new special mission aircraft deals with the US Air Force (P23), using its high-flying G550 business jet



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Image of the week

Virgin Orbit's 'Cosmic Girl' has arrived at its new home at Long Beach airport in California, after receiving an experimental airworthiness certificate. The 747-400 will carry LauncherOne rockets with small satellite payloads up to about 35,000ft, acting as a "flying launchpad". Flight tests start in 2018

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The week in numbers

67%

Flight Dashboard

Most Asia-Pacific passengers say in-flight wi-fi is a "necessity rather than a luxury"; 61% rate it above in-flight entertainment

\$37.1m

Flight Dashboard

H1 losses at Royal Jordanian Airlines were 70% worse than last year, but the carrier says turnaround efforts are working

↑ 10

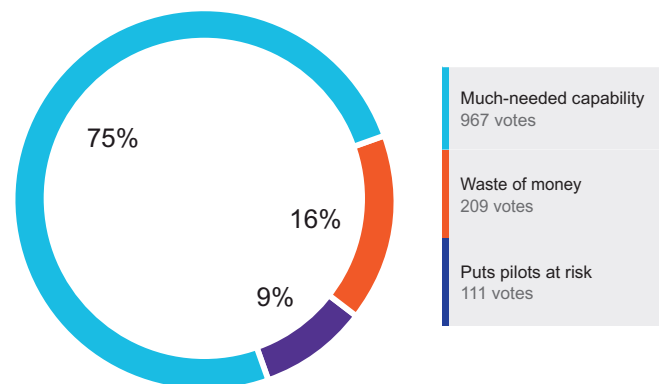
Flight Dashboard

That's 10 Max 10s; lessor BOC Aviation firmed up a Paris air show commitment, taking its Max-family order to 84 aircraft

Question of the week

Last week, we asked: **USAF light attack fleet?**
You said:

Total votes: 1,287



This week, we ask: **ATR's US order success?**

☐ Turboprop revival ☐ Silver lining ☐ A one-off win

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Power shift

Boeing has surprised supply chain specialists with its plan to establish an in-house avionics organisation, in a bid to break a model where suppliers take less risk, but get greater reward

To loosely paraphrase a saying attributed to Sir Winston Churchill, never waste a good crisis – or a new aircraft development programme.

Boeing has proposed a new midsize airplane family to enter service in the mid-2020s for commercial reasons. It perceives a gap emerging in the middle of the market, and believes that airlines may potentially be more profitably served by new technology than by an adaptation of existing products.

The commercial imperative may drive Boeing's pending launch decision, but a new aircraft programme provides a platform on which to pursue other corporate priorities, such as reshaping the economics of the commercial aviation supply chain.

Boeing's suppliers on average earn nearly twice its profit margin, despite exposure to less risk on new product development and execution. The forces creat-

In the avionics business, it will be expensive for Boeing to mount a competitive challenge

ing this lopsided dynamic are complex, but the consolidation of suppliers at the Tier 1 and Tier 2 level has certainly helped. Airframers now have fewer options than ever at the subassembly and assembly level, making the aircraft supply chain a classic sellers' market.

Boeing, loudly, and Airbus, more quietly, have been fighting these market forces for several years. Since 2012, Airbus's single-aisle cost optimisation programme and Boeing's partnership for success have each sought to reset supplier profitability by trading lower costs for higher volumes.



Maybe we'll do inside the cockpit too

In some areas where suppliers have not responded, Boeing has moved to insource the work.

But the partnership for success – albeit still an infant in the long-cycle aerospace industry – has yet to change raw economics. According to a recent analysis, profitability for suppliers and original equipment manufacturers is increasing at roughly the same rate.

That helps to explain why Boeing is to form a new avionics organisation. If trading volume for price increases is not moving the needle, perhaps expanding the scope of the insourcing effort can change the game.

But the opportunity in the avionics business seems limited. The increasing vertical integration strategy of Tier 1s such as Honeywell, Rockwell Collins and United Technologies Aerospace Systems will make it expensive for Boeing to mount a competitive challenge.

The supply chain will not easily yield its hard-won profit margins. Airbus and Boeing will continue trying to improve their relative profitability, but it will take a long time to develop competitive alternatives. ■

See This Week P7

The American dream

ATR has finally secured a US order, 20 years on from its last one. This will be music to the ears of the manufacturer's executives – not least because it will end constant questions about when the company would be back in the US market.

The Silver Airways commitment for 50 ATR 42-600s – including 20 firm – marks the final chapter of the European turboprop's turn-around, after it very nearly fell victim to the regional jet fixation that gripped the airline industry through the late 1990s and early 2000s.

That mania, spurred on by Bombardier's 50-seat CRJ and supplemented by Embraer's ERJ-145 family, eliminated nearly all ATR's competitors. The US regionals alone took 1,400 such jets between 1993 and 2006, as

these faster, smoother and quieter airliners threatened to relegate the large turboprop to permanent obsolescence.

But that era's turboprops were very different to today's machines. ATR and Bombardier's Q Series rode out the storm as production plummeted to barely sustainable levels, emerging with reinvented products designed to compete with jets more effectively.

Helped by the fuel price surge, the unquestionable economics of the turboprop began to win the day, and ATR's order book swelled to previously unimaginable levels. Frustratingly, the one missing ingredient was a US order. Now it has that, ATR's next challenge is to make sure the Silver deal is not a flash in the pan. ■

See Air Transport P10



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BRIEFING

CFM MARKS LEAP'S FIRST ANNIVERSARY

ENGINES CFM International's Leap-series engines recorded more than 200,000 flight hours and 100,000 cycles during the design's first year of operations. "Aircraft powered by the Leap engine are flying more than 95% of available days," says CFM chief executive Gaël Méheust. "This is unprecedented for a new engine." Fifteen carriers have placed Leap-1A-powered Airbus A320neo-family aircraft and 1B-equipped Boeing 737 Max 8s into service since 2 August 2016.

ISRAEL KEEPS UP INTEREST IN STOVL F-35

PROCUREMENT Israeli air force interest in Lockheed Martin's short take-off and vertical landing (STOVL) F-35B remains high, as the nation's defence ministry targets a final decision on orders before a new 10-year Foreign Military Financing agreement with the USA comes into effect in 2019. Tel Aviv has ordered 50 F-35L "Adir" fighters so far, and is also considering a possible future order for an advanced version of the Boeing F-15.

XIAN SENDS FIRST NEO WING TO TIANJIN

MANUFACTURING AVIC Xian Aircraft Industry has delivered its first Airbus A320neo wing shipset to the airframer's Chinese final assembly line in Tianjin. The supplier says production work began in May, after it evaluated the modifications required to manufacture the re-engined variant's wing alongside those for Ceo models. Airbus said in June that it plans to deliver the first A320neo from Tianjin in the fourth quarter of this year.

CAVOK CREW INJURED IN SAO TOME CRASH

INCIDENT A Cavok Air-operated Antonov An-74TK-100 freighter crashed while on departure from São Tomé International airport on 29 June, with its crew members sustaining injuries. The Ukrainian-registered twinjet (UR-CKC), recorded by Flight Fleets Analyzer as a 25-year-old example, came to rest on rough, sloping ground, with its nose section and left wing severely damaged.

AIR LEASE DETAILS TAP TRANSACTION

FLEET Air Lease will provide TAP Portugal with four Airbus A330-900neos and one A320neo. The lessor says the jets are scheduled for delivery between the fourth quarter of 2018 and the third quarter of 2019. "TAP is the launch airline customer for the A330-900neo, and these four aircraft represent a substantial commitment to reinvesting in the airline's widebody fleet," says Fernando Pinto, the carrier's chief executive.

MANILA FUNDS HERCULES UPGRADE

MODERNISATION Manila plans to upgrade the avionics on three Lockheed Martin C-130 transports, converting them from analogue to digital systems, the Philippine air force says. Flight Fleets Analyzer shows the service as operating five Hercules, across the B, H and T models, with an average age of 40 years.

PANASONIC TO ENTERTAIN AIR CHINA

CONNECTIVITY Air China has picked Panasonic Avionics to equip its incoming fleet of 10 Airbus A350-900s with the firm's eX3 in-flight entertainment and connectivity systems. Flight Fleets Analyzer shows the first of the carrier's new twinjets as due for delivery during December.



Investment no longer fits with Doha carrier's plans

INVESTMENT EDWARD RUSSELL WASHINGTON DC

Qatar loses hunger for American stake

Gulf airline drops its plan to acquire 10% of US airline after fierce opposition and continued allegation over subsidies

Continued opposition from American Airlines has prompted Qatar Airways to drop its plan to buy a 10% stake in the US carrier.

"Qatar Airways has taken the decision not to proceed with its proposed passive financial investment in American Airlines," the Doha-based carrier says.

"Further review of the proposed financial investment, taking into account the latest public disclosure of American Airlines, has demonstrated that the investment no longer meets our objectives."

American says it has "respect" for Qatar's decision, adding that the development has no impact on it. The US carrier had opposed the "unsolicited" investment, as it referred to it in securities filings, since the plans were disclosed in June.

"We aren't particularly excited about Qatar's outreach, and we find it puzzling, given our extremely public stance on the illegal subsidies that Qatar, Emirates and Etihad have all received over the years from their governments," said Doug Parker, chief executive of the Fort Worth-based carrier, in a letter to employees in June. "We remain committed to that effort, and we will remain so even with this potential investment."

American, along with Delta Air Lines and United Airlines, claims

that Emirates Airline, Etihad Airways and Qatar have benefited from more than \$50 billion in government subsidies, which have allowed them to dump capacity in the US market under open skies agreements. The US airlines have lobbied Washington since 2015 to limit access by the Gulf carriers, although no action has been taken to date.

In July, American notified investors that Qatar had filed an updated notice with the US Federal Trade Commission on its plans to buy up to a 10% stake, and repeated its view that the investment was unsolicited and would not change its board or management.

Qatar could have bought up to a 4.74% stake in American without its approval, but required board approval for any investment above that limit.

American, following the disclosure of the planned investment, notified its Oneworld Alliance partner that it planned to end their codeshare agreement in March 2018.

Separately, Qatar is to codeshare with the Brazilian division of Latin American carrier LATAM Airlines, following its decision to take a 10% shareholding. The agreement covers domestic LATAM services from São Paulo to 25 Brazilian cities, including Recife, Rio de Janeiro and Salvador. ■



Recovering Vueling gets IAG nod for expansion
This Week P8

THIS WEEK

PRODUCTION STEPHEN TRIMBLE WASHINGTON DC

Boeing insourcing switches to avionics

Airframer will task in-house unit with developing navigation and flight control systems, challenging current supply chain

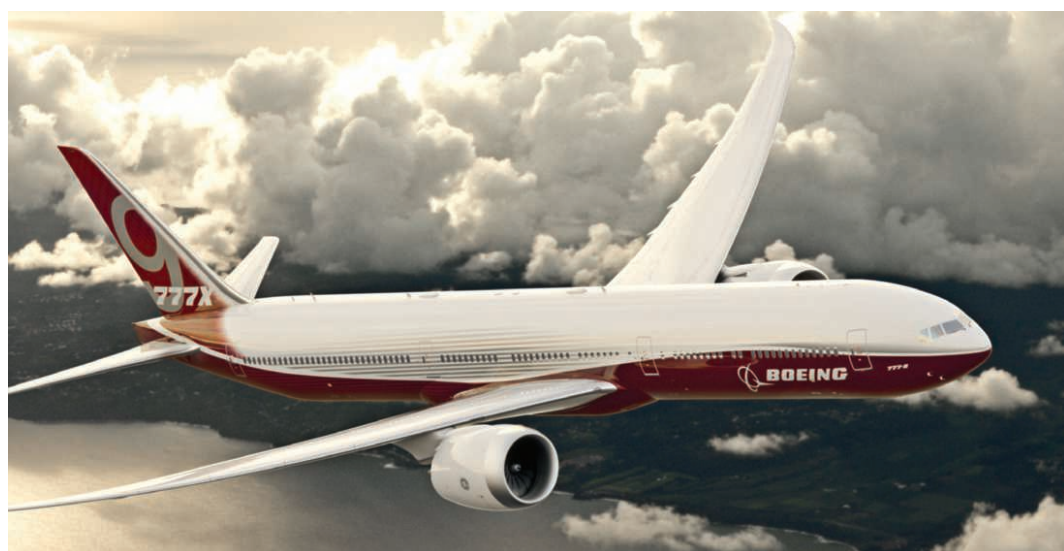
Avionics has become a surprise new front in Boeing's five-year-old campaign to wrest either better deals or higher-margin work from the grip of more profitable suppliers.

Boeing announced to employees on 31 July the formation of a new avionics and electronic systems team reporting to the corporate office of Greg Hyslop, chief technology officer and senior vice-president for engineering, test and technology. A team of 120 workers today will grow to 600 by 2019 as development begins on new avionics products, such as navigation, flight controls and information systems.

The products are "targeted" to enter service on Boeing aircraft in the next decade; in time for its proposed new midsize airplane.

The new organisation will "drive cost down and value up for our customers", says Boeing chief executive Dennis Muilenburg.

The move is part of a long-term Boeing strategy to shake up the structure of the aerospace supply chain. Along with Airbus, it has been frustrated by an industry structure that relies on the original equipment manufacturers to invest billions up front in new products, while suppliers con-



Company has already taken back the fabrication of 777X's composite wings from external specialists

sistently enjoy a higher profit ratio. Whereas Airbus and Boeing profit margins hover between 8-10%, supplier income is typically double that amount, according to a 2016 analysis by the Boston Consulting Group.

PRICE CONCESSIONS

In 2012, Boeing launched its partnership for success initiative, which attempts to exchange price concessions on current aircraft programmes for long-term deals on new types. The company has

cancelled licences for some suppliers to provide spare parts and formed Boeing Global Services, a business unit with a target to nearly triple in size by 2025.

So far, Boeing's strategy has not altered the financial dynamic in the supply chain, but it is becoming more aggressive. After insourcing the landing gear for the 777 in 2012, it has taken back other major tasks once assigned to top suppliers, including fabricating composite wings for the 777X and nacelle system engineering

and production for the 737 Max. Earlier this year, it also announced a new factory in Sheffield, UK, to produce actuators for the 737 and 777X programmes.

INTEGRATED SYSTEMS

In targeting the avionics sector, Boeing faces a big challenge to the credibility of its insourcing strategy. Although it pioneered the design and application of integrated flight management systems in commercial aircraft, it has had little hands-on experience with such technology in decades, and its current 120-strong team pales in comparison to the thousands of engineers and technicians employed by large avionics firms.

For Boeing's suppliers, the new avionics development organisation has to be viewed as more than a bluff in pricing negotiations. The company has to show it is willing and capable of insourcing avionics for new commercial aircraft, despite the risks of losing the services of an experienced – if potentially more expensive – supplier.

Pointing to its interests in the defence and space markets, Boeing says: "Our knowledge of the systems is very strong, and there is work being done in different parts of the company." ■

NEGOTIATIONS STEPHEN TRIMBLE WASHINGTON DC

Spirit reaches agreement over 787 fuselage and wing pricing

Spirit AeroSystems has reached an interim agreement with Boeing that could resolve a four-year-old impasse over future pricing on 787 fuselage and wing system structures, and enable it to bid for work on future programmes.

The new, non-binding agreement, which could be finalised by 30 September, prompted the supplier to report a \$353 million forward loss on the 787 programme in a second-quarter earnings report on 2 August.

Both sides have made huge strides in negotiations since early

May, when Spirit chief executive Tom Gentile acknowledged that a gap remained after years of dialogue. A master pricing agreement with Boeing expired at the end of 2014, before being extended by one year.

As further talks made little progress, the pair signed an interim pricing agreement to avoid a break in deliveries to the 787 assembly line.

Their new memorandum of understanding would set final pricing on the carbonfibre section 41 nose barrel for the 787

through 2022, as well as for pylons and wing components. The agreement also would extend Spirit's "accounting block" on the Dreamliner programme by 300 units, to 1,300 shipsets. Spirit also has created a "planning block" to increase this by a further 105 shipsets.

Gentile says the memorandum also resolves "open commercial issues" on the 737 Max programme, and enables Spirit to compete as a supplier for future Boeing programmes, such as its proposed new midsize airplane. ■



OPERATIONS DAVID KAMINSKI-MORROW LONDON

Recovering Vueling gets IAG nod for expansion

IAG has approved a further expansion of Spanish budget carrier Vueling's fleet, as half-year figures show it is overcoming the operational issues which severely affected it last year.

Disclosing a much-reduced interim operating loss during a results briefing on 28 July, IAG chief executive Willie Walsh said Vueling's recovery has been faster than expected. The board has given its backing for another five aircraft for the carrier, on top of those previously approved.

At the end of June Vueling had 47 Airbus A320neo jets on order, plus three outstanding A320s ordered during the month.

Walsh says the new management team at Vueling has created a "much stronger" and "better quality" network following a review of its operations, despite encountering "just as many" air traffic control restrictions as it had faced last year, plus difficulties at Barcelona, particularly with security and immigration controls. ■



Walsh says management has developed a "better quality" network

PROPOSAL
DAVID KAMINSKI-MORROW
LONDON

Russian concept brings 'elephant' to transport role

Russian aerodynamics researchers have revealed a concept for a new heavy transport aircraft to succeed the Antonov An-124.

Tentatively called "Slon" – the Russian term for "elephant" – the concept is outwardly similar to the Ukrainian-designed An-124, with a high-wing, four-engined layout, nose-loading capability and a low horizontal stabiliser.

Moscow's Central Aerohydrodynamic Institute (TsAGI) says the proposed aircraft would be able to transport 150t of freight over a range of up to 3,780nm (7,000km), while operating from a 3,000m (9,840ft)-long runway. But it could lift a maximum commercial load of 180t over a distance of 2,650nm.

The institute says this performance means the aircraft could compete not only with the An-124, but also more modern freighters, including the Boeing 747-8F.

TsAGI says the main geometric and weight parameters of the concept "have been determined" and that two variants are being considered. It has also carried out initial calculations of take-off, cruise and landing characteristics. ■

DEVELOPMENT AARON CHONG SINGAPORE

Boeing NMA concept draws Asia-Pacific carriers' interest

Slot constraints at region's airports favour cost-efficient midsize aircraft, airframer says

Boeing says it has received "huge interest" from Asia-Pacific airlines for its proposed new midsize airplane (NMA).

Dinesh Keskar, senior vice-president of Asia-Pacific and India sales, says the airframer has spoken to "over 50 airlines", ranging from low-cost carriers to full-service airlines, about the proposed aircraft.

Keskar notes that airlines' interest in the NMA follows the positive response that Boeing has received for the 737 Max 10 in the region. The future product will provide carriers with "far better" operating costs than the re-engined twinjet, while also of-

fering a growth vehicle for those faced with infrastructure constraints, he adds.

"In light of the growing slot constraints at major airports, it is a great aircraft to deal with that," says Keskar. "We could launch the NMA by the middle of the next decade... and these airlines are looking at aircraft that are slightly bigger than the 737 Max 10, but smaller than the 787."

The proposed 230-270-seat aircraft is likely to have a range of 4,500-5,000nm (8,320-9,250km), and Keskar says it could be operated on city pairs from destinations in Southeast Asia such as Singapore and Bangkok to, for

example, eastern Australian cities such as Sydney.

Meanwhile, for future wide-body orders in the Asia-Pacific region, he identifies Thailand and Vietnam as "key markets".

"Older widebodies are approaching their retirement cycle, and airlines would invest in new widebodies to take advantage of the stable fuel prices and better technology," he explains, noting that the current low price of oil "may not last at this rate in the next 10 years".

Boeing also is working with major carriers such as Cathay Pacific and Singapore Airlines to boost the take-up rate for main-deck freighters, Keskar says.

"There are still significant advantages that airlines will have in operating maindeck freighters," he says. "You get passenger revenue at the top and cargo revenue at the bottom. The recent 3-4% uptick in cargo has led us to believe that there are positive signs for the overall cargo business, even though it still remains under pressure and operators are suffering from lower yields." ■



Future product will be positioned between the 737 Max 10 and 787



ATR propels itself
back into US market
Air Transport P10

AVAILABILITY MIKE RAJKUMAR BENGALURU

Report highlights problems with Indian air force Ilyushins

Parts supply and maintenance issues blamed for serviceability rates falling far below target

A report by India's comptroller and auditor general (CAG) has highlighted the poor serviceability of 14 Ilyushin Il-76MD heavy transports and six Il-78 tankers operated by the nation's air force.

According to the document, average serviceability of the two fleets in the period from 2010-2016 was 38% and 49%, respectively. The required average figure for both types is set at 70%.

"On average, 41% of Il-76 and 32% of Il-78 [aircraft] remained grounded," the report says.

The low serviceability of the Ilyushin fleet has been attributed to poor availability of spares and a delay in signing a long-term maintenance support contract with the airframer. One of the main reasons for poor after-market support has been the need to conclude service and spare parts contracts with vendors of Russian and Ukrainian origin for the Il-76/78 fleet, the report says.

It also notes that their avionics have yet to be upgraded, resulting in them continuing to fly with



Indian defence ministry

Outdated avionics exclude Il-76 transport from international airspace

1985-vintage equipment. This has contributed to unserviceability, and prevented the aircraft from being allowed to operate in international airspace.

The Il-76's Soloviev D-30KP-1 turbofan engines must be overhauled after 2,000 flying hours, or 10 calendar years, while the Aviadvigatel PS-90As powering newer examples and Il-78s require this after every 3,000h. However, the CAG found that since no separate contract had been concluded for engine overhauls on the tankers, their power-

plants were instead worked on after reaching just 2,000h.

India's Il-78s are due for an overhaul in 2018-2019, with an upgrade also proposed. The CAG report notes that a long-standing issue with the type's aerial refueling pods has been rectified.

The air force's Il-76 transports were acquired between 1985 and 1989, with a further three added in an airborne early warning and control system role. Its six Il-78 tankers were bought between 2003 and 2004. The types are expected to remain in service until 2040. ■

INCIDENT
STEPHEN TRIMBLE
WASHINGTON DC

Landing mishap dents Sikorsky's Raider progress

A Sikorsky S-97 Raider crashed at the company's flight test centre in West Palm Beach, Florida on 2 August, with local news photographs showing that the compound helicopter prototype came down on a runway edge with its landing gear retracted.

Sikorsky says the two crew members escaped a hard landing without injury, with the S-97 in a hover during a test flight when the incident occurred.

The Raider features coaxial, rigid rotors and a variable-pitch pusher propeller: a configuration designed to achieve speeds higher than 220kt (407km/h) in level flight. Sikorsky launched the prototype with a \$200 million investment in October 2010, as the US Army was considering a replacement for its now-retired Bell Helicopter OH-58D Kiowa Warrior armed scouts.

The S-97 now serves as a technology testbed for the high-speed Sikorsky-Boeing SB-1 Defiant; a demonstrator and candidate for the US Army's Future Vertical Lift programme. Both models are based on technology developed with the Sikorsky X2. ■

FLEET JAMIE BULLEN LONDON

Leased E190-E2s the logical choice for Air Astana



Embraer

Kazakh flag carrier will take its five new aircraft from late in 2018

Kazakhstan's flag carrier, Air Astana, has agreed to lease five Embraer E190-E2s from AerCap. The Central Asian airline will take the jets on long-term lease, says AerCap, which adds that deliveries will begin in the last quarter of 2018.

AerCap is the launch lessor customer for Embraer's re-engined regional jet, with a combined total of 50 E190-E2s and E195-E2s on order.

Air Astana chief executive Peter Foster describes the E190-E2 as "the logical replacement of the

E190, which we have been successfully operating since 2011".

He adds: "The E190 has enabled us to open up smaller markets in southern Russia, the Caucasus and Central Asia, including smaller domestic routes."

Air Astana has nine E190s, Flight Fleets Analyzer shows.

Meanwhile, Embraer says it delivered 35 commercial airliners during the second quarter of this year: 31 E175s, two E190s and two E195s. This was an increase from 26 jets shipped in the same period a year earlier. ■



FLEETS EDWARD RUSSELL WASHINGTON DC

ATR propels itself back into US market

European manufacturer ends two-decade sales hiatus, as Silver Airways makes commitment for up to 50 turboprops

ATR has secured a breakthrough deal in the USA after a two-decade sales drought in the world's largest regional airliner market, with Silver Airways signing a letter of intent for up to 50 ATR 42-600s.

The development will be welcome news at ATR's headquarters in Toulouse. The European airframer, one of the few still building commercial turboprops, has not signed an order for new aircraft from a US carrier since 1997, when American Airlines converted 12 ATR 72-500 options, Flight Fleets Analyzer shows.

It has not been for lack of trying. In the mid-1990s ATR faced the perfect storm of a headline-grabbing crash – American Airlines flight 4184 in 1994 – and the rise of regional jets in the USA. Both factors contributed to a dearth of orders.

RENEWAL HOPES

ATR has conducted a number of demonstration tours of its products, including one with the ATR 72-600 in May 2016. At the time, it predicted demand for roughly 250 new turboprops in the USA, as replacements for the in-service fleet and for some regional jets used on short segments.

"The renewal of the turboprop fleet [is] where I think we're going to get a good shot," Patrick de Castelbajac, then chief executive of ATR, said during that tour. However, he admitted that the manufacturer was not engaged in any sales discussions at the time.

ATR's new chief executive, Christian Scherer, told Flight-Global in January that there was no "fundamental, natural economic" reason why its turboprops were not more successful in the USA, adding that it would pursue a "more aggressive" sales effort in the country.

Fort Lauderdale-based Silver announced in December 2015 that it was evaluating options for



Continental placed one of the last US orders for ATR-42s – in 1996

"The ATR 42-600 is the obvious aircraft of choice to upgrade older 30-50-seat regional fleets"

Christian Scherer
Chief executive, ATR

its fleet, including the replacement of its 21 Saab 340B turboprops. ATR opened a new pilot training centre in Miami, Florida – just a few kilometres from Silver's home base – in February, and the airline says it will train its pilots at the new facility.

Worth up to \$1.1 billion at list prices, the airline's commitment is split between 20 firm orders and 30 options, and it could convert some of this business to the larger ATR 72-600. Its first four ATR 42s should arrive in the fourth quarter of this year, pending regulatory approval.

It is worth noting that Silver's ATR order does not appear to have occurred following a heated sales campaign: the ATR 42 is the only Western-built turboprop with fewer than 70 seats in production today.

"Silver's detailed evaluation vindicates our belief that the ATR 42-600 is the obvious aircraft of choice to upgrade older 30-50-seat regional fleets," says Scherer.

ATR's troubles in the USA arguably began on 31 October 1994. That day, an ATR 72-200 operated by Simmons Airlines encountered icing conditions while in a holding pattern and, after an uncontrolled roll, plummeted into an Indiana soybean field, killing all 68 aboard. The crash initially prompted a temporary ban by the US Federal Aviation Administration on the aircraft flying into known icing conditions. The ban was lifted after new operating rules were put in place by January 1995, and larger de-icing boots were subsequently installed on all ATRs operating in the USA.

The ATR fleet struggled to recover from the bad press. This was exacerbated when, in 1996, the National Transportation Safety Board placed blame for the crash on French authorities, saying their

lack of action on known roll-control issues in icing situations led "directly" to the incident.

The US ATR fleet had been growing steadily prior to the crash, increasing by more than half from 81 in 1990 to a peak of 158 in 1994, Fleets Analyzer shows.

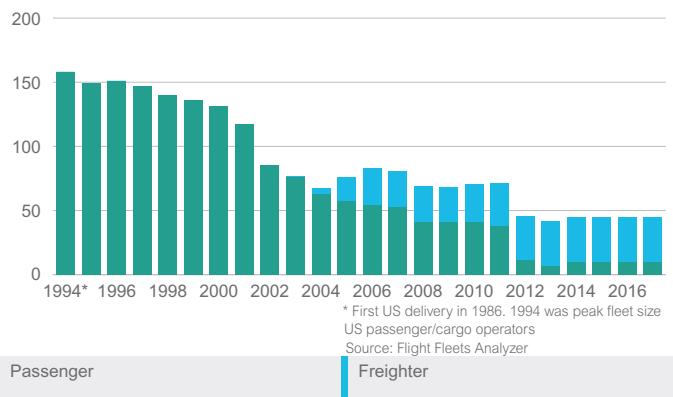
CARGO DEMAND

The last of 185 US ATR deliveries took place in 1998, and the passenger fleet has gradually declined to just 10 units since 2014. Meanwhile, demand for a cargo conversion has materialised, with the US fleet growing steadily since 2003 and now standing at 35 aircraft – all operated for FedEx.

The ATR family became relatively common in the regional fleets of American, Continental Airlines and Delta Air Lines. But after a Continental order for eight ATR 42-500s in April 1996 and American's option conversion in 1997, no orders were forthcoming until the Silver deal.

US carriers, by and large, shifted their regional aircraft orders to the burgeoning small jet market in the late 1990s. After a Mesaba order for 18 Saab 340Bs in late 1997, only Bombardier landed US orders – for the Q400 twin-turboprop at Alaska Airlines subsidiary Horizon Air and former Continental Connection operator Colgan Air – after 2000. ■

US airline ATR fleet trend





C-Series deliveries to
soar in second-half
Air Transport P12

BACKLOG GHIM-LAY YEO WASHINGTON DC

Max deliveries gaining pace, as Flydubai receives first jet

Boeing hands over initial example to third operator, while Southwest gets set for arrival

Gulf carrier Flydubai has taken delivery of its first Boeing 737 Max 8, as the programme's launch customer also draws close to accepting its first example of the re-engined twinjet.

Boeing on 31 July delivered the first of 75 Max 8s on order for low-cost carrier Flydubai, making it the third customer to receive the CFM International Leap-1B-engined single-aisle. Flight Fleets Analyzer shows the company had previously handed over a combined eight 737 Max 8 aircraft to the Lion Air Group, including Malaysia-based Malindo Air, plus Norwegian.

Flydubai ordered its 737 Max aircraft at the Dubai air show in 2013, and already operates a total of 58 737-800s.

"As the first Max customer in the region, we look forward to the further fuel and operating efficiencies that this aircraft will bring to our young, modern fleet," says the carrier's chief operating officer, Ken Gile.

Meanwhile, launch customer Southwest Airlines will take delivery of its first Max 8 later this month, ahead of the type's



Middle Eastern low-cost carrier has ordered 75 of re-engined type

planned introduction to revenue service on 1 October.

Speaking during a second-quarter earnings call on 27 July, chief financial officer Tammy Romo said the Dallas-based carrier will have 10 Max 8s by October, and expects to end 2017 with 14 of the type.

Southwest holds orders for 170 Max 8s and 30 Max 7s. As of 25 July, the airline had 67 737 Classics that it will retire by the end of the third quarter. The phase-

out will mark the largest number of aircraft retirements in the airline's history, says Romo.

Of its remaining Classics, 21 are on operating leases, and Southwest says it will incur a \$60 million special item charge due to the early termination of agreements.

About 10-15% of Boeing's more than 500 planned 737 deliveries this year are expected to be of the re-engined model. ■

Additional reporting by Stephen Trimble

TURBOPROPS
DAVID KAMINSKI-MORROW
LONDON

Siberian official gives Il-114-300 the cold shoulder

One of Siberia's government chiefs is proposing that Ilyushin's Il-112 military transport could be modified as a regional passenger airliner.

The head of the Sakha republic, Yegor Borisov, says the commercial Il-114 turboprop – production of which is being restarted with a modernised -300 variant – is not suited to its climate.

During a meeting with the federal air transport authority Rosaviatsia's chief, Alexander Neradko, Borisov discussed the issue of replacing obsolete regional aircraft over the course of 2017-2022.

Borisov believes the Il-112 twin-turboprop could be ideal for the area if adapted for passenger transport. Its design is outwardly similar to that of the ATR 72, with a high wing and horizontal stabiliser, in contrast to the low-wing, low-stabiliser arrangement of the Il-114.

Ilyushin lists the military version of the Il-112 as having a maximum payload of 5t, and the capability to transport a 3.5t payload over a range of 1,300nm (2,400km).

Rosaviatsia states, however, that a redesign would require "serious discussion" at industry and regulatory level. ■

REFURBISHMENT

Fresh interiors for Singapore A380s

Singapore Airlines (SIA) plans to retrofit 14 of its Airbus A380s, and expects to announce a timeline for the work by the end of the year. While it has not disclosed further details of the planned activity, a local media report says the carrier will install new seats across all classes, and upgrade the in-flight entertainment system. First-class suites which are currently on the lower deck could be moved to the upper deck, with the number halved to six from 12, the report also suggests, with the updated configuration also likely be used in five new A380s. Flight Fleets Analyzer shows these aircraft as due to be handed over between October 2017 and May 2018. The arrival of the new superjumbos will enable SIA to maintain the size of its A380 fleet at 19 aircraft, as its first five examples are returned to lessors. Fleets Analyzer indicates that MSNs 003, 005, 008 and 010 are leased from Dr Peters Group, while 051 is from Hannover Leasing.





RESULTS JON HEMMERDINGER BOSTON

CSeries deliveries to soar in second-half

Company holds firm on planned transfer of around 30 examples during 2017, with financial recovery "in full motion"

Bombardier is confident that its financial turnaround plan remains on track, after cutting its second-quarter operating loss from \$251 million to \$123 million. Its net loss declined to \$296 million, from \$490 million at the same point in 2016.

"We feel very good about where we are," says chief executive Alain Bellemare. "Our turnaround plan is in full motion, and we are confident we will be able to deliver on all our commitments."

Bombardier delivered 20 commercial aircraft in the second quarter, comprising seven Q400



Three CS300s were handed over in the first six months of this year

turboprops, four CRJ900s, three CS100s, three CS300s, two CRJ1000s and a CRJ700.

After handing over seven

CSeries jets in the first half of 2017, Bellemare says the manufacturer is on course to deliver "around 30" by year-end. It set a

goal last year of handing over 30-35 of the type in 2017, but efforts have been hindered by delays to the arrival of Pratt & Whitney PW1500G engines.

"As planned, the acceleration picks up in the second half of the year," Bellemare says.

Second-quarter revenue declined by 5%, to \$4.1 billion, but dropped by 16% at the commercial aircraft division, to \$640 million. However, the unit's operating loss of \$87 million was a notable improvement on a \$586 million reverse in the same period last year. ■

INCIDENT DAVID KAMINSKI-MORROW LONDON

Crew fatigue was factor in closed-runway landing

Indian investigators believe crew fatigue contributed to an incident in which an Air India Airbus A319 landed on a closed Mumbai runway, without clearance and despite being instructed several times to execute a go-around.

Runway 09/27 had been temporarily closed to allow two vehicles to carry out an inspection, after the crew of a departing aircraft indicated that it had sustained a bird strike.

India's aircraft accident investigation bureau says the A319 (VT-SCL), arriving from Abu Dhabi, had been 8-10nm (15-18km) from the airport when it

was instructed by approach control to contact Mumbai tower.

"After this there was no response or contact made by the aircraft," says the inquiry. The tower made "several" go-around calls, it adds, "but there was no reply".

One of the ground vehicle's crews observed an aircraft on short final for runway 27 and instructed the other vehicle to leave immediately. Both left the runway before the jet touched down.

The captain, as the monitoring pilot, had been trying to establish contact on the tower frequency at the time, but was unsuccessful. "There was a lot of disturbance on



Aircrew did not respond to repeated calls requesting a go-around

the frequency," says the inquiry. It adds that, from a height of 900ft, the pilots saw two vehicles near taxiway N5 and decided that, if they did not clear the runway, they would abort the approach at

the decision height of 230ft. The vehicles had left the runway by the time the jet was at 500ft.

Despite the crew's advising that a communication failure had led to the incident, the A319 was not checked for communication problems before being cleared to operate the next sector, and its cockpit-voice recorder was not removed.

None of the 88 occupants were injured in the 12 April 2013 incident, and the aircraft was undamaged. Investigators say the crew did not communicate with air traffic control on any tower frequency, adding that fatigue "contributed to the error". The inquiry recommends that processes be implemented to report and evaluate fatigue-related events. ■

FLEET AARON CHONG SINGAPORE

Leap-1A quality issue slows Air India's transition to A320neo

Air India has seen minor delays in deliveries of its Airbus A320neos, the nation's minister of state for civil aviation, Jayant Sinha, says.

Replying to a parliamentary question, he said the carrier had "experienced delay in deliveries of some A320neos fitted with [CFM International] Leap-1A engines by [a] few days, due to

non-availability of engines at Airbus's facility."

Flight Fleets Analyzer shows Air India has eight A320neos in operation, and is due to receive four more by year-end. It has a further seven Neos on order, due to be handed over in 2018 and 2019.

Sinha's statement was made on the same day that Airbus chief

executive Tom Enders revealed CFM had suffered a recent "quality escape" on the Leap-1A, relating to high-pressure turbine disks in a limited number of engines.

"CFM is completing root cause analysis and we are working with them, the authorities and our customers to minimise the impact for the airlines," Airbus says. ■



Aero Norway
looking before it
Leaps
News Focus P14

RESULTS DAVID KAMINSKI-MORROW LONDON

Profit improving as accelerating A350 boosts Rolls-Royce

Strong large-engines performance lets manufacturer grow despite slow sales in business jets and other programmes

Rolls-Royce delivered 209 large civil aircraft engines in the first half of the year, a substantial increase on the previous interim figure of 164.

The deliveries included 85 Trent XWB engines for the Airbus A350 programme: more than double the 41 achieved in the same period last year.

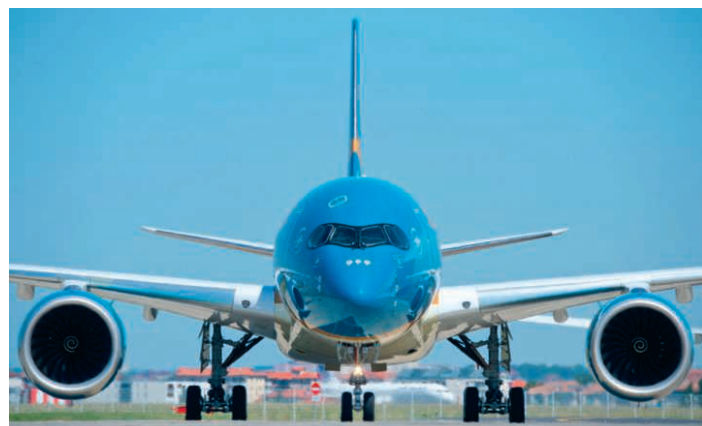
Large engine deliveries helped drive a sharp rise in underlying profit for the company's civil aerospace division, to £173 million (\$229 million) for the six months to 30 June. This offset weakening sales in other areas – business jet engines and International Aero Engines V2500 modules – which meant overall civil engine production slipped slightly, from 312 to 308 powerplants.

Underlying civil aerospace revenues rose by 14% to £3.68 billion, including a 12% increase for original equipment and a 15% rise from servicing.

R-R benefited from being the

exclusive supplier of engines for the A350, deliveries of which are steadily increasing. But its large engine deliveries also included higher Trent 900 sales for the A380. Emirates, Airbus's largest customer for the double-decker, has notably switched to the Trent 900 for its current deliveries.

R-R also generated greater sales of Trent 700 engines for the A330,



Airbus

Company has benefited from being sole engine supplier on twinjet

but delivered a lower number of Trent 1000s for the Boeing 787.

Meanwhile, accelerating transition to the A320neo, away from the A320ceo, contributed to a 20% reduction in revenues for the V2500 programme.

In the service arena, expanding

numbers of current-production Trent engines supported a rise in revenues for the half-year.

R-R says the £173 million underlying profit, up from £31 million in the same period last year, has been supported by factors including aftermarket growth. ■

MAINTENANCE

Provision reflects 'in-service challenges' faced by Trent 1000

Technical issues with Trent 1000 powerplants for the Boeing 787 led Rolls-Royce to include a provision for its maintenance effort to address the problem.

Speaking during a half-year results briefing on 1 August, chief executive Warren East referred to "in-service challenges" the company is facing in its civil aerospace business, describing these as being a "big issue for us right now".

East says the scheduled programme of maintenance, particularly for the Trent 1000, is "causing some problems" for R-R and its customers, but that the company is "working very hard" to minimise operational disruption.

R-R says it has redesigned elements of its service programme – through "various 'lean' improvement initiatives" – to reduce lead time and return engines to opera-

tion more quickly, reducing the impact on operators.

Additional maintenance on Trent 1000s comprised the largest component of increased technical costs of £59 million (\$78 million) in the six months to 30 June.

The company expects "increased activity" in the second half relating to the maintenance programme, which is dealing with "a number of technical issues". ■

DEVELOPMENT MAVIS TOH SINGAPORE

Second C919 prototype sails through power-on



ImagineChina/REX/Shutterstock

First test aircraft has not been flown since its maiden sortie on 5 May

Comac achieved power-on for its second C919 narrowbody prototype on 28 July. The event signifies that aircraft 102's power system is functioning normally, and lays the foundation for subsequent tests, says the Chinese manufacturer. Its target is for a first flight during 2017.

During the round of power tests – from the initial review to the actual process – all went according to the process flow, Comac says, resulting in the entire cycle being cut to 10 days.

Comac will use six flight-test aircraft during its C919 campaign. Aircraft 102 will focus on engine, auxiliary power unit and fuel system tests, but will also be used for some extreme weather testing.

Aircraft 101 conducted its debut sortie on 5 May, but has not been flown since. Comac told FlightGlobal at the Paris air show in June that work was ongoing to detail the programme's flight-test plan and modules, stressing that no major issues were encountered during the first flight. ■



MAINTENANCE MICHAEL GUBISCH LONDON

Aero Norway looking before it Leaps

Closed down by Pratt & Whitney in 2012, revived CFM56 repair shop is drawing on its strengths as an independent

Engine overhaul shop Aero Norway has carved a niche as an independent CFM56 support specialist – a role the company plans to also assume for CFM International's Leap powerplants from 2020.

The Stavanger-based outfit started life as Braathens' engine shop, and then became a wholly owned subsidiary of Pratt & Whitney until it was closed by the US manufacturer in 2012, only to reopen with new investors the next year.

In withdrawing, P&W cited concern over surplus capacity in the CFM56 overhaul market. But arguably, the shop would sit oddly within the P&W network of today. The manufacturer's overhaul joint ventures with airlines in China, New Zealand, Singapore and Turkey, plus its wholly owned maintenance, repair and overhaul shop in the USA, all service its own engines or those of its OEM joint ventures, albeit that some offer CFM56 services too. But under P&W ownership, the Norwegian Engine Center – as it was then known – never developed capabilities for its parent's products.

GULF INVESTMENT

The 2013 reopening followed the company's acquisition by Bahrain-based Aero Gulf Group, aided by investors from Dubai and Qatar. Under the name Sola Engine Center, it restarted overhauls in 2014. Its current owner, Qatari businessman Tariq Al Jehani, acquired the business in 2015.

The shop serviced 30 engines in 2014, says general manager Glenford Marston, and the total increased to 64 by 2016. This year, Marston forecasts, the shop will handle 80 engines. Aero Norway employs a staff of 136.

CFM56-3 engines – which power Boeing 737 Classics – account for about 70% of Aero Norway's volume today. The balance is split between CFM56-5B



Two-thirds of 737 and A320 engines require turbine disassembly work

and -7B engines, which power Airbus A320neo-family jets and 737NGs, respectively.

Marston targets parity between the CFM56-3 and -5B/7B from 2018. But he notes a resurgence of -3 shop visits as operators continue using 737 Classics for longer than planned amid lower fuel prices and, in a volatile economic environment, risk aversion.

By Marston's estimate, only 15-20% of CFM56 shop visits are available to independent service providers, as most engines are either covered by aftermarket agreements with the manufacturer or supported by airline-associated MRO facilities such as Air France-KLM's maintenance division and Lufthansa Technik.

He believes airline-associated MROs can negotiate more favourable terms because their parent carriers are the OEMs' customers. Independent shops "don't get any kind of rebate" from OEMs, says Marston.

Furthermore, airline-associated MRO can avail itself of economies of scale. The parent fleets provide a baseload, and surplus shop capacity can be used to serve third-party customers.

Accordingly, Aero Norway needs to differentiate itself by providing its users with more customised service and flexibility, says Marston. He argues that large overhaul shops are geared up to support large fleets and lack the flexibility to focus on individual client requirements. "The small customer doesn't get a fair deal," he says. "You are not going to get the same treatment as you would coming to an independent shop, because all my customers are [treated as] Number 1, whether you have one aircraft or 20."

About two-thirds of power-

plants processed at Aero Norway have their high-pressure compressor and turbine system disassembled. The rest involve lighter tasks and create less than \$700,000 in revenue each.

In 2016, the company generated a turnover of \$44 million.

MARKET POTENTIAL

Marston says Aero Norway's business since the reopening has developed "much better than I actually thought". This reflects longer-than-expected service of 737 Classics, but also the balance of quality, efficiency and flexibility, he argues.

With CFM56-3 shop visits set to decline, Aero Norway aims to service Leap engines from 2020. There have been preliminary discussions with CFM about expanding capabilities to the new engine generation, but Marston says the shop is still evaluating investment requirements and market potential.

One option to ease access to repair licences and technical data might be to partner with an airline that operates aircraft powered by Leap engines. "If that's the only way we can get there, we have to," says Marston. He is confident, however, that Aero Norway will support the new generation in the future. "It is a CFM shop and it will remain a CFM shop," he says. ■



With 136 staff, company hopes to handle 80 powerplants this year



BAE waits for Eurofighter export deals
Defence P16

EVALUATION LEIGH GIANGRECO WASHINGTON DC

Longsword drawn as new challenger to Combat Dragon

Air Tractor-based candidate added to air force experiment, as service says other participants set to break cover in trial

L3 Technologies has joined a trio of other participants in the US Air Force's OA-X/Combat Dragon III experiment which started at Holloman AFB, New Mexico on 31 July, demonstrating the armed reconnaissance capabilities of its Air Tractor AT-802L-based Longsword.

An adaptation of a tail-dragging cropduster, the Longsword joins the Sierra Nevada/Embraer A-29 Super Tucano, Textron Aviation's Beechcraft AT-6 Wolverine turboprop and the Textron AirLand Scorpion jet in an evaluation of off-the-shelf options to fill a light air support role.

While the L3-promoted model's participation feels like a late addition, the USAF notes that it had not announced all the companies invited to take part in the experiment, instead allowing the

contractors to identify themselves. With the demonstration now under way, additional participants will be announced soon, the service adds.

L3 unveiled the militarised AT-802L at the Paris air show in June, with the heavily adapted Air Tractor gaining glass cockpit avionics, an L3 Wescam MX-15 electro-optical/infrared sensor pod, and hardpoints under the wings and belly. The company says it has a pending sale for 12 Longswords to Kenya.

Meanwhile, a newly released acquisition document reveals a potential path for the USAF to acquire such a capability to support special operations forces.

The USAF has partnered with the Special Operations Command's fixed-wing acquisition office to launch an open-ended



L3's AT-802L conversion adds a glass cockpit, sensors and hardpoints

technology hunt called light attack support for special operations (LASSO). This could be followed by the release of a broad area announcement to industry, which would seek information on advances in new technologies for light attack aircraft, according to an acquisition planning document dated 28 July.

The planning document suggests a new route to market for the contenders in the Combat Dragon III experiment.

USAF officials have repeated that OA-X is an experiment and has no procurement funding attached to the outcome. The recent acquisition notice emphasises that point, stressing that the

service issued the presolicitation for market research and does not promise a request for proposals.

The service will conduct the experiment and make decisions from there, air force secretary Heather Wilson told FlightGlobal at the Experimental Aircraft Association's AirVenture show in Oshkosh, Wisconsin on 26 July.

"It's not a procurement – it's an experiment, so we can learn something," Wilson says.

"The time between when the chief of staff said, 'let's try this,' and when the aircraft were delivered for testing was five months. That's the kind of innovation in a lot of different areas that we want to see." ■

DEVELOPMENT LEIGH GIANGRECO WASHINGTON DC

KC-46A powers through electromagnetic tests



A suspended transformer assessed the 767-based tanker's shielding

Electromagnetic effects (EME) testing with Boeing's KC-46A tanker has been completed, with the milestone representing another step towards the manufacturer delivering the first of the 767-based aircraft to the US Air Force at the end of this year.

Conducted on Boeing's second low-rate initial production aircraft in a full tanker configuration, including with its Cobham wing aerial refuelling pods installed, the activity involved a large transformer being positioned above the aircraft, to test electromagnetic pulse protection under simulated flight conditions. The company describes the tanker as being pro-

tected "by various hardening and shielding technologies".

"This successful effort retires one of the key risks on the programme," Boeing programme manager Mike Gibbons says.

A report published by the US Government Accountability Office earlier this year indicated that the EME testing phase was due to be completed during May, but Boeing says the pace of this activity has not affected its delivery schedule. The company plans to hand over its first aircraft before the end of 2017, and to meet the USAF's "required assets available" milestone as scheduled during October 2018. ■



PRODUCTION CRAIG HOYLE LONDON

BAE waits for Eurofighter export deals

With last of 72 aircraft for Saudi Arabia shipped, company seeks further sales to follow contracts from Kuwait and Oman

BAE Systems delivered 10 Eurofighter Typhoons in the first half of this year, as the UK company and its European partners wait for further international sales to safeguard long-term production of the type.

Of the aircraft shipped from BAE's Typhoon final assembly line in Warton, Lancashire in the six months ending 30 June, four were for the UK Royal Air Force and six went to export customers.

These included the last four fighters from a 72-unit Project Salam deal with Saudi Arabia, and the lead pair of aircraft for Oman, which has ordered 12 for delivery through 2018. "Typhoon capability expansion is [on] schedule" for the Royal Saudi Air Force, the company says.

"Good progress continues to be made on airframe manufacture for the contract to supply 28 Typhoon aircraft to Kuwait secured



Muscat is receiving Typhoons and Hawk trainers from the company

by Italian Eurofighter partner Leonardo in 2016," BAE notes.

"Discussions with current and prospective operators of the Typhoon continue to support expectations for additional contract awards," the company says. But in a half-year earnings report published on 2 August, it adds: "There can be no certainty as to

the timing of these orders, and [they] are unlikely to positively impact production delivery rates for at least 24 months. The balance of customer demand for aircraft and production rates will be under constant review, with adjustments made as appropriate."

BAE also has updated the status of its Hawk 165 advanced jet

trainer programme for Saudi Arabia. Eighteen aircraft from a 22-unit deal signed by Riyadh in 2012 have been delivered so far, and "manufacturing for the second batch of 22 aircraft, awarded in 2015, continues on schedule".

Referring to the follow-on deal, BAE says it "will undertake the final assembly of these aircraft in Saudi Arabia, with the first major units planned to be delivered in the third quarter of the year". The company will, meanwhile, complete the delivery of eight Hawk 166s to the Royal Air Force of Oman before year-end, with the first two ready for acceptance.

Separately, the company says: "Discussions continue with Hindustan Aeronautics [HAL] for the supply of a further 32 [Hawk] aircraft kit sets, which will result in aircraft built under licence by HAL for the Indian air force and Indian navy". ■

ASSESSMENT LEIGH GIANGRECO WASHINGTON DC

Army investment lifts Block II Chinook project



Boeing plans to upgrade more than 500 examples of heavy transport

The US Army has awarded Boeing a \$276 million contract to build and test three Block II-standard CH-47 Chinooks, giving the transport helicopter an additional 680kg (1,500lb) of lift capacity. Manufacturing of the Block II-model aircraft will begin in Philadelphia next year, with flight testing to follow in 2019.

In May, Boeing completed flight trials involving the new version's swept-tip rotor blades, which it says offer an up to 725kg

increase in lift. Further enhancements will include an improved drive train and a larger aft section to house new engines in the future. The type's six fuel tanks also will be redesigned to two.

The activity entered its engineering, manufacturing and development phase in April. Boeing plans to deliver its first operational example in 2023, and eventually upgrade more than 500 Chinooks to the next-generation configuration for the US Army. ■

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Leonardo
advancing its UK
efficiencies
News Focus P19

MODERNISATION CRAIG HOYLE LONDON

Digital avionics upgrade will take French AWACS to 2035

New cockpit systems will ensure compliance with air traffic and navigation requirements

An avionics upgrade will enable France's Boeing E-3F airborne warning and control system (AWACS) fleet to remain operationally relevant until at least 2035, the nation's DGA defence procurement agency says.

In use since 1992, the French air force's four E-3Fs are to have their analogue cockpits replaced with a digital flight deck featuring five full-colour multifunction displays, the DGA says. The modernisation activity also will introduce a digital autopilot capability for the CFM International CFM56-powered type.

The upgrade programme will enable the aircraft to remain compliant with current and emerging air traffic control and navigation requirements, and cut in-cockpit flightcrew from four to three.

Supported by Boeing and using a common system developed for major AWACS upgrades for the US Air Force and NATO, the modifications will be per-



Modifications should improve reliability and reduce support costs

formed by Air France Industries KLM Engineering & Maintenance (AFI KLM E&M). Work will begin in 2019, with updated aircraft to be returned to operational use from 2022. According to the DGA, the updates will be performed alongside scheduled heavy maintenance visits, to minimise the amount of time that individual airframes are out of use.

It says the updates will en-

hance the E-3F's operational performance, but also improve reliability and reduce support costs. AFI KLM E&M's contract includes a seven-year maintenance deal.

Boeing and its French maintenance partner have previously worked together on a mid-life update of the E-3F's onboard mission computers and operator stations, delivering modernised aircraft from July 2014. ■

SAFETY
LEIGH GIANGRECO
WASHINGTON DC

USMC grounds aged KC-130Ts following crash

The US Marine Corps has indefinitely grounded 12 Lockheed Martin KC-130T tanker/ transports operated by the Marine Forces Reserve, following the 10 July crash which killed 16 service personnel.

An investigation into the fatal accident is ongoing, and the USMC says it will not comment on its potential root cause at this time. The grounding order will not affect other variants of the C-130, the service confirms.

The destroyed KC-130T was due to fly from MCAS Cherry Point, North Carolina to Naval Air Facility El Centro, California, and then on to MCAS Yuma, Arizona. At about 4pm local time, air traffic controllers lost radar contact, with the aircraft having come down near Itta Bena, Mississippi.

Early indications were that a problem occurred at cruise altitude, the USMC said following the accident. Two large, dispersed debris fields were discovered at the crash site. ■

MANUFACTURING LEIGH GIANGRECO WASHINGTON DC

International funding smooths F-35 production

Lockheed Martin has been awarded \$2.18 billion from Foreign Military Sales (FMS) customers and international partners in the Joint Strike Fighter programme via the US government, in support of an interim contract to continue F-35 production.

The stopgap award linked to 50 international aircraft had been expected, following a 7 July "undefinitised contract action" (UCA) which continued domestic production of the Lightning II for the US military.

The F-35 Joint Programme Office (JPO) had previously valued the international contract at up to \$2.28 billion, and has not re-

vealed the cause of the \$100 million reduction.

The UCA, which has a \$5.57 billion price ceiling, allows Lockheed to continue producing F-35s until a contract is finalised for the programme's 11th lot of low-rate initial production (LRIP). This should cover 141 aircraft: a combined 91 for the US armed services, plus 28 for international partners and 22 FMS aircraft for export buyers.

"The US Department of Defense will continue to negotiate the LRIP 11 contract with Lockheed Martin, and expects to finalise this by the end of the year," the DoD says. "We are confident



Lightning II partner nations including the UK are seeking 28 aircraft

the final negotiated Lot 11 aircraft unit prices will be less than Lot 10, and represent the best interests of the government and provide acceptable profit to the contractor."

Separately, the DoD and Pratt & Whitney are negotiating the F-35 programme's Lot 11 engine contract. The JPO says it expects a conclusion this year. ■



Aerospace Big Data

6-7 December 2017 | London, UK

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Reducing boom of
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Cover Story P20

MANUFACTURING CRAIG HOYLE LONDON

Leonardo advancing its UK efficiencies

Recent restructuring already paying dividends, with unified company offering customers more innovative solutions

Little more than six months after implementing a “one company” structure in the UK, Leonardo MW is seeing clear benefits from the new way of working, says chief executive Norman Bone.

Previously, the numerous operations working beneath holding company Finmeccanica meant there would be “multiple opinions on the same subject”, Bone says. Fully operational since 1 January, having combined the UK activities of its AgustaWestland, DRS Technologies, Finmeccanica and Selex ES units, Leonardo MW can now approach customers offering a “more end-to-end solution”, he notes.

“We really needed to look at the way we operated, and how we partnered,” Bone says. Pointing to budgetary constraints facing military customers and the need to quickly provide more complex capabilities, he says the relationship has shifted towards increased risk-sharing and joint development.

Examples include a new Eurofighter Typhoon in-service support model being delivered with BAE Systems for the Royal Air Force, dubbed Tytan, which aims to reduce costs by 30-40%.

“We talked about each other’s problems, challenges and opportunities, and found a way to build a relationship with the end user, the Ministry of Defence and ourselves. That’s allowed a massive saving, greater efficiencies, greater productivity for the aircraft, and the air force to recycle money back into capability,” the Leonardo official says.

Overall, Tytan is expected to save the RAF more than £550 million (\$727 million), with efficiencies coming from increased service intervals and improved monitoring and fault prediction, which will result in avionics boxes being removed from aircraft less frequently.

One potential area of capital



An improved support model for the RAF’s Typhoons will help fund extra capabilities

reinvestment for the UK is an active electronically scanned array (AESA) radar, being developed for the Eurofighter programme’s partners.

The UK has had a long interest in introducing new radar technology with additional capabilities, specifically in the electronic-attack domain, and previously studied the potential integration of an AESA array with the RAF’s Panavia Tornado GR4s.

ACTIVE STEP

“The nations are still debating it,” Bone says of the Typhoon’s planned Captor-E enhancement, for which the UK is the lead advocate. “The debate is: do the partners want to go that way now, or in the future?”

Another focus area for Leonardo MW centres on safeguarding rotorcraft manufacturing at its Yeovil site in Somerset.

Discussions around a rotary-wing unmanned air system (RWUAS) programme are ongoing, linked to the company’s strategic partnering arrangement with the MoD.

“We are now having an engagement that is thinking about things in a different way, and showing greater opportunity,” Bone says, describing a RWUAS platform as “definitely one of the key futures” for the company’s helicopter activities in the UK. “I think it will

be wider than a navy application – whether that’s with the UK or other countries,” he adds.

Leonardo Helicopters chief executive Daniele Romiti last month said that the company could transfer production of its AW149 to the UK, should the type be selected to meet the nation’s future military medium-lift requirement.

“We really needed to look at the way we operated and how we partnered”

Norman Bone

Chief executive, Leonardo MW

“I’m not overly concerned at this stage,” Bone says of Yeovil. “We’re working really well with the government and the MoD to develop that future capability strategy. It’s up to us to fill the time between with great exports.”

He says the AW159 Wildcat is a “phenomenal offering”, with the UK having a “tremendous opportunity list” around the world. Developed for the British Army and Royal Navy, the type has so far secured two international sales for a combined 10 examples, from the Philippines and South Korea.

Production of the AW101 is also continuing in the UK, including for a Norwegian search and rescue programme. Bone also expects the company to be involved

in some capacity as the UK introduces a new fleet of Boeing AH-64E Apache attack helicopters.

Other examples of Leonardo MW’s new business approach include its involvement in the MoD’s rapid capabilities office structure. This led to it demonstrating its BriteCloud active decoy, which will be available for operational use with the RAF’s Tornado GR4s this year.

RISK-SHARING

It also teamed with MBDA and Qinetiq for a maritime laser directed-energy weapon technology demonstration programme named Dragonfire, where the partners shared investment and risk. He notes that if a procurement follows, “We get 30% of something, rather than 100% of nothing”, by competing alone.

Leonardo also pursued the MoD’s Mode 5 interrogation friend-or-foe system contract to equip more than 350 aircraft, ship and land vehicle types, facing a Raytheon/Thales team and Hensoldt; formerly Airbus Defence & Space’s electronics division.

“We started as third favourite, but we looked at a very different commercial model, not at putting through our own product,” Bone says. After Hensoldt opted to exit the contest, Leonardo joined forces with its former rival as Team Skytale, and won the deal. ■



TECHNOLOGY STEPHEN TRIMBLE OSHKOSH

Reducing boom of supersonic X-plane is worthy QueSST

NASA engineers validate unusual engine inlet position to divert sound upwards, ahead of flight testing set for 2020

A series of windtunnel tests has revealed that the unusual engine inlet positioning for NASA's supersonic X-plane meets the performance goals for the Lockheed Martin-designed aircraft, a NASA Glenn Research Center aeronautics engineer says.

Acting as a vanguard for a new class of business jets capable of flying over land, the quiet supersonic transport (QueSST) X-plane demonstrator will begin a series of flight tests in 2020 with an inlet placed atop the fuselage and behind the cockpit: a rare configuration for a supersonic aircraft not seen since early 1950s designs, such as the Convair F2Y Sea Dart amphibian.

The unusual engine placement was driven by the purpose of the QueSST demonstrator, explained NASA Glenn engineer Ray Castner at the Experimental Aircraft Association's annual gathering in Oshkosh, Wisconsin on 25 July.

NASA is funding the flight

demonstration to evaluate how boom-shaping techniques, developed through decades of research, affect how people on the ground perceive the acoustic disruption caused by breaking the sound barrier. It will present the data to the US Federal Aviation Administration by the mid-2020s, with the hope of persuading the agency to modify or eliminate a half-century-old ban on

"We now have our engine up top. The disturbance from the engine does not propagate down"

Ray Castner

Engineer, NASA Glenn Research Center

supersonic flight by civilian aircraft over populated areas.

"Most supersonic aircraft have the engines near the front on the nose, or underneath in the clean



Lockheed Martin design will be flown over a city twice at Mach 1.4

air flow," Castner says. "We now have our engine up top and that's for boom-shielding. That way, the disturbance from the engine goes up, and does not propagate down to the ground and contribute to boom signature."

NASA's Glenn Research Center in Cleveland, Ohio, performed 73h of testing of a model of the X-plane in the facility's 2.4 x 1.8m (8 x 6ft) windtunnel; the first laboratory tests of such an engine inlet position for a supersonic aircraft that the agency is aware of.

The results satisfied NASA's engineers that the X-plane's unique inlet position will work.

"This inlet is actually more efficient than I thought it would be," Castner says. "It was about 96-98% efficient, so that's pretty good."

Although the positioning was different, the nature of NASA's QueSST demonstration allowed Lockheed to use a relatively simple inlet design. During flight tests, NASA plans to have the aircraft take off, make two passes over a city at Mach 1.4, and then land. The design includes a diverterless bump to steer boundary layer airflow away from the inlet, but requires no moving pieces required for supersonic aircraft designed to cruise at higher speeds.

"It's a [sonic] boom demonstrator. It's not an inlet demonstrator," Castner says. "There is a higher performing inlet that we could have chosen, but a lot of those inlets have moveable parts."

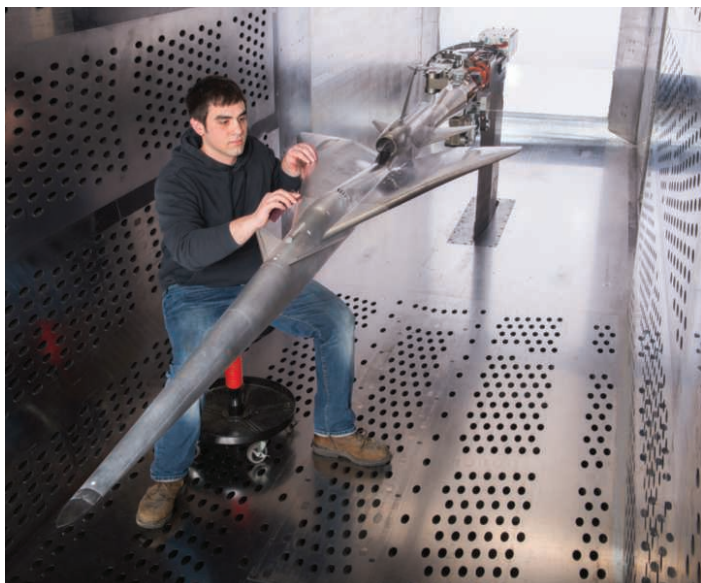
NASA's concerns about boundary layer flow over the top of the fuselage with the inlet's placement drove other design decisions, he adds. After Lockheed completed the preliminary design, NASA released an image of the demonstrator with six vortex generators set between the cockpit canopy and the engine inlet. Lockheed placed the vortex generators there to energise the boundary layer flow and prevent the inlet from ingesting relatively stagnant air.

The Glenn windtunnel activity also performed aerodynamic tests of the X-plane model in more than 40 configurations.

The design is shaped to reduce the sonic boom disruption to 75dB on the ground, compared with 105dB for the Aérospatiale/BAC Concorde. That goal has driven designers to extend the length of the nose almost absurdly. That extra length reduces the pilot's forward visibility, so NASA is installing an external vision system to enable the pilot to see straight ahead.

Canard surfaces placed just forward of the cockpit also help shape the position of the supersonic shockwave, Castner says. The aircraft also features small surfaces on the vertical stabiliser that form a miniature T-tail. "Its only job is boom-shaping," Castner says. "It contributes to the low sonic boom signature."

NASA plans to release a solicitation to industry for contractors to build the Lockheed X-plane starting in fiscal year 2018. ■



Glenn researchers tested more than 40 configurations of concept



G550 on a mission
Conversions P23

ROTORCRAFT CRAIG HOYLE LONDON

Black Hawks will battle Australian fires

Joint-venture company buying up to 20 refurbished UH-60s for emergency blaze response and disaster relief missions

StarFlight Australia will operate a fleet of up to 20 ex-US military Sikorsky UH-60 Black Hawk utility helicopters adapted for aerial firefighting operations, under a deal worth at least A\$63 million (\$50.4 million).

Formed by Kaan Air Australia and LifeFlight Australia in 2015, the joint-venture company says it will offer Black Hawks “repurposed specifically for aerial firebombing operations during future bushfire seasons around Australia and New Zealand, and for year-round emergency services and disaster relief work”.

Ten aircraft are covered by an initial deal announced on 27 July, which also includes options to double this fleet size.

Sikorsky will refurbish the rotorcraft at its Pinkenba facility in Brisbane, Queensland, with the “hand-picked” airframes to arrive in Australia early next year. Ex-

pected to take three months per aircraft, the work will include fitting more powerful GE Aviation T700-701D engines and upgraded gearboxes, and installing a helicopter terrain awareness and warning system.

StarFlight Australia chief executive John Skeen says the fleet investment “represents a significant milestone for the firebombing and disaster relief helicopter industry in Australia, particularly in terms of efficient rotary-wing attack to reduce loss of life and property during bushfire events.”

Kaan Air Australia chairman Ferda Yildiz says that in addition to supporting operations in Australia and New Zealand, the venture is aiming “to expand this co-operation in other parts of the world” using its modified Black Hawks. Sikorsky also will provide maintenance support for the fleet in Brisbane.



Sikorsky will adapt ex-US military aircraft at facility in Queensland

The Australian-registered rotorcraft will have a range of 324nm (600km), a 160kt (296km/h) cruise speed and a lift capacity of 3,500kg (7,710lb), according to its future operator.

StarFlight Australia lists its current inventory – which is

used to support missions including firefighting and emergency response – as including examples of the Airbus Helicopters/Kawasaki Heavy Industries BK117, Bell Helicopter 412, Kamov Ka-32 and Leonardo Helicopters AW119KE and AW139. ■

DEVELOPMENT STEPHEN TRIMBLE MOSCOW

Iran powers up Saba-248 ambitions

After unveiling the Saba-248 light-twin helicopter in March, Iranian industry officials revealed new details about the programme’s development schedule, supply chain and performance at last month’s MAKS air show in Moscow.

The appearance of the Saba-248 in Iran caught industry watchers by surprise, revealing a potentially competitive offering bearing a likeness to the Bell Helicopter 427.

The rotorcraft completed its first flight in 2016, and entry into service within Iran is scheduled in 2019, says Rohallah Famerini, a deputy managing director for commercial and economic affairs for the Iran Helicopter Support and Renewal Company (IHSRC), the Saba-248’s designer.

IHSRC initially plans to certifi-



Twin Safran Arrius engines are currently used with indigenous design

cate the aircraft for operations within Iran only, with proposed applications including search and rescue and disaster response for civilian agencies.

Iran plans to lean heavily on Western suppliers for critical equipment for the new model. Its

first example is powered by two Safran Helicopter Engines Arrius powerplants.

Promotional material for the Iranian design lists it as having a cruise speed of 129kt (238km/h), a maximum speed of 150kt and a range of up to 524nm (970km). ■

TRAINING
CRAIG HOYLE LONDON

Skyhawk goes back to school with ATP order

Textron Aviation’s Cessna unit has secured a follow-on order for its Skyhawk 172 from US pilot training specialist ATP Flight School, in a step which will boost the operator’s fleet of the type to almost 130 examples.

Announced during the Experimental Aircraft Association’s AirVenture fly-in in Oshkosh, Wisconsin on 28 July, the deal builds on another 15-unit order placed by the operator in late 2016.

“Deliveries of the new Skyhawks, integrated with next-generation Garmin G1000 NXi avionics, will begin in the third quarter,” Textron says.

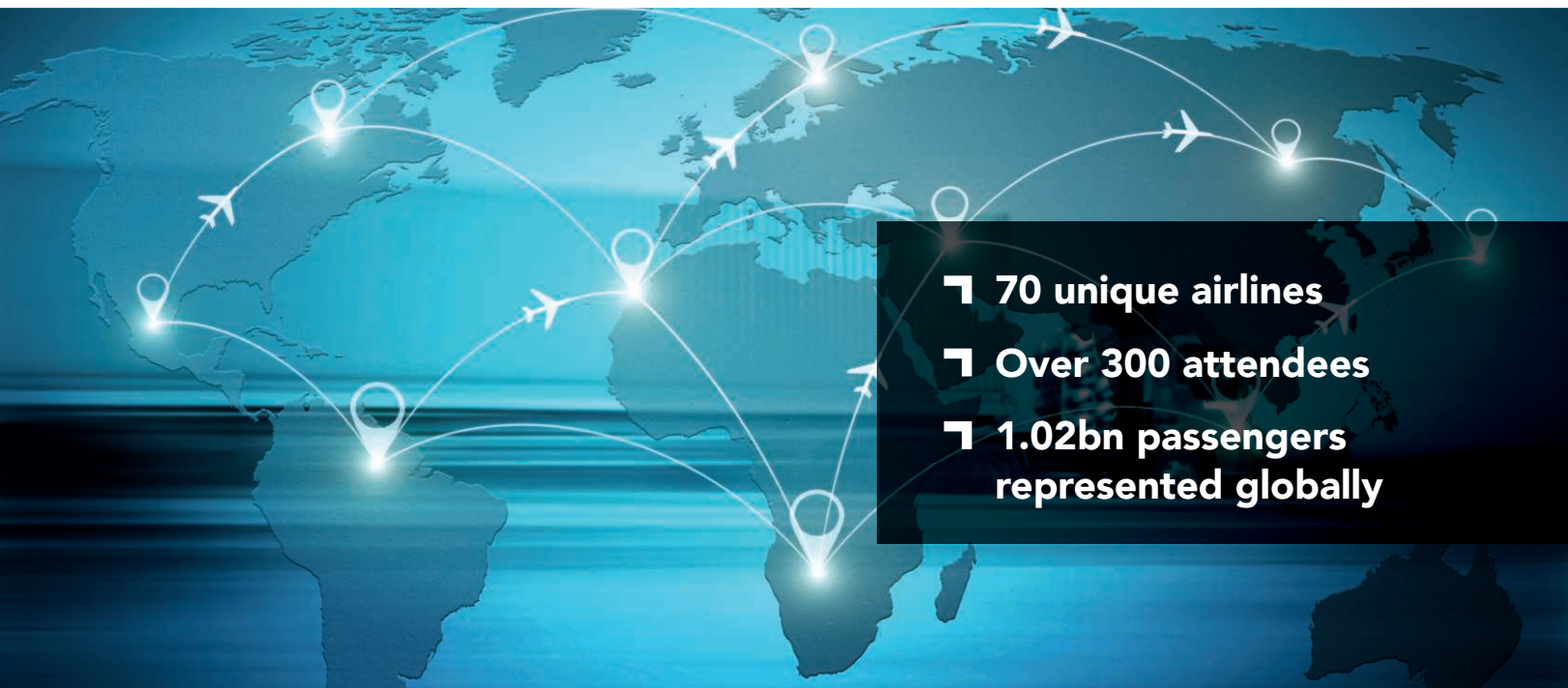
ATP Flight School has 42 training centres around the USA, with a total fleet of about 300 aircraft. ■

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G550 on a mission

For 50 years, Gulfstream has turned private jets into special purpose platforms; if it wins two high-value US Air Force contracts, the business could be secure for decades more



The Israeli air force has operated G550-based special electronic missions aircraft since 2005

LEIGH GIANGRECO SAVANNAH

Inside Gulfstream's special mission modification facility in Savannah, Georgia, two green aircraft are bulking up – from sleek private business jets to action-ready military configurations. With their seasick pallor, the G550s have an almost Frankenstein quality as their iconic oval windows are closed up, noses are flung open and tails are stripped away to prepare for more exotic missions.

For 50 years, Gulfstream has been doing this type of conversion of its business jets into special mission aircraft, starting with the delivery of a modified Gulfstream I for the US Navy's bombardier and navigation training mission. Since then, the company's special mission portfolio has expanded into executive airlift, medical evacuation, transport, airborne early warning and control, and intelligence, surveillance and reconnaissance (ISR). More than 2,500 Gulfstream jets fly around the world, including 207 built for special missions in 39 countries, with 70 supporting the US government.

"That additional 10,000ft can make a huge difference in identifying enemy forces"

Troy Miller

Vice-president of special mission sales, Gulfstream

Currently, the US Air Force is grappling with two high-value aircraft recapitalisation contracts, to replace its Northrop Grumman E-8C Joint Surveillance Target Attack Radar System (JSTARS) and Lockheed Martin EC-130H Compass Call fleets. For Gulfstream, capturing both deals could cement its special mission business for years. But both replacement programmes are fraught with acquisition delays and industry squabbles.

On the JSTARS side, the USAF has dragged its feet for years. After battling other services on the need to replace its current Boeing 707-based E-8Cs with a manned jet, rather than an unmanned ISR platform, it finally appeared to have put the programme on track last year.

For these electronic warfare platforms, Gulfstream has some notable international experience. G550s are used by several air forces as VIP transports, but Israel operates a conformal airborne early warning variant, also being acquired by Italy. Israel also operates a G550-based aircraft called "Shavit", with special electronic missions payloads partly accommodated by the sort of belly canoe which characterises the USAF's E-8C JSTARS fleet.

The JSTARS recapitalisation is slated to reach initial operational capability by 2024, and the USAF is scheduled to award a contract in fiscal year 2018.

In July, Gulfstream revealed that its JSTARS offering would include an inflight refuelling receptacle mounted on the G550's nose. However, the company has also considered using a more conventional refuelling position on the aircraft's crown. The G550 would not be alone in its nose-mounted design; the USAF's Fairchild Republic A-10s and Boeing B-1s have similar receptacles. No Gulfstream aircraft has been certified for air-to- »

» air refuelling, but the air force requires the capability for the JSTARS ground surveillance mission. Current Gulfstream aircraft store fuel in the wings, rather than a separate bladder or tank.

Meanwhile, the Compass Call replacement programme has proceeded in fits and starts as a changing USAF acquisition strategy has come under fire. The service is proposing a so-called “cross-deck” plan to transplant mission equipment from legacy EC-130H aircraft into new airframes. It initially wanted to move to a G550-based platform, but last year competitors including Boeing and Bombardier demanded an open competition for the replacement.

So the air force changed strategy earlier this year, abandoning its push for a sole-source award to Gulfstream, and instead named L3 Technologies as the systems integrator for the Compass Call cross-deck effort. However, that plan failed to satisfy Boeing and Bombardier, which argued that a history of partnerships with L3 would amount to an unfair advantage for Gulfstream.

Boeing claimed in a 25 May statement: “The air force’s approach is inconsistent with Congress’s direction in the 2017 National Defense Authorization Act and seems to ignore inherent and obvious conflicts of interest. We believe that the US Air Force and taxpayer would be best served by a fair and open competition, and that the air force can still meet its stated timeline of replacing the ageing fleet of EC-130Hs within 10 years.”

Notably, according to USAF documents, both the Boeing 737 and Bombardier Global 6000 miss the performance marks for Compass Call. The mission requires a total cargo capacity of 9,080kg (20,000lb), including 5,900kg of prime mission equipment. But in

the Global 6000’s battlefield airborne communications mode configuration, its payload capacity is “marginally insufficient”, the service says. It has also noted that Bombardier’s offering does not meet aperture requirements without modification, and would require a supplemental type certification that could incur up to \$180 million in additional costs and a three-year schedule delay.

Boeing’s 737 would be forced to burn significant fuel to reach its maximum 41,000ft altitude, trading loiter time for height, and is unable to meet both needs, the USAF says.

NIMBLE HIGH FLYER

During a July media day in Savannah, Gulfstream officials pushed the G550 as the ideal solution for both the air force’s JSTARS and Compass Call missions, but did not reach into as much detail as during a 2015 JSTARS media blitz. During a tour two years ago, Gulfstream and its prime contractor partner for the JSTARS competition, Northrop, showed off a modified G550 with a large belly canoe to house radar sensors. While Gulfstream generally looks to re-use existing canoe designs, it is likely that a new design will be chosen for the JSTARS mission.

Troy Miller, Gulfstream’s vice-president of special mission sales, and Leda Chong, senior vice-president of government programmes and sales, hail the smaller business jet as more nimble – while characterising airliner-based offerings as cumbersome. Miller emphasises the G550’s higher altitude, comparing a traditional airliner certified to fly at 41,000ft with a Gulfstream’s 51,000ft capability, and argues that large engines hanging off an airliner’s wing could affect the aircraft’s field of view.

“One of the biggest issues is terrain block-



age,” Miller says. “That additional 10,000ft can make a huge difference in identifying enemy forces that are using mountains or rugged terrain to mask their movements. The radars themselves are able to perform at higher altitudes, and because of additional line of sight they can do more collection.”

Both Gulfstream and its competitors have argued that size matters for the JSTARS and Compass Call missions, but while airliner manufacturers are pitching “room for growth” as a selling point for their platforms, Gulfstream argues that those aircraft simply provide excess space. “One of the advantages of being smaller: I can be closer to the area of interest,” Miller says. “There is a significant number of airfields, for which the air force and navy evaluate annually, that business jets can operate from and airliners cannot.”

While business jets may be able to land in tougher spots and on more air bases, manufacturers such as Gulfstream must still be able to weather a stormy commercial market. An industry outlook from Flight Ascend Consultancy, released ahead of the 2017 European Business Aviation Convention and Exhibition in Geneva in May, predicts that deliveries will decline by almost 4% this year, with an excess of models damping prices. Ascend characterised Gulfstream’s G450, G550 and G650 models as “soft” and “on watch”.

Gulfstream counters that its business jet orders have not dipped, and that a significant backlog still exists.

“It has not dropped off,” the company said in July. “We continue to have a backlog stretching into 2018. We have approximately 245 G650s and G650 ERs [extended range] in service. It continues to be a very strong performer for us.”

The company does not split its backlog for



Belly canoe houses radar on Northrop Grumman’s proposed G550-based JSTARS solution



Replacements for the USAF's aged E-8C fleet are hoped to be operating from 2024

US Air Force

the G650 and the ER variant, since both aircraft roll off the same production line. Demand has remained steady for the G650, although the airframer admits it expects sales to decrease from the 200 firm orders it received after the type's launch. Company officials also have answered with an emphatic "no" when asked whether G650 production would end in 2019. Gulfstream has also pushed back on the assumption that a year-long backlog was small in the grand scheme of orders.

"It's really not a sneeze away," says Gulfstream. "Typically it would be nine- to 12-months backlog for the 550, for example. So if you think late 2015 is actually 17 months, it's almost double the nine-month backlog that we would typically have."

Whether the declining business jet market means Gulfstream is pursuing the special mission sector with more urgency remains unclear, although Chong and Miller would like to sell

more specialised G550s. In an interview with FlightGlobal at the Paris air show in June, Miller said that while the magnitude of military aircraft demand was increasing, Gulfstream was focusing on the commercial market.

Back inside the modification facility, the two business jets fresh from the production line are stripped of their engines, avionics and interiors. Flight controls and wing leading edges are taken away, leaving a basic, reduced-weight aircraft ready to be optimised for the special mission role, Miller explains. On one aircraft, the tail is removed and replaced with a cone to make room for sensors in the rear of the aircraft. Gulfstream also makes significant changes to the nose, which now houses heavy sensors.

OFF THE SHELF

Part of the modification process seems redundant: bundles of newly installed wiring are removed and replaced when preparing special mission aircraft, because jets coming off the production line are all identical. That process, says Miller, is an advantage for Gulfstream, buying it the freedom to respond to a special requirement with any available aircraft. That freedom, he claims, is not available to competitors offering airliner-based products, which typically undergo some modification on the production line if destined for a special configuration.

One of the more perplexing reconfigurations is the removal of Gulfstream's patented oval windows. On almost all special mission aircraft, the heavy windows are removed to either reduce weight or use the space for a different capability. Often, the space is outfitted with purpose-made plugs with connectors to attach sensors.

Gulfstream continues manufacturing the jets with windows, rather than omit them initially, since they are required for certification. The company could obtain a waiver, but Miller says designing aircraft without windows would reduce its flexibility. "It's not a signifi-

cant cost or time consideration to be able to do that [modification]," he says.

All the modifications are mounted externally to the green aircraft structure, which is engineered to include mounting points and contact points for sensors. Gulfstream not only designs the outer mould line of the aircraft, but works with its customers to understand where those sensors and equipment are to be placed.

"I would imagine that doing this as a third-party is even more challenging," Miller says. "So we think it's really important to have the same processes, people, facilities and certification flight test going on."

Still, the actual installation and flight test of mission equipment would remain the responsibility of the prime contractor, he adds. In some cases, Gulfstream will install and fly an inert dummy resembling the shape and weight of the mission equipment, since some of the sensor work is classified and completed at the prime's facility. But Gulfstream remains engaged through the delivery of the aircraft and may even provide product support for the lifespan of the aircraft, he says.

"It's not as if we do the group A modifications, hand the keys over to the prime and say goodbye," he says. "It's a relationship we have with the primes and the end users for the entire lifespan of the aircraft."

Although the USAF has emphasised that there is no connection between the JSTARS and Compass Call competitions, Gulfstream is developing a 10-year plan to manage the potential capture of both contracts. The company is examining where it could expand facilities and realise synergies across programmes, such as by sharing tools.

"We have strategic planning sessions all the time about how do we best utilise all of these assets," Chong says. "Whether it takes the form of human resources, facilities, materials, all of that. So it's not one or the other thing. I call it an orchestration." ■



US Air Force

Ground crew prepare an EC-130H Compass Call at Bagram air base, Afghanistan. Its mission equipment will be moved to another platform

Reusability has long been a hot topic in launchers, and while 2017 has seen notable progress in re-flying major components, development is being driven by objectives beyond cost savings

Bringing a Falcon 9 booster back home is a fiery business, but fuel is cheap

All systems are go, again

SpaceX via ZUMA Wire/REX/Shutterstock

DAN THISDELL LONDON

Europe's bid to slash the cost of access to space has received a boost in the form of a reusable rocket engine intended to cost just €1 million (\$1.1 million) – compared with the €10 million cost of the disposable Vulcain2 that powers the Ariane 5 heavy lifter.

At the Paris air show in June, the European Space Agency signed a contract with Ariane prime contractor ArianeGroup to develop a demonstrator called Prometheus. The reusable liquid oxygen-methane engine concept will undergo ground testing in 2020 and is ultimately intended to power European launchers from 2030.

Meanwhile, ArianeGroup chief executive Alain Charneau says, “all the stops” remain pulled out in the development of Ariane 6, set to fly from 2020. Launches are expected to cost €70 million, less than half the bill for Ariane 5 and on a rough par with the cost of a ride on SpaceX's smaller Falcon 9. Ariane 6 features a modular design and developments of proven Ariane 5 technology, including an iteration of Vulcain2. Its solid fuel boosters – two or four, depending on payload mass – will double as the first stage of the in-development Vega C light launcher.

All of this European activity is in great part a response to competitive pressure from SpaceX, whose prices have shaken up the launch market. Falcon 9 is not technically radical. But, with several hundred million dollars of investment and launch contracts from a NASA eager to outsource, SpaceX has, unburdened by legacy technology or infrastructure, created a streamlined business able to undersell rivals such as Ariane 5 and the Atlas V and Delta IV launchers from US leader United Launch Alliance (ULA). Those established launchers are hugely reliable but costly; all use dispersed industrial infrastructures and technology dating to the 1980s. ULA is a Lockheed Martin-Boeing joint venture born of Cold War-era organisational priorities. Ariane rockets come together via a cumbersome network of suppliers devised not for cost efficiency but by a European political reality that has historically dictated that contracts be spread equitably across all EU member states which contribute to a programme budget.

SELF-RELIANCE

Europe's response to SpaceX is not only the technically more efficient Ariane 6 and its smaller sister, Vega C, which is a bigger development of the current Vega and set to fly from 2019. Leaders in Brussels have made a clear statement of intent to retain an indigenous European capability to access space, and as such have stepped away from the notion of



Future iterations of ESA's Ariane 6 may incorporate engine recovery and reuse technology

juste retour budget-spreading in favour of the consolidation of the Ariane programme. ArianeGroup is a joint venture between Ariane prime contractor Airbus and propulsion specialist Safran – the business was formally called Airbus Safran Launchers until 1 July – and has recently taken control of launch operator Arianespace, which runs Europe's space port in Kourou, French Guiana.

Hence, Europe's launch offering now sits under one roof, from concept and design through to sales and operations. Vega, also operated by Arianespace, is provided by prime contractor ELV, owned by Avio and the Italian Space Agency. That arrangement had recently to pass scrutiny by the European competition authorities, which decided that Arianespace's essentially in-house relationship with Ariane 5 and 6, and also the Soyuz medium-weight lifter, would not disadvantage ELV or prospective customers of the much lighter Vega.

Liquid fuel rocket motors can be restarted many times and so are in principle reusable if protected during re-entry

The European Commission and European Space Agency (ESA) are essentially buying services from ArianeGroup – which, while contracted to develop launchers whose performance is dictated by the Commission and ESA, must compete for their business. Critically, ArianeGroup relies on commercial business such as orbiting telecommunications satellites and must be cost-competitive to survive. The number of launches bought annually by European institutions – be they the Commission or ESA, weather service EUMETSAT or national governments – is small compared with the large number of flights to space demanded by US counterparts whose

business most typically goes, for national security or political reasons, to ULA, SpaceX or Orbital ATK.

But while industrial structure, manufacturing and design are clearly driving down launch costs, much attention is being paid to another, much more visible, approach to economy: reusability. Here again, SpaceX is making headlines, having successfully recovered main stages with engines to the ground via powered soft landings; so far this year it has also successfully flown recovered and refurbished boosters. And, significantly, it has re-used one of its Dragon space station resupply cargo capsules.

RECOVERY FIRST

ArianeGroup's Prometheus engine is being billed as reusable. But as Charneau notes, rocket motors running on cryogenic fuel are inherently restartable and in principle reusable; in any case Ariane 5 motors go through a couple of test burns on the ground before flight. The same cannot be said of solid rockets – once started they consume their fuel to exhaustion, and the nozzles are burnt, pitted and stressed beyond refurbishment. With Prometheus, reusability of course presupposes recovery after flight, and right now, Charneau says, the development priority is very much on the engine.

Having said that, much work has been done in Europe on recovery concepts, and ESA has made clear that launcher development is an ongoing process; iterations of Ariane 6 could, later in the 2020s, include reusability. European thinking on reusability is focused on recovering the engine, which makes up the bulk of the cost of a launcher. In 2015, Airbus Defence & Space showed its Adeline (ADvanced Expendable Launcher with INnovative engine Economy) concept. This featured a detachable, winged engine housing that would, with turboprop power, fly back to a runway landing – to Cayenne's Félix Eboué international airport, »

» for example, just a few kilometres from Kourou. Scale model testing of the return housing is believed to have verified its aerodynamics for flight.

ULA's competitive response has been to initiate development of its modular Vulcan concept, to succeed Atlas V and Delta IV in the 2020s. Like ArianeGroup, ULA's reusability concept looks at engine recovery – but in flight, by parachute and helicopter.

From SpaceX, meanwhile, some insight into the refurbishment process came from vice-president for commercial sales Jonathan Hofeller, speaking at a space insurance conference in London in June. He told the World Space Risk Forum that where it took SpaceX nearly a year to refurbish the first booster for re-use, a second was readied in a couple of months. Each part, he says, is refurbished, and the plan is that if a recovered booster as a whole cannot be made as good as a new one it will be retired. SpaceX, he says, talks about “flight-proven” boosters and sees “reliability as closely coupled with reusability”.

Meanwhile, one example of the suborbital New Shepherd rocket and crew capsule being developed by Blue Origin, the company founded by Amazon boss Jeff Bezos, has flown to the edge of space four times. It has yet to carry a human passenger, but the plan is



The Adeline concept puts the rocket motor in a re-entry capsule for flyback recovery

to ferry paying passengers to just beyond the official 100km altitude barrier that delineates Earth from space.

The aptly named Ariane Cornell, head of north American sales for New Shepherd's very big brother, New Glenn, told the London space risk forum that Blue Origin's suborbital programme was partly about building experi-

ence to go fully orbital. New Glenn – a very heavy lifter, being designed to put 13t to geostationary orbit or a massive 45t to low-Earth orbit – is being developed to fly in 2020. Like Falcon 9, it will land on a barge at sea, and its highly throttleable BE4 engines (being developed in conjunction with ULA) will let it touch down softly and vertically, like Falcon 9. But where Falcon 9 uses rocket power to make a tail-first descent from space, New Glenn is being equipped with steering fins to “literally fly back”.

Experience will tell, but it should be noted that the history of reusable spacecraft is not encouraging. NASA's Space Shuttles were intended to fly over and over, almost like an airliner, but in practice post-flight refurbishment was slow and costly. Iconic as it may have been, the Shuttle programme was a failure when measured against its objectives of slashing costs and providing the USA with airline-style access to space. Over 30 years, with as many as four orbiters in service at any time, there were just 135 Shuttle missions – on average one every 12 weeks, or less than four flights per orbiter per year. According to NASA, the cost of a typical flight was \$450 million. Disposable launchers would have been cheaper, and design aspects of this very complex vehicle featured in the total loss of two orbiters, killing 14 crew.

The stress associated with launch should not be underestimated. Simple physics says that, for a given mass, it takes about 70 times as much energy to go orbital as suborbital. Cornell observes – on the topic of New Origin building experience for the orbital rocket project – that a New Shepherd suborbital launch costs just 2% of what it will cost to put a New Glenn into orbit.

A SPACE REVOLUTION

Today's reusable launcher designs benefit from the Space Shuttle experience, as well as four decades of subsequent technology development. And none of them involves vehicles as complex as the Space Shuttle. SpaceX boss Elon Musk insists that reusability will slash costs and revolutionise space flight. Cornell says reusability will cut costs and hence increase demand. Blue Origin's goal – admittedly not in the near term – is to help “millions of people to live and work in space”. Musk echoes that sentiment, SpaceX's mission statement being “to revolutionise space technology, with the ultimate goal of enabling people to live on other planets”.

But whether reusability becomes a significant factor in launch cost control remains to be seen; what is possible is not the same as what is cost-effective, and there are significant mitigating factors, even if reliability is ultimately able to match that of virgin hardware. When presenting Adeline, engineers at



Earlier this year, SpaceX notched up a first by seeing a Dragon capsule through two missions



Confounding dreams of airline-style operations, post-flight refurbishment of the Shuttle proved slow and costly

Airbus Defence & Space reckoned Falcon 9-style full-booster reusability could cut payload capability by a third to a half, depending on the mission, to accommodate the fuel needed to fly back from the edge of space and to lift the requisite landing gear and thermal protection needed to survive re-entry, not to mention the mass associated with structural robustness to withstand multiple flights. Fuel is cheap, though – less than \$200,000 for a \$60 million Falcon 9 launch, says Musk – so flying a bigger rocket than needed may be no false economy; if maximum launcher performance is needed for a particular mission, then the vehicle might not be recovered.

The same Airbus engineers reckon the Adeline idea, by focusing on a much smaller but high-value component – the engine – could cut operating costs by about 30%. Another aspect of the reusability they considered is to park a restartable, liquid-fuel rocket stage in low-Earth orbit. A main launch would deliver to this waiting “space tug” a payload and the fuel needed to carry it higher – to a 36,000km (22,000 mile) geosynchronous orbit in the case of a telecommunications satellite – reusing a stage without having to bring it back to Earth.

UTILITY VEHICLES

By leaving much of the rocket in orbit, the space tug idea would reduce the size – and cost – of launchers. Satellites would no longer need to carry their own fuel to reach final orbit, possibly reducing their cost and increasing their capability, and tugs could be

SpaceX sees reusability as not only about cutting costs – launch, recover, relaunch in 24h is a “near-term” goal

used to upgrade, repair, resupply or reposition existing satellites. At the end of their useful lives, the tugs could also be used to carry a payload to deep space or be burned up safely in the atmosphere.

Having said that, even 50 years since in-orbit docking was first realised in preparation for the Apollo Moon missions – not without hair-raising drama and no less than Neil Armstrong at the controls of Gemini 8 – such manoeuvres remain challenging and dangerous. The December 2015 Soyuz flight to the International Space Station left Russian flight controllers reportedly “worried” when an automatic docking system failure forced cosmonaut pilot Yuri Malenchenko to close the last metres manually, safely delivering himself, British astronaut Tim Peake and American Tim Kopra. A quick Google search for “docking mishap” turns up a litany of near-misses and lost spacecraft.

But SpaceX’s thinking on reusability reflects a key objective beyond mere cost-cutting, which is to accelerate the speed of operations. As Hofeller puts it, a “near-term” goal is to launch, refuel and re-launch within 24h. That focus on launch cadence is also evident

in another SpaceX project, which is to introduce fully automated self-destruction in the event of a launch anomaly. That system, he says, is largely about reducing the number of people associated with a launch, and hence demand on the pad infrastructure.

There are many factors affecting cost, and the benefit of reusability may prove only marginal. In the case of Prometheus, going from €10 million to €1 million for the engine would take €9 million off the promised €70 million cost of an Ariane 6 launch, notwithstanding any other cost savings realised in the construction of whatever iteration of Ariane ESA is flying by 2030.

If that €1 million engine can be flown five times, the per-flight hardware costs drop to €200,000, plus refurbishment. So, as long as motor refurbishment costs less than 80% of a new unit there is money to be saved in reuse. However, what is not clear is the total cost penalty of reusability. That is, fuel and refurbishment costs aside, how much more expensive is the construction of a component built to withstand re-entry and the strain of multiple use than one built more lightly, and with less complexity, for use-and-discard?

If the launch industry can achieve the capital cost-reduction expectations of a concept like Prometheus and the launch cadence acceleration potential of innovations like automated self-destruct, then cost of launch may be set for a dramatic overhaul in the next decade or so. Reusability may prove to be a side-show to the real revolution. ■

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

From 1967... the next big thing

US homeland security chief John Kelly, who has just taken over as White House chief of staff, was briefly stumped by a technical question during a recent forum in Colorado.

Having described CT technology as the “next thing” in defence against explosives, Kelly was asked to clarify the meaning of “CT”.

“No, I don’t know what CT stands for,” he admitted, before former Transportation Security Administration director John Pistole came to the rescue.

“Computer tomography,” Pistole said, to which Kelly replied: “Nerd.”

Kelly might be forgiven for his ignorance of this futuristic advance in airport security. CT scanning, used extensively in medicine, was conceived by British engineer and Nobel prize-winner Sir Godfrey Hounsfield in 1967. Which makes it only, er, 50 years old.

Flying bikes

Our man in the wilds of Wisconsin snapped this gem from Canada’s Murphy Aircraft at the world’s biggest fly-in, AirVenture in Oshkosh.

While it might look like the outcome of something that went wrong in the factory, the two-seat Radical STOL kitplane is actually offered with an optional underwing fitting to carry bikes. Naturally – for reasons of



Images of El Al’s first Boeing 787 show that its livery design includes a little bit of chutzpah likely to irritate folk in Toulouse. Written on the aft fuselage of the Dreamliner are the three little words “Proudly All Boeing”: another painful reminder to Airbus of its perennial bridesmaid status with the Israeli flag-carrier. However, El Al might have to amend its exclusive slogan with an asterisk. The reason is that the national airline, through its tour operator Sun D’Or, is finalising a long-negotiated agreement to take over local carrier Israil – the airline which gave Airbus its break in Israel, and whose small fleet mainly comprises A320s. Mazel tov!

aerodynamic balance – you have to transport a pair.

Perfect for when you’re unable to prioritise your hobbies, suggests our scribbler.

Whine club

From a Pratt & Whitney press release: “At the competition, more than 60 teams from seven countries, including a five-member Pratt & Whitney team, will put their knowledge, skills and teamwork to the test across a variety of maintenance tasks...”

Let’s hope they had nothing to complain about; might have

given “engine whine” a new meaning.

Dearly departed

Few of us would associate airports with soul-soothing ambience, or – for obvious reasons – want to think of them as places from which to make our final departure from earth. Not so in India, however, where the first airport-themed crematorium has opened.

The facility, in the state of Gujarat, features two large aircraft replicas and airport-like announcements to guide funeral groups to the correct “departure gate”, where there are either traditional funeral pyres or modern electric furnaces, reports the *Times of India*.

The crematorium owners explain that they wanted to create an “airport-like atmosphere to soothe and console” grieving families.

“The word crematorium is harsh,” maintains president Somabhai Patel. “That is why we have named it Antim Udan Moksha [Last Flight to Salvation] airport.”



Er, boss... I think I might have got the kit boxes a bit mixed up

Stinson flight

Miss Katherine Stinson, the nineteen-year-old American

100 YEARS AGO

aviatrix, recently went to the Curtiss factory at Buffalo and

bought a machine... as she wanted to make a special flight under the auspices of the Red Cross.

Transport plan

Two American shipbuilders have propounded an

75 YEARS AGO

enterprising scheme for building transport aircraft

in their shipyards. Officials at the War Production Board of the United States do not seem enamoured of the idea.

Airbus funding

In effect, the Ministry of Technology is awarding a

50 YEARS AGO

£50 million contract to a foreign company, Sud-

Aviation, to design and build an aircraft [the Airbus A300] over which Sud will have complete technical control. Goodness knows what the Public Accounts Committee will have to say about this in years to come.

F-16s for Taiwan

US President George Bush says he is re-examining the

25 YEARS AGO

Government’s decision to block the sale of 150 F-16s to Taiwan

for fear of offending mainland China. General Dynamics’ unions argue that the sale would save 3,000 jobs at the Fort Worth plant.

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More biofuel for thought

Your article on Norway's supply of biofuel (*Flight International*, 4-10 July) makes repeated references to reducing carbon dioxide emissions.

While accepting that providing a renewable source of fuel is desirable in its own right, I cannot see that this makes any contribution to CO₂ reduction. I understood that CO₂ comes from burning the fuel, irrespective of how it is supplied.

If the article refers to the differing CO₂ output that arises from the production of the fuel, then (while surprised) I would also suspect that such savings are entirely trivial compared to the CO₂ produced from burning the fuel.

Richard Waller
via email

Absent friends

Reading your Straight & Level item about Eric "Winkle" Brown (*Flight International*, 25-31 July) made me cast my mind back and think about the great pilots I knew as friends, flew with and learned from.

NOMENCLATURE

Lightning strikes thrice

Albert Gorton's recent letter (*Flight International*, 1-7 August) regarding a name for the UK's Lockheed Martin F-35s raises a key issue in aircraft circles.

Since English Electric's marvellous interceptor served the Royal Air Force between the Lockheed P-38 and the F-35, in the UK the new type should strictly be called a "Lightning III"; not a "II".

While on the same topic, the incoming Beechcraft T-6C is called the "Texan II" by the US Air Force. This should surely be renamed "Harvard II" – as in Canada – in keeping with the RAF's tradition?

Perhaps a high-level committee is required?

Richard Lambert

Kimbolton, Cambridgeshire, UK



Lockheed Martin

Aren't we missing one?

More familiar names include Neville Duke and John Judge and, from my French piloting background, Col Jean Roland Daney.

At the end of the Second World War, he was tasked by the French air ministry to test-fly and evaluate every Axis combat aircraft he could lay his hands on. He told me the three finest ones were the Messerschmitt 262, the Mitsubishi Zero and the Focke-Wulf 190, in that order.

He refused to fly the Messerschmitt 163; a colleague did so against his advice, and the machine exploded.

But I particularly remember Faith Newmark – a former film actress and a pilot for the Air Transport Auxiliary, who I knew as she bought one of my own aircraft from me.

I vividly remember returning in formation from the factory at Dijon, arriving at Le Touquet in evil weather. On filing our flight plans for Gatwick, the French controller – confronted with this exceedingly elegant, slightly

fragile looking 60-plus lady – exclaimed: "But Madame! This is not weather for a lady like you!"

At this she yanked out what looked like a half-hundred-weight of log books, with so many hours on Spitfires, Lancasters, B-17s and so on. The poor controller wordlessly handed over the flight plan pad.

Such memories bring on fits of sadness for friends departed!

Richard Chandless

Crêches-sur-Saône, France

Throwing the book at them

I read Malcolm Bowden's correction to my letter published about the meaning of the word "oversight" (*Flight International*, 18-24 July).

The *Oxford English Dictionary* that I use was published in 2004 – not over 25 years ago, as suggested – and states that the meaning of the word "oversight" is "an unintentional failure to notice or do something".

No ambiguous meaning there. Perhaps Mr Bowden has an American version?

My concern is that lawyers involved in any safety-related incident or aviation accident could use such an ambiguous meaning of the word "oversight" to get guilty individuals or organisations off the hook. Certainly the FAA should not be using such wording.

Alan Curry

Stockport, UK

Give the 737 Max a leg-up

On reading about the latest iteration of the venerable 737, the Max 10, recent publications refer to the limitation the airframe has in terms of fuel efficiency and unstick speed. The restriction in fan diameter due to ground clearance is a huge disadvantage with respect to the A321neo.

With regard to the necessity of raising the nose of the 737 Max to accommodate a larger diameter engine, it is evident that extending the length of the main landing gear is not a possibility without moving the pylons on the wing.

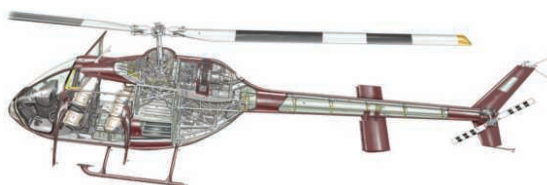
A solution could be to introduce a very small angle to the axis of the pivot of the main landing gear, in such a way that in retracted mode, with undercarriage leg extensions of around 0.9m (3ft), the wheels would be stowed one in front of the other.

This could be done with minimal alteration to the structure and safety of the aircraft.

The wing's structure would not change, and the impact of landings would be absorbed the same way as when the airframe was designed.

Rodolfo Serna

via email



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raa.org/page/2017ACMain

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apex.aero

26-27 September

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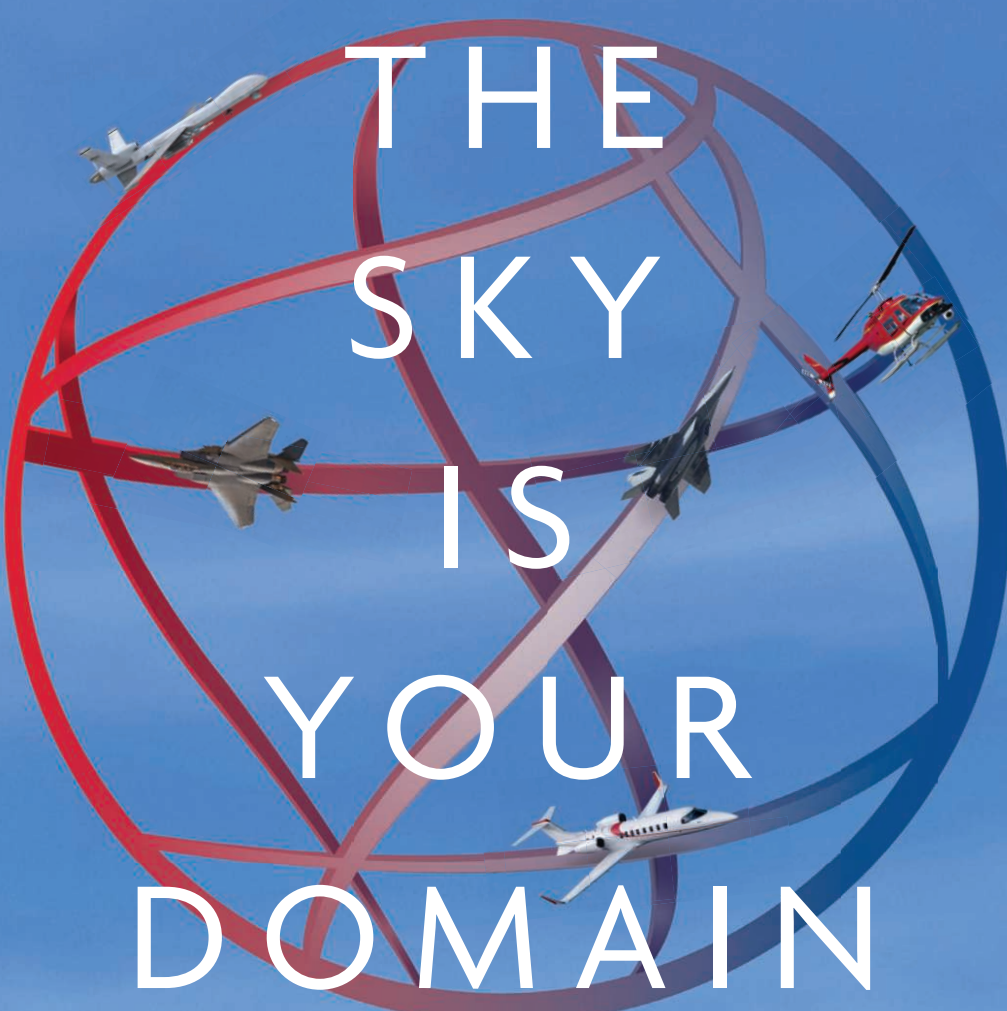
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Further general information about the Island is available on the Isle of Man Government web site at www.gov.im

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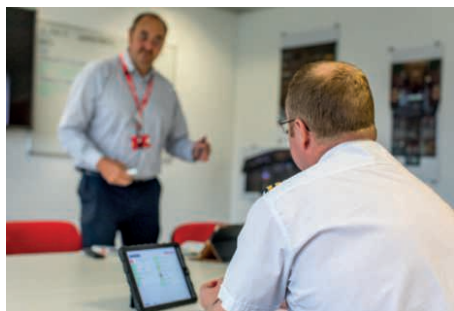


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WORK EXPERIENCE STEVE BARKER

Smoothing the journey from A to B

Steve Barker is specialist services manager for global flight support company Flightworx, making sure every detail is in place for clients, from fuel and landing permits to hotel bookings and ground transport

How did you get into aviation?

I've always felt passionately about aviation, but it was joining the Air Cadets that really triggered my life-long interest in aircraft. I joined the Air Training Corps when I was 13 years old, experiencing flying and gliding. After leaving school I intended to follow a career in aircraft engineering, but instead I opted to join the Royal Air Force as an assistant air traffic controller.

Your career so far?

Before Flightworx, I spent 22 years in the Royal Air Force, initially as an assistant air traffic controller, before being selected for air traffic controller training, completing tours at Terminal, Area Radar and overseas units. Each day produced different challenges, whether working as the duty tower controller, controlling multiple circuits and aircraft types at once, or as the London military allocator, overseeing a large area of UK airspace, integrating and co-ordinating the needs of military aircraft with those of our civilian counterparts. More than anything, the role taught me the importance of teamwork, communication, forward planning and to always expect the unexpected.

What is Flightworx?

Flightworx offers complete worldwide flight support solutions for private, commercial and specialist operators. We look to provide efficient, smart solutions for our clients, with services including flight planning, delivery of overflight and landing per-



Barker cut his teeth in aviation as an air traffic controller for the RAF

mits, commercial ops and management, ferry flights and delivery. Our neutral and independent fuel comparison and procurement service, Flightworx Fuel, negotiates best-in-class prices for Jet A1 and Avgas. Our ATOL-protected, 24-hour travel agency, Travelworx, accesses competitive prices for all aspects of travel, including booking hotels, ground transport and concierge services for your passengers and crew.

What does your role at Flightworx entail?

I started working for Flightworx

in 2008 in the operations department as specialist services manager. My role is in specialist flight planning and trip support and sees me and my team of 25 operations colleagues dealing with unique and bespoke requests from clients on a regular basis. Such requests range from planning long-range ferry flights for all sizes of aircraft, to obtaining clearances for landing a helicopter on a private yacht.

What do you find most challenging about your job?

It can be a challenge to satisfy every client request since my job

is so variable. It's important to be challenged at work and some clients' requests are more complex than others. For example: planning flights and obtaining permissions for widebody aircraft with limited airworthiness and very specific trip requirements; smaller, single-engined piston types conducting multisector trips around the world; and obtaining clearances to some rather unusual destinations. It's also important to keep up with technological advances, as well as the ever-increasing development of airspace and regulatory changes. Of course, we are fully prepared for when we receive a more unique request and the team works hard to ensure that every request is met with the high standards of customer service and industry expertise that are expected from us.

Where next for your career?

As we see more and more special projects each week, I look forward to developing our specialist services department, as well as focusing on those clients who demand specific skill sets when planning their trips, and providing them with experienced staff to meet their requirements. ■



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